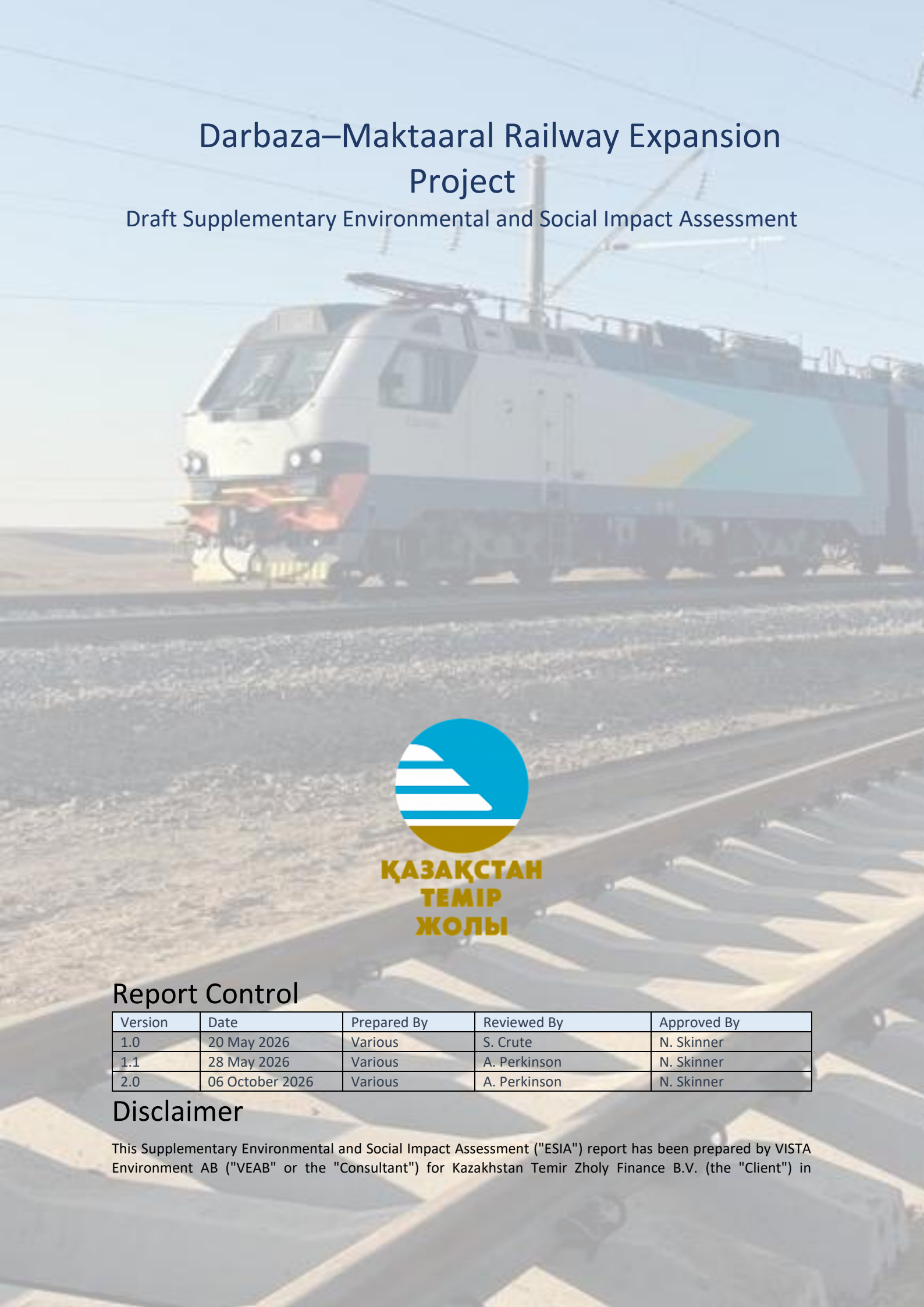
Darbaza–Maktaaral Railway Expansion Project

Draft Supplementary Environmental and Social Impact Assessment



ҚАЗАҚСТАН ТЕМІР ЖОЛЫ

Report Control

Version	Date	Prepared By	Reviewed By	Approved By
1.0	20 May 2026	Various	S. Crute	N. Skinner
1.1	28 May 2026	Various	A. Perkinson	N. Skinner
2.0	06 October 2026	Various	A. Perkinson	N. Skinner

Disclaimer

This Supplementary Environmental and Social Impact Assessment ("ESIA") report has been prepared by VISTA Environment AB ("VEAB" or the "Consultant") for Kazakhstan Temir Zholy Finance B.V. (the "Client") in

connection with the Darbaza–Maktaaral Railway Expansion Project (the "Project"), pursuant to the consulting services contract between the Client and the Consultant dated December 2025.

The report has been prepared solely for the purposes set out in Section 1.1 and for the benefit of the Client. It may also be relied upon by the international financial institutions providing or considering finance for the Project, and their advisers, for the purposes of their environmental and social due diligence. No other person or entity may rely on this report, in whole or in part, without the prior written consent of VEAB. VEAB accepts no duty, responsibility or liability to any party other than the Client.

The findings, conclusions and recommendations in this report are based on information provided by the Client and its contractors, publicly available information from sources referenced herein, and field observations, surveys and stakeholder consultations undertaken by the Consultant during the assessment period. VEAB has not independently verified information provided by third parties and accepts no responsibility for errors or omissions in such information. Where data were unavailable, incomplete or inconclusive, this is identified in the relevant section of the report.

This report is a Supplementary ESIA prepared in the context of an active construction project. As described in Chapter 1, construction of the Project commenced in 2024 prior to the completion of lender-aligned environmental and social due diligence, and the temporal and spatial scope of the assessment reflects the practical limitations of assessing impacts that have already occurred. The report reflects conditions and information available as at the date of issue. Subsequent changes in Project design, regulatory requirements, environmental or social conditions, or the availability of new information may affect the conclusions of this report, and VEAB is under no obligation to update the report unless separately instructed in writing.

The Services have been performed with the level of skill and care reasonably expected of a competent environmental and social consultant on projects of comparable scope, and in accordance with the Asian Development Bank Safeguard Policy Statement (2009), the IFC Performance Standards on Environmental and Social Sustainability (2012), the AIIB Environmental and Social Framework (2024), and the applicable laws of the Republic of Kazakhstan. No other warranty, express or implied, is given.

This report contains information confidential to the Client. The Client may disclose the report to project lenders and to such other parties as are reasonably required in connection with the Project, including in fulfilment of public consultation and disclosure obligations under applicable lender requirements. Save as set out above, the report shall not be reproduced or distributed, in whole or in part, without the prior written consent of the Client and VEAB.

Table of Contents

EXECUTIVE SUMMARY 17
1. INTRODUCTION AND BACKGROUND 29
1.1 Purpose and Scope 29
1.2 Roles and Responsibilities 30
1.3 Project Overview 31
1.4 Strategic Significance and National Policy Context 33
1.5 Project Status and Phasing 34
1.6 Project Risk Classification 34
1.7 Scope, Boundaries and Limitations 34
1.8 Relationship with the ESCA and Other Concurrent Studies 35
1.9 Structure of the Report 36
2. PROJECT DESCRIPTION 38
2.1 Preamble 38
2.2 Need for the Project 38
2.3 Summary Project Setting 41
2.4 Project Categorization 42
2.5 Alignment Overview and Project Components 43
2.6 Associated Facilities 76
2.7 Construction 76
2.8 Earthworks and Track Materials 80
2.9 Manpower 81

2.10 Equipment 81
2.11 Access Roads 86
2.12 Water Supply & Waste Water 86
2.13 Construction Waste 87
2.14 Borrow Pits 87
2.15 Batching Plant 88
2.16 Project Operations 88
2.17 Organizational Responsibilities 92
3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK 94
3.1 General 94
3.2 National Environmental Legislation 94
3.3 Administrative Framework 97
3.4 National Environmental Impact Assessment (OVOS) Legislation 100
3.5 Environmental Regulations and Standards 101
3.6 Sanitary Protection Zones and Electromagnetic Field Standards 106
3.7 Tree Cutting 107
3.8 Permits and Licenses 108
3.9 International Agreements and Conventions 109
3.10 Asian Development Bank Safeguard Policies (SPS, 2009) 111
3.11 IFC Performance Standards (2012) 113
3.12 AIIB Environmental and Social Framework (ESF, 2024) 114
3.13 World Bank Group / IFC Environmental, Health and Safety Guidelines 115
3.14 Gap Analysis 118
4. ANALYSIS OF ALTERNATIVES 125
4.1 Consideration of Alternatives 125
4.2 Project vs No Project Scenario 126
4.3 Route Direction Variants 130
4.4 Community Feedback-driven Alignment Adjustment (Keles District) 135
4.5 Traction Variants 136
4.6 Staging Alternatives 137
4.7 Alternative 10kV Auxiliary Power Line 138
5. METHODOLOGY 142
5.1 Impact Assessment (IA) as a Process 142
5.2 Applicable Lender Requirements and Good International Industry Practice 144
5.3 Scoping Methodology 145
5.4 Identification of Project Activities, Sources and Impact Pathways 146
Identification and Sensitivity of Valued Environmental and Social Receptors 148
5.5 148
5.6 Characterisation of Impacts and Determination of Magnitude 151
5.7 Assessment of Significance 157
5.8 Mitigation Hierarchy and Embedded Mitigation 159
5.9 Residual Impacts 162
5.10 Retrospective Assessment of Works Already Undertaken 163
5.11 Cumulative Impact Assessment Approach 164
5.12 Topic-Specific Methodologies 165
6. ESIA SCOPE 167
6.1 Scoping 167
6.2 Physical or Project Scope 167
6.3 Spatial Scope 167
6.4 Temporal Scope 168
6.5 Technical Scope 170
7. BASELINE CONDITIONS 176
7.1 Introduction 176
7.2 Project Setting and Area of Influence 179
7.3 Physical Environment 191
7.4 Biological Environment 231
7.5 Socio-Economic Environment 257

7.6 Cultural Heritage Baseline 278
7.7 Landscape and Visual Amenity 283
8. IMPACT ASSESSMENT AND MITIGATION AND MANAGEMENT MEASURES 284
8.1 Preamble 284
8.2 Valued Environmental Receptors 285
8.3 Summary of Impacts by Project Stage 291
8.4 Topic Based Narrative by Design Stage 304
9. STAKEHOLDER ENGAGEMENT & GRIEVANCE MECHANISM 426
9.1 Public Consultation Requirements & Objectives 426
9.2 Public Consultation Completed to Date 427
9.3 Future Consultation Strategy 441
9.4 Disclosure 443
9.5 Grievance Mechanism 443
9.6 Grievance Focal Points 451
9.7 Worker GRM 452
9.8 Disclosure of the Grievance Process 452
10. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN 454
10.1 Preamble 454
10.2 Environmental and Social Monitoring 455
10.3 Construction Environmental and Social Management Plan (CESMP) 455
10.4 Overarching Implementation Arrangements 457
10.5 KTZ – Owner and Supervision 458
10.6 EPC Contractor & Sub-contractors 460
10.7 Independent E&S Monitoring 463
10.8 Training, Competency and Capacity Development 464
10.9 CESMP Review and Update 473
10.10 Corrective Actions 473
10.11 Meetings and Site Visits 473
10.12 EPC Contractor & Sub-contractor Management 474
10.13 Independent E&S Consultant (IESC) 475
10.14 Operation and Maintenance Phase 475
11. CONCLUSIONS AND RECOMMENDATIONS 480
11.1 Conclusions 480
11.2 Recommendations and Next Steps 480
ANNEX A – ESMP 483
ANNEX B – PRELIMINARY BAP 533
ANNEX C – HABITAT MAPS 565
ANNEX D – SITE / TOPIC ESMPS 566
ANNEX E – PRELIMINARY CLIMATE RISK ASSESSMENT 567
ANNEX F – DRAFT CRITICAL HABITAT ASSESSMENT 594
ANNEX G – IMPACT ASSESSMENT SUPPORTING TABLES 645

List of Tables

Table 1: Key Project Parameters 32
Table 2: Structure of the Supplementary ESIA Report 36
Table 3: Lender E&S Categorisations and Triggered Standards 42
Table 4: Summary of Project Elements 44
Table 5: Yerdaut Station Characteristics 48
Table 6: Yerdaut Station: Track Volumes, May 2025 revision 50
Table 7: Intermediate Station: Track Inventory 54
Table 8: Comparative scale of the three stations and two passing loops 58
Table 9: Passing Loops within the Project Alignment 61
Table 10: Passing Loop No. 2: Track Inventory 61
Table 11: Culvert Specification, Shardara Reservoir Area 63
Table 12: Bridge Schedule 63
Table 13: Principal Design Parameters 66

Table 14: Bridge Foundation Arrangement 66
Table 15: Principal plant on a typical bridge site 68
Table 16: Indicative material and excavation quantities (per typical bridge) 68
Table 17: Bridge Configuration 70
Table 18: Substructure Configuration 71
Table 19: The hydraulic design parameters adopted at the bridge crossing 71
Table 20: Level-crossing Locations 73
Table 21: Manpower Summary 81
Table 22: Indicative Plant and Equipment Inventory — Construction Phase 82
Table 23: Key National Environmental Legislation Relevant to the Project 94
Table 24: Key Social, Labour and Gender Legislation Relevant to the Project 96
Table 25: Selected National Maximum Permissible Concentrations (MPC) for Atmospheric Air in Populated Areas 102
Table 26: WBG / WHO Ambient Air Quality Guidelines 102
Table 27: WBG Indicative Values for Treated Sanitary Sewage Discharges 103
Table 28: Indicative National Ambient Noise Limits 103
Table 29: WBG Ambient Noise Guidelines 104
Table 30: Workplace Noise Limits 104
Table 31: Guideline Values for Vibration Velocity (DIN 4150-3, mm/s) 105
Table 32: Principal Permits and Licences for the Project 108
Table 33: Principal International Agreements and Conventions Relevant to the Project 109
Table 34: Comparison of National Requirements and Lender Frameworks (ADB SPS 2009, IFC PS 2012, AIIB ESF 2024) 119
Table 35: Comparison of E&S Impacts between the Project and the No Project Scenario 126
Table 36: Route variant comparison 132
Table 37: Supplementary E&S Evaluation of Variants A and B 133
Table 38: General Criteria for VER Sensitivity 149
Table 39: Classification of Extent of Impact and Assigned Scores 153
Table 40: Classification of Duration of Impact and Assigned Scores 153
Table 41: Classification of Frequency of Impact and Assigned Scores 154
Table 42: Criteria for Magnitude of Impacts Used in the IA 156
Table 43: Matrix for Determining Significance of Environmental and Social Effects 157
Table 44: Elements within Temporal Scope of ESIA 169
Table 45: Summary of Scoping Outcome 170
Table 46: Principal Data Sources Used in the Baseline Characterisation 177
Table 47: Affected Districts of Turkistan Region (in Order along the Alignment) 180
Table 48: Topic-Specific Definition of the Area of Influence 184
Table 49: Indicative Quaternary Lithostratigraphic Units Along the Project Corridor 197
Table 50: Hydrogeological Conditions 199
Table 51: Existing licensed subsoil-use contracts in Saryagash District 201
Table 52: Indicative Long-Term Climate Norms along the Project Corridor 202
Table 53: Local climatological data from MS Zhetysay and MS Shardara 203
Table 54: Monthly precipitation distribution at the two stations (mm): 203
Table 55: Observed Climate Change Trends in Kazakhstan, 1941–2011 206
Table 56: Indicative Climate Change Projections for Kazakhstan under CMIP6 SSP Scenarios 207
Table 57: Indicative Existing Sources of Air Pollutants in the Project Corridor 209
Table 58: Indicative Ambient Air Quality Reference Values, Project Corridor (Rural Southern Kazakhstan) 211
Table 59: Indicative Existing Sources of Ambient Noise in the Project Corridor 213
Table 60: Summary of Prior Project Noise Sampling 214
Table 61: Key Parameters of the Shardara Reservoir on the Syr Darya River 216
Table 62: Principal Watercourses and Water Bodies in or near the Project Corridor 217
Table 63: Location of Main Rivers and Bridges 219
Table 64: Summary of Natural Hazards Relevant to the Project Corridor 224
Table 65: Summary of triggered Critical Habitat 235
Table 66: The Stakeholders consulted or approached as part of the Project ESIA process 235
Table 67: Shardara IBA/KBA 240
Table 68: IBA and KBA qualifying species of Shardara Reservoir (BirdLife International, 2024). 241

Table 69: Bird species recorded during winter surveys (February 2025 and January/February 2026). 243
Table 70: Bird species recorded during spring surveys (May and June/July 2025) 246
Table 71: Raptors and Vultures (2025-2026 Surveys) 247
Table 72: Habitat extent within the Project footprint 251
Table 73: Flora of conservation significance identified within the IBAT 10 km search area and adjacent road survey, although none were recorded along the Project alignment. 252
Table 74: Non-native and invasive species of note within the project area. 254
Table 75: The most sensitive and vulnerable protected areas, habitats and species relevant to the impact assessment. 256
Table 76: Population Indicators in Project-Affected Districts (2025) 259
Table 77: Communities within the Project Area of Influence 260
Table 78: Sectoral Economic Indicators (2025) 262
Table 79: Labour Market Indicators in Project-Affected Districts (2023) 264
Table 80: Average Monthly Nominal Wages by Economic Sector in Turkistan Region 265
Table 81: Average Monthly Nominal Wages in Project-Affected Districts 266
Table 82: Summary of Project-Affected Land 270
Table 83: Archaeological Sites 279
Table 84: Valued Environmental Receptors 286
Table 85: Impact, Mitigation and Significance for Design 293
Table 86: Impact, Mitigation and Significance for Land take 294
Table 87: Impact, Mitigation and Significance for Construction 295
Table 88: Impact, Mitigation and Significance for Operations and Maintenance 299
Table 89: Construction Waste Forecast Identified in the National Environmental Impact Assessment 367
Table 90: Cross-corridor structures by access function (whole alignment) 407
Table 91: Dedicated underpasses and conditional crossings 408
Table 92: Longer-spaced reaches between potential livestock-access structures 409
Table 93: Estimated greenhouse gas emissions, Darbaza to Maktaaral Railway 417
Table 94: Rail compared with road 419
Table 95: Cumulative actions considered (status and physical scope) 420
Table 96: Summary of Material and Conditional Residual Effects 422
Table 97: Lender Requirements for Stakeholder Engagement 426
Table 98: Schedule and Venues of Community Consultations, 19–21 May 2026 430
Table 99: Consultation Summary 434
Table 100: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process. 440
Table 101: Committed Biodiversity Stakeholder Consultation Programme 442
Table 102: CESMP Topic-Specific Plans 456
Table 103: Method Statements 457
Table 104: KTZ Reporting Responsibilities 459
Table 105: EPC Contractor Reporting Responsibilities 462
Table 106: Training and Induction Requirements 464
Table 107: O&M Topic Specific Plans 475
Table 108: Project documents relevant to this Preliminary BAP. 534
Table 109: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process. 536
Table 110: Committed Stakeholder Consultation Programme 537
Table 111: Summary of Residual Impacts and Required Action 538
Table 112: An introduction to the indicative and possible offset and ACA actions, including a high-level assessment of action's practical feasibility. 542
Table 113: Proposed roles and responsibilities for the key stakeholders during the design, implementation and monitoring of the Final BAP 546
Table 114: Exemplars of thresholds for change, which will be developed and agreed for each action and presented in the Final BAP. 547
Table 115: Project documents relevant to this Preliminary BAP. 552
Table 116: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process. 553
Table 117: Committed Stakeholder Consultation Programme 554

Table 118: Summary of Residual Impacts and Required Action 555
Table 119: An introduction to the indicative and possible offset and ACA actions, including a high-level assessment of action's practical feasibility. 559
Table 120: Proposed roles and responsibilities for the key stakeholders during the design, implementation and monitoring of the Final BAP 562
Table 121: Exemplars of thresholds for change, which will be developed and agreed for each action and presented in the Final BAP. 563
Table 122: Summary Climate Risk Ratings 575
Table 123: Hazard Risk Assessment 576
Table 124: Asset-Level Vulnerability Assessment 581
Table 125: Adaptation Measures 584
Table 126: The Critical Habitat criterion adopted as part of this CHA and how they have adopted relevant criterion from both ADB's SPS and IFC's PS6. 597
Table 127: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process. 598
Table 128: Terrestrial and freshwater species potentially present within 50 km of the project area 601

List of Figures

Figure 1: Project Location 31
Figure 2: Existing Main Cross-Border Rail Lines and the Proposed Darbaza–Maktaaral Alignment 40
Figure 3: Diagram of Stations and Passing Loops along the Project Alignment 46
Figure 4: Diagram of Stations and Passing Loops along the Project Alignment (extract from KSD Engineering General Plan, Sheet 5800-1-ГП-002) 46
Figure 5: Yerdaut Station general layout 52
Figure 6: Yerdaut Station Track Layout 53
Figure 7: Intermediate Station Track Layout 55
Figure 8: Maktaaral (Atakent) Station general layout 60
Figure 9: Passing Loop No. 2 Track Layout 61
Figure 10: Passing Loop No. 5 Track Layout 62
Figure 11: Bridge over Syr Darya, General View / Façade 69
Figure 12: Bridge over Syr Darya 70
Figure 13: Location of Construction Camps 79
Figure 14: Location of Borrow Pits 88
Figure 15: Impact Assessment Process 143
Figure 16: Source–Pathway–Receptor Model as Applied to the Impact Assessment 146
Figure 17: VER Assessment Relationship 151
Figure 18: Regional Setting and Project Location – Project Alignment from Darbaza (Northern Terminus, KM 0) to Maktaaral (Southern Terminus, KM 115) 182
Figure 19: Project Alignment Showing the Five Affected Districts of Turkistan Region (Saryagash, Keles, Shardara, Zhetysay, Maktaaral) 182
Figure 20: Northern Section – Track-Laying and Traction Power Gantries near Yerdault Station, Saryagash District 187
Figure 21: Reedbed and Salt-Tolerant Vegetation along the Margin of the Shardara Reservoir, Shardara District 187
Figure 22: Open Water and Reedbed Mosaic, Shardara Reservoir, Shardara District 188
Figure 23: Project Embankment Construction along the Margin of the Shardara Reservoir, Shardara District 189
Figure 24: Syr Darya River Crossing at Low Flow 190
Figure 25: Existing Rail Infrastructure in Maktaaral 191
Figure 26: Project Alignment with Elevation Annotations – Spot Elevations along the Surveyed Alignment from Darbaza to Maktaaral 193
Figure 27: Longitudinal Elevation Profile of the Project Alignment 194
Figure 28: Climograph for Representative Northern and Southern Sections of the Project Corridor 204
Figure 29: Wind Frequency Rose for the Project Corridor Area at 100 m above Ground (Long-Term Average; Bimodal North–South Predominance) 204
Figure 30: Seismic Risk in Saryagash 226
Figure 31: Seismic Risk in Maktaraal 226

Figure 32: Wild Fire Risk in Saryagash 226
Figure 33: Wild Fire Risk in Maktaraal 226
Figure 34: River Flood Risk in Saryagash 228
Figure 35: River Flood Risk in Maktaraal 228
Figure 36: Urban Flood Risk in Saryagash 228
Figure 37: Urban Flood Risk in Maktaraal 228
Figure 38: Water Scarcity & Extreme Heat Risk in Saryagash 229
Figure 39: Water Scarcity & Extreme Heat Risk Risk in Maktaraal 229
Figure 40: Landslide Risk in Saryagash 230
Figure 41: Landslide Risk Risk in Maktaraal 230
Figure 42: KBA/IBAs 239
Figure 43: Nationally Protected Areas 242
Figure 44: The location of the breeding bird colony at the southern end of the project alignment (show in purple to the east) at in the south-eastern corner of the reservoir, near the village of Azattyk, approximately 1 km to the south. 245
Figure 45: Ariel imagery of one of the breeding bird colonies in the reedbeds. 245
Figure 46: An exemplar map illustrating the habitat mapping completed along the Project alignment. This map is focused on the Syr Darya River at the northern end of the Reservoir. 250
Figure 50: Preliminary Vibration Screening at Maktaaral / Pakhtaaral / Atakent (KM 115) 336
Figure 51: Preliminary Vibration Screening at Ushagash settlement (approximately KM 50) 337
Figure 52: Preliminary Vibration Screening at Sarıžylga–Bereke (approximately KM 40) 337
Figure 53: Preliminary Vibration Screening at Aktas / Algabas (near KM 0) 338
Figure 54: Maktaaral Station Noise Contours 376
Figure 55: Erdaulet Station Noise Contours 376
Figure 56: Kuris Village Noise Contours 377
Figure 57: Ushagash Village Noise Contours 378
Figure 58: Sarıžylga–Bereke Village Noise Contours 378
Figure 59: Şyrıldak–Jabaytöbe Village Noise Contours 379
Figure 60: Preliminary Operational Vibration at Maktaaral / Pakhtaaral / Atakent (KM 115) 383
Figure 61: Preliminary Operational Vibration at Ushagash settlement (approximately KM 50) 383
Figure 62: Cross-corridor passage structures along the Darbaza–Maktaaral alignment, by type and chainage. Pink bands mark the largest spacings between livestock-suitable passages. 411
Figure 63: Project Alignment 570
Figure 64: Projected Spring (March–April–May) Precipitation Percent Change — Kazakhstan and Central Asia (2040–2059, SSP5-8.5, P90 model ensemble, relative to 1995–2014 baseline). 574
Figure 65: River Flood Hazard Map — Syr Darya Corridor (Baseline, Riverine Flooding, 100-Year Return Period). Inundation depth shown in decimetres. Source: WRI Aqueduct Floods v2 (2020). 579
Figure 66: River Flood Hazard Map — Syr Darya Corridor (2050 Projection, Business as Usual/Pessimistic Scenario, Riverine Flooding, 100-Year Return Period, MIROC-ESM-CHEM model). Source: WRI Aqueduct Floods v2 (2020). 580
Figure 67: Indicative alignment of the proposed project 595
Figure 68: The approximate area of the Central Asian Flyway in comparison to the project area and the West Asian/East African Flyway 606
Figure 69: The location of the breeding bird colon at the southern end of the project alignment (show in purple to the east) at in the south-eastern corner of the reservoir, near the village of Azattyk, approximately 1 km to the south 608
Figure 70: Ariel imagery of one of the breeding bird colonies in the reedbeds. Egrets can be seen on the left of the photo. This colony is one of several in the area and measures 100 m by 65 m in size. Photo taken from drone footage during project surveys in 2025. 608

Acronyms and Abbreviations

The following acronyms and abbreviations are used in this Supplementary ESIA. Russian and Kazakh transliterations are provided in italics where the original term is the legal or technical reference; English glosses are given for orientation.

Acronym	Definition
ABS	Automatic Block Signaling
ACBK	Association for the Conservation of Biodiversity of Kazakhstan
ADB	Asian Development Bank
AF	Associated Facility
AIIB	Asian Infrastructure Investment Bank
AOI	Area of Influence
AQG	Air Quality Guidelines (WHO)
BAP	Biodiversity Action Plan
BAT	Best Available Techniques
BFD	Bird Flight Diverter
BMP	Biodiversity Management Plan
BNS	Bureau of National Statistics (Republic of Kazakhstan)
BOD	Biochemical Oxygen Demand
BOMP	Biodiversity Offset Management Plan
BWO	Basin Water Organization
CAP	Corrective Action Plan
CAREC	Central Asia Regional Economic Cooperation
CBD	Convention on Biological Diversity
CCKP	Climate Change Knowledge Portal (World Bank)
CDRI	Coalition for Disaster Resilient Infrastructure
CERC	Committee for Environmental Regulation and Control (MENR, Republic of Kazakhstan)
CESMP	Construction Environmental and Social Management Plan
CHA	Critical Habitat Assessment
CHS	Community Health and Safety

Acronym	Definition
CIS	Commonwealth of Independent States
CLO	Community Liaison Officer
CMIP6	Coupled Model Intercomparison Project Phase 6
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COD	Chemical Oxygen Demand
CORDEX	Coordinated Regional Climate Downscaling Experiment
CR	Critically Endangered (IUCN Red List category)
CRU	Climatic Research Unit (University of East Anglia)
dBA	A-weighted decibel
DD	Data Deficient (IUCN Red List category)
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DJF	December–January–February (climatological season)
DO	Dissolved Oxygen
E&S	Environmental and Social
EBRD	European Bank for Reconstruction and Development
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMoP	Environmental Monitoring Plan
EN	Endangered (IUCN Red List category)
EPC	Engineering, Procurement and Construction
ESCA	Environmental and Social Compliance Audit
ESEL	Environmental and Social Exclusion List (AIIB)
ESF	Environmental and Social Framework (AIIB, 2024)

Acronym	Definition
ESG	Environmental, Social and Governance
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMR	Environmental and Social Monitoring Report
ESMS	Environmental and Social Management System
ESP	Environmental and Social Policy (AIIB)
ESS	Environmental and Social Standard (AIIB)
ETS	Emissions Trading Scheme
EU	European Union
FAP	Feldsher–Akusher Post (rural primary healthcare facility)
F-BAP	Preliminary Biodiversity Action Plan
FPIC	Free, Prior and Informed Consent
FRA	Federal Railroad Administration (United States)
GBV	Gender-Based Violence
GBVH	Gender-Based Violence and Harassment
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery (World Bank)
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIP	Glavnyy Inzhener Proekta (Chief Project Engineer)
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GOST	Gosudarstvennyy Standart (post-Soviet State Standard)
GRM	Grievance Redress Mechanism
ha	Hectare
HGV	Heavy Goods Vehicle

Acronym	Definition
IA	Impact Assessment
IAEA	International Atomic Energy Agency
IAQM	Institute of Air Quality Management
IBA	Important Bird and Biodiversity Area (BirdLife International)
IBAT	Integrated Biodiversity Assessment Tool
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICWC	Interstate Coordination Water Commission (Aral Sea Basin)
IEA	International Energy Agency
IESC	Independent Environmental and Social Consultant
IFC	International Finance Corporation
IFI	International Financial Institution
IHA	International Hydropower Association
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
ITU	International Telecommunication Union
IUCN	International Union for Conservation of Nature
JJA	June–July–August (climatological season)
JSC	Joint Stock Company
KBA	Key Biodiversity Area
KEGOC	Kazakhstan Electricity Grid Operating Company
KfW	KfW Development Bank
km	Kilometre
KSD	KSD Engineering LLP (Project design consultant)
KTZ	Kazakhstan Temir Zholy (National Railway Company JSC)
kV	Kilovolt
LAeq	Equivalent continuous A-weighted sound pressure level

Acronym	Definition
LAR	Land Acquisition and Resettlement
LARP	Land Acquisition and Resettlement Plan
LC	Least Concern (IUCN Red List category)
LED	Light-Emitting Diode
LLP	Limited Liability Partnership
LPG	Liquefied Petroleum Gas
LPS	Longitudinal Power Supply
m	Metre
MAC	Maximum Allowable Concentration (Kazakhstan SanPiN)
MAM	March–April–May (climatological season)
MENR	Ministry of Ecology and Natural Resources (Republic of Kazakhstan)
MODIS	Moderate Resolution Imaging Spectroradiometer (NASA)
MPC	Maximum Permissible Concentration (Kazakhstan air-quality standard)
MW	Megawatt
NASA	National Aeronautics and Space Administration
NDC	Nationally Determined Contribution (UNFCCC)
NDV	Normativy Dopustimykh Vybrosov (Maximum Permissible Emissions)
NE	Not Evaluated (IUCN Red List category)
NG	Net Gain (biodiversity)
NH_3	Ammonia
NNL	No Net Loss (biodiversity)
NO_x	Nitrogen Oxides
NT	Near Threatened (IUCN Red List category)
NTS	Non-Technical Summary
O&M	Operations and Maintenance
OHL	Overhead Line
OHS	Occupational Health and Safety

Acronym	Definition
OSMS	Obyazatelnoe Sotsialnoe Meditsinskoe Strakhovanie (Mandatory Social Health Insurance, Kazakhstan)
OVOS	Otsenka Vozdeystviya na Okruzhayushchuyu Sredu (national Environmental Impact Assessment)
PAP	Project Affected Person
PCB	Polychlorinated Biphenyl
PCR	Project Completion Report
PCFM	Post-Construction Fatality Monitoring
PL	Passing Loop
$PM_{2.5}$	Particulate Matter with aerodynamic diameter ≤ 2.5 µm
PM_{10}	Particulate Matter with aerodynamic diameter ≤ 10 µm
POP	Persistent Organic Pollutant
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PR	Performance Requirement (EBRD)
PS	Performance Standard (IFC, 2012)
RDB	Red Data Book (Republic of Kazakhstan)
RFI	Request for Information
RK	Republic of Kazakhstan (Respublika Kazakhstan)
RoW	Right of Way
SanPiN	Sanitarno-Epidemiologicheskie Pravila i Normativy (Sanitary–Epidemiological Rules and Norms)
SEE	State Ecological Expertise (Republic of Kazakhstan)
SEP	Stakeholder Engagement Plan
SES	Socio-Economic Survey
SN RK	Stroitelnye Normy Respubliki Kazakhstan (Construction Norms of the Republic of Kazakhstan)
SO_2	Sulphur Dioxide
SON	September–October–November (climatological season)

Acronym	Definition
SP RK	Svod Pravil Respubliki Kazakhstan (Code of Rules of the Republic of Kazakhstan)
SPS	Safeguard Policy Statement (ADB, 2009)
SPZ	Sanitary Protection Zone
SR	Safeguard Requirement (ADB SPS, 2009)
SSP	Shared Socio-economic Pathway (IPCC climate scenarios)
TDS	Total Dissolved Solids
TNVIM	Transit Noise and Vibration Impact Assessment Manual
TOR	Terms of Reference
TPH	Total Petroleum Hydrocarbons
TSA	Targeted Social Assistance (Republic of Kazakhstan)
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TWA	Time-Weighted Average
UIC	Union Internationale des Chemins de fer (International Union of Railways)
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
UV	Ultraviolet
VdB	Vibration velocity level in decibels
VEAB	VISTA Environment AB
VOC	Volatile Organic Compound
VSN	Vedomstvennye Stroitelnye Normy (Departmental Construction Norms)
VU	Vulnerable (IUCN Red List category)
WB	World Bank

Acronym	Definition
WBCSD	World Business Council for Sustainable Development
WBG	World Bank Group
WEAP	Water Evaluation and Planning System
WHO	World Health Organization
WRI	World Resources Institute

Executive Summary

Introduction

The Darbaza–Maktaaral Railway Expansion Project is a greenfield, single-track railway of approximately 115km in length, with an additional 45 km of sidings and passing loops, under construction in the Turkistan Region of southern Kazakhstan. It is being delivered by Kazakhstan Temir Zholy JSC (KTZ) through Kazakhstan Temir Zholy Finance B.V. as Contracting Entity, under an EPC contract with Integra Construction KZ LLP. The line will connect the existing rail network at Darbaza (near Saryagash) to the Maktaaral–Syrdarya border checkpoint, providing an alternative freight corridor to Uzbekistan and relieving congestion at the Saryagash–Tashkent crossing. At full operation, the line will accommodate approximately 46 train movements per day, predominantly freight, with diesel traction.

Parameter	Description
Project name	Darbaza–Maktaaral Railway Expansion Project
Implementer	Kazakhstan Temir Zholy JSC (KTZ)
EPC contractor	Integra Construction KZ LLP
Location	Turkistan Region, southern Kazakhstan; five rayons crossed by the alignment
Main alignment	c. 115 km of new single-track railway, plus c. 45 km of sidings and passing loops
Major structures	33 alignment-crossing structures (25 bridges, including the 505 m Syr Darya crossing, 5 railway overpasses, 2 road overpasses and 1 tunnel), plus c. 130 drainage culverts
Ancillary infrastructure	two 10 kV overhead transmission lines (OHTL) crossing the Shardara IBA/KBA.
Stations / sidings	Three stations (Yerdaut, Intermediate and Maktaaral) and two passing loops
Operations	c. 46 trains/day (23 each way), predominantly freight; diesel traction; 24-hour operation
Construction start	2024 (in advance of lender E&S documentation)
Planned completion	December 2026

Construction commenced in 2024 and overall completion is planned for December 2026. Construction therefore commenced ahead of the disclosure of this Supplementary ESIA and its associated Environmental and Social Management Plan (ESMP).

This Supplementary ESIA has been prepared at a point when construction of the Project is already under way. The assessment is therefore forward-looking and proportionate to the activities that remain to be undertaken. It focuses on the remainder of the construction phase, the operational phase, and on those late design adjustments that can still reasonably be implemented — for example site-specific measures required to address any material residual agricultural or livestock access constraints identified through verification of the as-built crossing arrangements, the design of operational mitigation such as bird-flight diverters and noise barriers, and the development of management instruments to govern construction completion and long-term operations.

Pre-construction and detailed-design stage matters are not the principal focus of this document. Where pre-construction or design considerations are described, this is either (i) to record the design context that frames residual operational and community impacts, or (ii) to identify site-specific adjustments or corrective measures that remain technically and operationally practicable within the remaining construction period, together with operational mitigation such as noise barriers and bird-protection measures.

Compliance with applicable national requirements and lender standards during the construction works already undertaken is addressed separately, in parallel, through the Environmental and Social Compliance Audit (ESCA) and the Environmental and Social Management System (ESMS) Audit. Together, these reports provide a retrospective assessment of construction activities and environmental and social management systems, and establish and define a time-bound Corrective Action Plan. Land acquisition and resettlement are addressed in the Land Acquisition and Resettlement Plan (LARP), prepared concurrently. Together, the Supplementary ESIA, the ESCA and the LARP constitute the project's environmental and social documentation package. The relationship between these workstreams and the Supplementary ESIA is set out in Section 1.8.

Readers are asked to interpret the findings, recommendations and management commitments in this Supplementary ESIA in that context.

Strategic Rationale and Financing Context

The Project is identified by KTZ and the Government of Kazakhstan as a national strategic priority under multiple frameworks, including the National Project “Strong Regions — Driver of Country Development”, the Presidential instruction of 5 July 2022 on transport-transit potential, and the Concept for the Development of Transport-Logistics Potential to 2030. The strategic case rests on the operational saturation of the existing Arys–Saryagash–Tashkent corridor, which has carried approximately 22 million tonnes of freight per year and is now at near full capacity. The new line is expected to (i) provide a direct, shorter rail route from southern Turkistan Region to Uzbekistan, Afghanistan and beyond, bypassing the Saryagash and Tashkent rail nodes; (ii) extend the transit-freight pathway over Kazakhstan territory; (iii) create throughput surplus on the corridor; (iv) generate direct and indirect employment in southern Kazakhstan; and (v) deliver an environmental benefit through partial modal shift of freight from road to rail.

The Project is being prepared for financing in alignment with the safeguard requirements of the Asian Development Bank (ADB SPS 2009), the IFC Performance Standards (IFC PS 2012), and the AIIB Environmental and Social Framework (AIIB ESF 2024), in addition to the applicable laws of the Republic of Kazakhstan and the WBG EHS Guidelines for railways.

Assessment Approach and Scope

The Supplementary ESIA has been prepared as a forward-looking instrument that complements — but does not duplicate — the parallel Environmental and Social Compliance Audit (ESCA), which addresses retrospective compliance of construction activities to date and issues a time-bound Corrective Action Plan (CAP). Verified ESCA findings are incorporated into the construction-phase ESMP through dedicated entries cross-referenced to CAP item identifiers (for example, ESCA OHS-3, ESCA CHS-3, ESCA IPG-1, ESCA LWC-2). The LARP, prepared in parallel under Annex B of the Contract, addresses land acquisition, compensation, livelihood restoration and the project-level grievance redress mechanism. The preparation of the LARP also forms part of the Project’s actions to align land acquisition and resettlement processes with the requirements of lenders and to address land acquisition and resettlement-related gaps identified through the parallel ESCA process.

Impact significance has been determined through the standard hazard × receptor methodology of ADB SPS 2009, with magnitude scored across size, extent, duration, frequency, probability and reversibility, and receptor sensitivity scored against local/national/international value categories. The mitigation

hierarchy (avoid, minimise, restore, offset) has been applied at design, land take, construction and operations and maintenance stages. The assessment is supported by field surveys for biodiversity (including February 2025 winter waterbird transects and 2025 biodiversity studies in the Shardara Reservoir IBA/KBA), a Critical Habitat Assessment and Preliminary Biodiversity Action Plan, preliminary noise and vibration modelling using the FRA TNVIM (2018) framework and DIN 4150-3, an IAQM construction dust assessment, a Preliminary Climate Risk Assessment over the 120-year design life, and six community consultations in May 2026.

Policy and Regulatory Framework

The Project is required to comply with the Environmental Code of Kazakhstan (2021) and subsidiary regulations on air quality, water quality, noise, vibration, waste and hazardous materials. The national OVOS Stage III procedure and the State Ecological Expertise apply, and Article 246 of the Environmental Code requires the integration of bird-protection measures in the design of electrical networks. Sanitary Protection Zone requirements and tree-cutting permitting apply to specific elements of the works. The Cultural Heritage Law on the Protection and Use of Objects of Historical and Cultural Heritage applies to the archaeological resources along the alignment. The Land Acquisition process started in accordance with the requirements ofand Resettlement Framework operates under the Land Code of Kazakhstan, with district-level Akimats coordinating land acquisition.

Lender requirements applied in addition to the national framework include ADB SPS 2009 (Safeguard Requirements 1–3), IFC Performance Standards 1–8, the AIIB ESF (2024) Environmental and Social Standards, and the WBG General EHS Guidelines and the Sector EHS Guidelines for Railways. The Indigenous Peoples safeguard is not triggered for the Project; this conclusion has been formally documented in the Supplementary ESIA on the basis of the demographic composition of the corridor districts and the absence of any group meeting the IFC PS7 / ADB SPS Appendix 3 / AIIB ESS3 trigger criteria.

Baseline and Receptors of Concern

Physical and biological setting

The corridor traverses a predominantly flat, semi-arid landscape of steppe, semi-desert and irrigated agricultural land, with annual precipitation in the range 100–200 mm and mean daily summer maxima regularly exceeding 35–40 °C. The hydrology is dominated by the Syr Darya River and its associated irrigation network, fed predominantly by snowmelt from the Tien Shan. The alignment crosses the river at approximately KM 83.5 on a 500 m bridge and traverses the eastern margin of the Shardara Reservoir Important Bird Area / Key Biodiversity Area for approximately 16 km on a raised embankment.

The Shardara IBA/KBA is the single most material biological receptor on the alignment. It is internationally recognized under Criterion A4iii (waterbird assemblages exceeding 20,000 individuals), supports eight IBA qualifying species and multiple Kazakhstan Red Data Book species, and triggers Critical Habitat under the lenders' biodiversity safeguards for the Dalmatian Pelican, Pygmy Cormorant and the Syr-Darya Shovelnose Sturgeon. The terrestrial sections of the alignment provide habitat for IUCN Vulnerable mammals (Goitered Gazelle, Marbled Polecat), the IUCN Vulnerable Central Asian Tortoise, and Kazakhstan Red List flora (notably Salvia korolkowii and Eminium lehmannii).

Socio-economic setting

The corridor passes through five rayons of Turkistan Oblast, a predominantly rural area characterise d by mixed Kazakh and Uzbek communities and agricultural livelihoods. Land use includes arable cro pping, intensively managed polytunnel and polythene horticulture, particularly soft-
fruit production in the southern districts, and livestock grazing. Settlements, agricultural land, irrigati on infrastructure and established livestock and community movement routes occur throughout the Project corridor.

No Indigenous Peoples, as defined under ADB SPS Safeguard Requirement 3, IFC PS7 or AIIB ESS 3, ar e present within the Project Area of Influence; these safeguards are therefore not triggered.

Key Impacts and Residual Significance

The impact assessment identifies 128 distinct impacts across the four assessment stages (design, land take, construction, operations and maintenance), with the construction stage producing the largest number of entries. The pre-mitigation significance distribution and the residual position after the application of the mitigation hierarchy are summarized in the table below. Four residual impacts remain High: the permanent loss of habitat within the Shardara IBA/KBA and the associated effects on Dalmatian pelican and migratory birds. A further three impacts on IUCN-listed fish during in-channel works are High pending confirmation through the Final BAP. All are conditional on implementation of the Biodiversity Action Plan.

Stage	High residual impact	Medium residual impact	Low residual impact	Non-significant impact
Design	1 (Shardara IBA/KBA)	4 (groundwater, archaeology, landscape, village views)	6	1
Land take[1]	3 (Shardara: IBA, Dalmatian Pelican, migratory birds)	4	6	0
Construction	0	2 (IBA temporary loss / fragmentation)	Most construction impacts	10
Operations & maintenance	0	3 (operational noise, operational vibration)	Most O&M impacts	9

Material impact themes

Biodiversity and the Shardara IBA/KBA. Permanent habitat loss of approximately 150 ha within the IBA/KBA (c. 0.15% of total area, concentrated in c. 130 ha of braided channels and floodplain grassland and c. 20 ha of Tugai scrub, reedbed and open mud), permanent collision and electrocution risk from the two 10 kV overhead lines, and temporary disturbance and hydrological fragmentation during construction. The residual position is conditional on the BAP.

Agricultural irrigation. Construction activities have the potential to affect irrigation and drainage infrastructure and temporarily interrupt water supply to agricultural land. During the LARP census, users of 141 agricultural plots raised concerns regarding potential irrigation disruption; these represent concerns regarding potential impacts and do not constitute confirmed cases of interruption or damage. Project design records identify 79 structures serving irrigation ditches, canals and drainage channels.

Specific irrigation infrastructure affected by construction includes a water-conveyance pipe at KM25.9, for which restoration and reinstatement of maintenance access have been completed; the LOTOK

[1] In this document, land take refers to the total land area — both permanent and temporary — physically required for the Project footprint, comprising the rail formation and Right of Way, station and passing-loop footprints, bridges and embankments, and ancillary and temporary construction facilities (worker camps, borrow pits, batching plants, laydown areas and access roads). Land take is distinct from land acquisition and resettlement, which concerns the legal acquisition of land and the compensation and livelihood-restoration entitlements of affected people; those matters are addressed in the parallel Land Acquisition and Resettlement Plan (LARP).

channel at Ushagash, where restoration is underway and the principal foundation works have been completed; and the LOTOK channel at Atakent, where relocation works and the associated land-acquisition process are underway. KTZ has confirmed that the irrigation issue raised during consultation at Berlik relates to the same LOTOK channel at Ushagash and is not a separate irrigation impact.

Remaining construction-phase risks will be managed through the Irrigation Network Management Plan, including advance notification, maintenance of irrigation continuity where works affect active canals, reinstatement of disturbed infrastructure and commissioning/functionality verification.

For sections already constructed, KTZ will complete as-built verification of relevant irrigation and drainage crossing structures and consult users at locations where irrigation-related concerns were raised to determine whether Project-related physical damage or associated crop, production, income or other economic losses have occurred. The findings will be documented in an Irrigation Verification Report and, where Project-related impacts or losses are verified, a Corrective Action Plan will identify the required remedial works, compensation and/or livelihood-restoration measures.

Land acquisition, physical and economic displacement. Because construction commenced in 2024 ahead of lender-aligned due diligence, the Land Acquisition and Resettlement Plan (LARP) addresses both retrospective and ongoing land acquisition impacts and has been prepared in accordance with national legislation and the requirements of the ADB Safeguard Policy Statement (2009), IFC Performance Standard 5 and AIIB Environmental and Social Standard 2. Land acquisition is a government-led process coordinated by the Turkistan Region and district Akimats, with KTZ in a coordinating and financing role. For plots where acquisition had not commenced by the time of the survey, 16 February 2026, corresponding to Akimat Decree No. 50, is applied as the cut-off date.

Permanent acquisition affects 371 land plots, comprising 48 privately owned and 323 leased plots, with a combined affected area of approximately 417 ha. The plots are associated with 331 unique affected entities, comprising 308 households and 23 legal entities, with an estimated affected population of 1,744 persons. A total of 138 affected parties, comprising 132 households and six legal entities, are classified as severely affected, and 93 affected households are identified as vulnerable. The Project affects 101 residential, auxiliary, commercial and business-related structures on 25 plots. Relocation impacts affect 14 households and one legal entity. The large majority of impacts otherwise comprise economic displacement associated principally with loss or fragmentation of agricultural land, agricultural production and associated livelihood impacts.

As of 25 August 2026, compensation payments had been completed for all affected land plots subject to compensation in Zhetysay and Keles districts. In Maktaaral district, payments had been completed for 35 plots. In Saryagash district, one payment remained outstanding, relating to a residential land plot in Yerdaut that is subject to an ongoing court case. The LARP also identifies 41 plots subject to documented voluntary donation, supported by signed donation letters. Outstanding compensation, replacement-cost, relocation, livelihood-restoration and documentation requirements will be verified and closed through implementation of the LARP and associated monitoring arrangements.

Cross-corridor connectivity. The railway will create a permanent linear barrier across agricultural and grazing land, with the potential to sever established livestock movement routes and access between settlements, pasture, agricultural land and water resources. The Project design includes numerous cross-corridor structures, including dedicated agricultural and livestock underpasses and larger box culverts. Community consultation has identified livestock access as an important local issue, including at KM 22.9, KM 42.8 and KM 55.1, where substantial livestock movements across the alignment were reported. Although crossing provision is relatively extensive along the corridor, its adequacy depends on the location and practical usability of individual structures relative to established livestock and agricultural movement routes. Localized severance may therefore occur where suitable crossings are not conveniently located or where their configuration limits practical use by livestock or agricultural users. Consultation with affected communities has informed the crossing design at specific locations,

including the provision of 4.0 × 2.5 m livestock passages at KM 22.9, KM 42.8 and KM 55.1. The distribution of potential livestock-access structures has also been reviewed to identify longer-spaced reaches warranting closer consideration; however, spacing alone is not treated as an indicator of inadequate access. For sections already constructed, the adequacy of the as-built crossing provision will be verified against actual agricultural and livestock access requirements. Where a material connectivity deficiency is identified, technically and operationally practicable corrective measures will be implemented before the start of operations.

Operational noise. Operational noise modelling predicts exceedances of the IFC daytime (55 dB(A)) and night-time (45 dB(A)) guideline values at six locations along the alignment. Noise barriers are committed at Maktaaral and Erdaulet stations to address the identified operational noise impacts.

Operational vibration. Operational vibration modelling identifies 18 receptors at Maktaaral and Ushagash above the FRA TNVIM 72 VdB Occasional Events criterion. A detailed operational vibration assessment will be undertaken at these locations to confirm the extent and significance of the predicted effects and determine the mitigation required. Additional Project-specific vibration mitigation will be implemented where demonstrated to be necessary by the detailed assessment.

Construction vibration. Construction-vibration screening identified 142 receptors within 100 m of the works, including 35 within 30 m and three within 10 m. Construction vibration will be managed in accordance with DIN 4150-3, supported by condition surveys, real-time vibration monitoring and defined Peak Particle Velocity (PPV) trigger and action levels at 50% and 75% of the applicable guideline value. Pre-construction baseline condition surveys will be undertaken at Maktaaral; where works have already commenced, current-condition surveys will be completed at the earliest opportunity. Specific controls will apply at Ushagash, where two receptors are located within the 10 m screening band.

Community health and safety. Construction-phase risks from public encroachment, traffic from haulage operations and emergency response capability; operational risks from trespass on railway infrastructure and at level crossings. Mitigation centers on fencing, signage in Kazakh and Russian, traffic management, a community-facing Grievance Redress Mechanism (GRM), and full automation of public road level crossings with barriers and warning systems.

Occupational health and safety. High-risk activities including working at height, lifting operations, deep excavations, bridge construction over watercourses and work in proximity to live rail. Mitigation through Working at Height permits, lifting plans, excavation safety procedures, and a workers' GRM. Construction-phase heat stress (WBGT at 32 °C corresponds to 44% single-day productivity loss at 400 W intensity) treated as a High Occupational Health and Safety (OHS risk per the Climate Resilience Assessment.

Labour, workforce and worker accommodation. The Project is delivered by an EPC contractor (Integra) with approximately 10 subcontractors and a peak workforce of around 800 specialists across dispersed work fronts, giving rise to material labour and working-conditions considerations: employment sourcing and the balance of local and non-local hire; workforce influx and its interface with rural host communities (including SEA/GBVH risk); occupational health and safety on high-risk activities (work at height, lifting, deep excavations, the Syr Darya bridge, and work near live rail); and the management of approximately 10 worker accommodation camps to the IFC/EBRD Worker Accommodation (2009) standard across a multi-subcontractor structure. These are addressed through the Labour Management Procedures, Workforce Management Plan and Camp Management Plans of the construction-phase ESMP and, for the construction already undertaken, through the parallel ESCA Corrective Action Plan; supply-chain, child, forced and migrant-labour considerations are addressed under PS2. Workforce-community risks are addressed in combination with the community health and safety and GBVH provisions.

Cumulative impacts. The Project's environmental and social impacts have been assessed in combination with other existing, planned and reasonably foreseeable developments, applying the IFC Good Practice Handbook on Cumulative Impact Assessment and Management (2013). The assessment considers the Project alongside the existing Arys–Saryagash–Tashkent rail corridor, the regional road network and border facilities, the Shardara reservoir and hydropower infrastructure, the Mirzachoel irrigation system and irrigated cotton production, and reasonably foreseeable future actions including Stages 2 and 3 of the Darbaza–Maktaaral program. Five valued environmental and social components were carried forward: the Shardara IBA/KBA waterbird assemblage, the Syr Darya hydrological regime, ambient air quality, community health and safety, and agricultural livelihoods. With the Project's mitigation and management framework implemented, the residual cumulative position is Low for the Syr Darya hydrological regime; Medium for the Shardara IBA/KBA waterbird assemblage (with Net Gain pursued through the Biodiversity Action Plan and offset framework), for ambient air quality at the sensitive receptor locations during construction, for construction-phase community health and safety (reflecting concurrent multi-project workforce influx in the corridor), and for agricultural livelihoods.

Mitigation Framework and Key Commitments

Mitigation is structured around the design, land-take, construction and operations and maintenance phases, and is operationalized through three Environmental and Social Management Plans (ESMPs) presented as Tables A-1, A-2 and A-3 of the ESMP (Annex A). Each row of these tables identifies the ESIA impact ID or ESCA CAP reference, the EMP reference number, the topic, the impact or issue, the specific commitment, the monitoring indicator, the implementation responsibility, and the monitoring responsibility. The key commitments below represent the most material elements of the framework.

Design and pre-construction phase

- Verification that the formation has been narrowed across the IBA/KBA to constrain the permanent footprint to approximately 150 ha, and that four additional bridge structures have been incorporated within the Shardara crossing to maintain hydrological connectivity in addition to the main Syr Darya river crossing.

- Hydraulic capacity review of the Syr Darya bridge, all culverts and drainage structures benchmarked against SSP5-8.5 P90 projected peak discharge conditions, with remediation incorporated into remaining works.
- Climate-adjusted Stress-Free Temperature specification for all Continuous Welded Rail sections, referenced to projected maximum rail surface temperatures to at least 2050.
- The LARP establishes an entitlement framework providing compensation at replacement cost for affected land, structures, trees and agricultural production, together with relocation and transition allowances and additional assistance for severely affected and vulnerable households, supported by a livelihood restoration program, a grievance redress mechanism, and internal and external monitoring. The total estimated LARP budget is approximately KZT 1.40 billion (about USD 2.93 million), rising to roughly KZT 1.54 billion (about USD 3.22 million) with a 10% contingency, to be financed by the Government of Kazakhstan through the Akimats and KTZ. The Plan is implemented in parallel with ongoing works and distinguishes between retrospective cases, where acquisition is complete and the focus is verification and gap-closing, and pending cases to be handled prospectively. Preparation was subject to data limitations—including incomplete valuation and voluntary-donation documentation and the varying status of acquisition across plots—and KTZ will verify affected persons, assets and entitlements during implementation and update the LARP through an addendum where material changes arise, consistent with lender requirements.

Construction phase

- Implementation of the Construction Environmental and Social Management Plan (CESMP) and its topic-specific plans: Pollution Prevention Plan, Air Quality Management Plan (incorporating the full IAQM "highly recommended" measures for the High Risk classification), Construction Noise Management Plan, Construction Vibration Management framework, Soil Management Plan, Traffic Management Plan, Workforce Management Plan, Camp Management Plan, Biodiversity Management Plan, Cultural Heritage Chance Finds Protocol, Irrigation Network Management Plan, and the OHS Heat Action Plan.
- Continuity of irrigation supply: canal interruptions scheduled outside the May–September cropping season where achievable, minimum 14 days' written notice for any active canal interruption, temporary bypass arrangements where unavoidable, and no interruption exceeding 72 hours without a documented alternative supply. For completed sections, KTZ will undertake as-built verification and consultation at locations where irrigation-related concerns were raised, with Project-related physical deficiencies rectified and any verified crop, production, income or other economic losses addressed through a Corrective Action Plan and the applicable LARP provisions.
- Habitat restoration of all temporary works areas within the IBA/KBA to pre-construction habitat type; vegetation establishment monitored for at least two growing seasons post-restoration.
- Verify the adequacy of the as-built livestock and agricultural crossing provision against actual access requirements, with particular attention to locations where affected communities have raised specific access concerns and to longer-spaced reaches where the availability of suitable alternative crossings may result in material diversions. Where verification identifies a material connectivity deficiency, KTZ and the EPC Contractor will consult with affected users and implement technically and operationally practicable corrective measures. These may include improving access to an existing crossing, adapting a suitable existing structure or, where necessary and technically feasible, providing additional crossing provision. Verification and any required corrective measures will be completed before the start of operations.
- Implementation of the ESCA-derived corrective actions: site-level OHS supervision with stop-work authority; routine OHS training, weekly toolbox talks and PPE enforcement; community notification procedures for high-impact construction activities with 48-hour advance notice in Kazakh and Russian; and documented emergency response equipment inventory at each active work front.
- Construction Water Management Plan addressing consumptive use in the chronically water-stressed Syr Darya Basin, coordinated with the Ministry of Water Resources and Irrigation and the Syr Darya basin water organization.

Operations and maintenance phase

- Noise barriers at Maktaaral and Erdaulet stations, with the package at Küriş, Ushagash, Sarıžylga–Bereke and Şyrıldak–Jabaytöbe confirmed by detailed operational noise modelling at the EPC stage; trackform mitigation at Maktaaral and Ushagash sufficient to bring predicted vibration within the FRA TNVIM 72 VdB Occasional Events criterion; horn-use protocols and locomotive-idling restrictions at passing loops in or adjacent to the IBA/KBA.
- Bird Flight Diverters on the two 10 kV overhead distribution lines through the IBA/KBA and 1 km buffers north and south; bird-safe pole-top design (e.g. either a minimum 1.5 m horizontal and 0.6 m vertical clearance between energized parts or insulation of exposed live parts); horn use prohibited and train speeds restricted within the IBA/KBA during the breeding season

(April–August) to a maximum speed of 50 km/h (30 mph); operational lighting commitments extended to the 1 km buffer.

- Post-Construction Fatality Monitoring (PCFM) in accordance with the EBRD/IFC/KFW 2023 PCFM handbook. PCFM will comprise four surveys per month during peak migratory periods and two surveys per month otherwise, with searcher-efficiency and scavenger-removal trials applied to derive corrected mortality estimates. The entire line, including the IBA/KBA should be surveyed for the first year and the IBA/KBA should surveyed for a minimum of three years and repeated every five years for the operational life of the railway; additional or amended mitigation deployed within 90 days where mortality of a globally threatened (IUCN Endangered or Critically Endangered) species is detected or where collision events persist.
- Operational Pollution Emergency Response Plan specific to the Shardara Reservoir crossing, with pre-positioned spill response equipment at strategic locations and joint exercises with Kazsushar and the IBA management body; tank-and-valve spill-holding system in the track drainage at the Shardara passing loops and cargo restrictions across the Shardara crossing (no unstabilized hazardous bulk liquids).
- Operational Air Quality Monitoring at sensitive receptors adjacent to the alignment (including Akuy village), with annual monitoring campaigns for NO_2, PM_{10} and $PM_{2.5}$ over a representative seven-day period during peak rail traffic; corrective action through locomotive maintenance, fleet renewal or operational scheduling where exceedances are identified.
- Operational Waste Management Plan for the rolling stock and engine maintenance facility, structured on the waste hierarchy, with 110% secondary containment for hazardous waste, chain-of-custody manifests to licensed disposal, and annual third-party audit.

Cumulative Impacts

The principal cumulative management measures are coordination with corridor-level Government and Akimat planning on construction traffic, workforce and biodiversity monitoring; engagement with the transboundary BWO Syr Darya / ICWC water-management regime; integration of the Project's biodiversity monitoring into wider corridor monitoring; forward-planning conditions for the Stage 2/3 ESIAs; and inclusion of cumulative-impact metrics in the semi-annual monitoring report to the Lenders.

Climate Resilience

A Preliminary Climate Resilience Assessment (CRA) has been undertaken over the 120-year design life of the railway. The overall climate risk to the Project is rated HIGH. Three hazards drive the rating: river flood (HIGH baseline, HIGH future), with the 500 m Syr Darya bridge as the most climate-sensitive single asset and with spring precipitation in the Syr Darya headwaters projected to increase by up to +50% under upper-bound (SSP5-8.5 P90) estimates by 2050; rainfall-induced landslide (HIGH), concentrated on embankment slopes adjacent to the Shardara Reservoir; and mean surface temperature (LOW at baseline, HIGH future), with projected warming of more than 2.0 °C above the 1985–2014 baseline by 2145 driving thermal expansion, track buckling and worker heat stress. Additional Moderate risks include heat stress (treated as HIGH for construction-phase OHS planning), drought and water scarcity in the chronically water-stressed Syr Darya Basin, and wildfire.

Stakeholder Engagement and Grievance Redress

Six community consultation sessions were held in May 2026 at locations within Saryagash and adjoining districts along the alignment, attended by representatives of KTZ and Lenders. The consultations presented the preliminary ESIA findings, the LARP, and the Grievance Redress Mechanism, and invited community feedback. Specific commitments now incorporated into the ESMP include the requested agricultural underpasses at Oshakty village okrug (KM 36.5 - KM40.8, and between KM 44.8 and KM 44.9), targeted construction noise and vibration management at the six

locations identified through the technical assessment, and operational air quality monitoring at Akuy village. The Environmental Project Information Brochure (ePIB) and the LARP information brochure are available in English, Kazakh and Russian.

The project-level Grievance Redress Mechanism operates at three levels — Level 0 (site / Community Liaison Officer), Level 1 (district / Akimat Grievance Redress Committee), and Level 2 (regional / Oblast Grievance Redress Committee) — with recourse to the national legal system available to complainants at any stage. The mechanism is accessible to all categories of stakeholder including workers (through a dedicated workers' GRM accessible to subcontracted and migrant labour, permitting anonymous grievances and available in the languages spoken by the workforce). Quarterly summary reporting and independent review of grievance handling by KTZ are committed. Indigenous Peoples are confirmed as not present within the area of influence.

ESMP, Implementation Arrangements and Next Steps

The ESMP is structured as three components — Table A-1 (Design and Pre-Construction), Table A-2 (Construction), and Table A-3 (Operations and Maintenance) — supported by the topic-specific framework plans referenced in Section 10.3. Each commitment is anchored to a specific ESIA impact ID or ESCA CAP item, with named implementation and monitoring responsibilities and a defined monitoring indicator. Following integration of the Passage Structures Review and the Climate Resilience Assessment, the ESMP comprises 35 design / pre-construction entries, 63 construction entries, and 24 operations and maintenance entries.

Environmental Monitoring Plan (EMoP)	Coverage
Table A-1: Design and Pre-Construction	Verification of as-built design against ESIA commitments (formation narrowing in IBA/KBA, four additional Shardara bridges, agricultural underpasses, culvert capacity, alignment offsets to archaeology); preparation of BAP, BOMP, LARP, CHMP, vulnerability screening, Gender Action Plan; ESCA CAP closure items; climate resilience design checks; cross-corridor passage verification and remedial design
Table A-2: Construction	Topic-specific construction plans (Pollution Prevention, Air Quality, Noise, Vibration, Soil, Traffic, Camp, Biodiversity, Cultural Heritage Chance Finds, Irrigation Network, Heat Action); pre-clearance ecological surveys and translocations; IBA-specific construction management plan; verification of as-built livestock and agricultural crossing provision and implementation of practicable corrective measures where material access deficiencies are identified; and ESCA-derived OHS / labour / community notification commitments; flood monitoring and water management
Table A-3: Operations and Maintenance	Noise barriers at Maktaaral and Erdaulet; detailed operational vibration assessment at Maktaaral and Ushagash and any additional Project-specific mitigation demonstrated to be required; Bird Flight Diverters and bird-safe pole-top design; PCFM and vantage-point monitoring; Pollution Emergency Response Plan for the Shardara crossing; wildlife-permeable fencing and underpasses; temperature-triggered speed restrictions; embankment condition inspections; wildfire management; operational waste management; 5-yearly climate resilience reviews

Implementation responsibilities

KTZ holds overall accountability for ESMP implementation, monitoring, reporting, and the operation of the GRM. The EPC Contractor (Integra) is responsible for the delivery of the construction-phase

commitments through its CESMP and the topic-specific plans, supported by named role-holders (H&S Specialist, Labour Officer, Community Liaison Officer interface, Ecologist, Cultural Heritage Monitor). Subcontractors are required to meet equivalent standards and to provide evidence of compliant employment, wages, working hours and OHS arrangements prior to mobilization. Coordination with national authorities (Ministry of Ecology and Natural Resources, Ministry of Water Resources and Irrigation, Kazhydromet, Kazsushar, the cultural heritage authorities and the national fisheries and herpetological authorities) is committed through specific ESMP entries.

Reporting and review

Climate resilience and E&S performance are reported through semi-annual Environmental and Social monitoring reports submitted to ADB, AIIB and IFC as applicable, compiled by KTZ. Corrective actions are tracked to closure in the subsequent semi-annual report. The ESMP, the BAP and the Climate Resilience adaptation framework are subject to review at substantial completion, at the end of the defects liability period, and at five-yearly intervals during operations.

Next steps

1. Disclosure of the Supplementary ESIA and the ESMP in English, Kazakh and Russian, with the Non-Technical Summary, in accordance with lender disclosure requirements.
2. Approval of the Biodiversity Action Plan, and confirmation of the offset commitments required to achieve No Net Loss for the IBA/KBA and Net Gain for the Critical Habitat triggers.
3. Completion of the detailed operational noise modelling, the detailed construction vibration assessment, and the targeted Climate Resilience Review during the EPC stage.
4. Closure of the ESCA Corrective Action Plan items embedded in the construction-phase ESMP, with documented evidence of remediation.
5. Verification of the as-built agricultural and livestock crossing provision against actual access requirements and practical usability, with technically and operationally practicable corrective measures implemented where a material connectivity deficiency is identified.
6. Completion of the Ushagash LOTOK restoration and Atakent LOTOK relocation, including the associated land-acquisition requirements, verification of functionality and operation and maintenance access, and rectification of any Project-related deficiencies identified.

Conclusion and Residual Risk Position

The Project is technically feasible, strategically warranted and capable of being brought into alignment with the safeguard requirements of ADB, IFC and AIIB through the implementation of the mitigation, monitoring and management framework set out in this Supplementary ESIA and the associated ESMP. With full implementation of the framework, the residual position is dominated by one HIGH residual impact — the permanent loss of habitat within the Shardara Reservoir IBA/KBA — for which the achievement of No Net Loss (IBA/KBA) and Net Gain (Critical Habitat triggers) is conditional on the implementation of the Biodiversity Action Plan and the offset framework. The residual climate risk for the highest-rated hazards (river flood, mean surface temperature, rainfall-induced landslide) is expected to reduce from HIGH to MODERATE with the implementation of the adaptation measures committed in the ESMP, subject to detailed design verification. Construction-phase impacts on agriculture, irrigation, community health and safety, noise, vibration, soils and water are reducible to Low residual significance with the implementation of the CESMP and its topic-specific plans. The operational-phase residual position is Low for most receptors, with Medium residuals for operational noise at the six identified locations and operational vibration at Maktaaral and Ushagash pending confirmation of the detailed mitigation package at the EPC stage.

Continued vigilance is required during the remainder of the construction program, particularly in relation to the in-river works at the Syr Darya crossing, the works within the IBA/KBA, the vibration-

generating activities at Ushagash and Maktaaral, and the implementation of the ESCA-derived corrective actions on OHS, community notification, subcontractor labour compliance and emergency response. The framework documented in this Supplementary ESIA is intended to be a living instrument, updated as the detailed assessments scheduled for the EPC stage are completed and as monitoring data accumulates during operations.

1. Introduction and Background

1.1 Purpose and Scope

This Supplementary Environmental and Social Impact Assessment (Supplementary ESIA) has been prepared by VISTA Environment AB (VEAB, or the "ESIA Team") on behalf of Kazakhstan Temir Zholy Finance B.V. (the Client), acting in support of Kazakhstan Temir Zholy JSC (KTZ) as Project implementer, in respect of the Darbaza–Maktaaral Railway Expansion Project (the Project). The Supplementary ESIA forms a key component of the environmental and social due diligence being undertaken in support of potential financing of the Project by the Asian Development Bank (ADB), the International Finance Corporation (IFC), and the Asian Infrastructure Investment Bank (AIIB) (collectively, the Lenders). Its primary purpose is to:

- supplement the existing national Environmental Impact Assessment (Otsenka Vozdeystviya na Okruzhayushchuyu Sredu, OVOS) and earlier project-related environmental and social documentation to address gaps identified against applicable Lender requirements;
- identify, characterise, and evaluate the residual environmental and social risks and impacts of the Project for both the construction and operational phases, with particular focus on the priority topics identified at the inception stage;
- define proportionate, risk-based mitigation, monitoring, and management measures consistent with the mitigation hierarchy, applicable national legislation of the Republic of Kazakhstan, and the Lenders' environmental and social policies and standards; and
- provide the basis for standalone Environmental and Social Management Plans (ESMPs) for the construction and operational phases, together with a Biodiversity Management Plan and a preliminary Biodiversity Action Plan.

The Supplementary ESIA also draws on the Project's national Report on Possible Impacts (OVOS), prepared for the detailed working design under the Environmental Code of Kazakhstan. The OVOS and associated technical documentation provide updated Project design information and national assessment data, including detailed emissions calculations, environmental protection measures and other technical inputs. These data have been reviewed and incorporated where relevant, while this Supplementary ESIA applies the additional scope, assessment methodology and mitigation requirements necessary to address the requirements of ADB, IFC and AIIB.

The Supplementary ESIA is forward-looking in nature. It focuses on supplementing the existing environmental and social assessment documentation, addressing gaps against applicable international standards, and strengthening management measures for the remainder of construction and for the operational phase. Construction-phase compliance with applicable requirements is addressed separately through a parallel Environmental and Social Compliance Audit (ESCA) prepared under the same overall assignment; the relationship between the two workstreams is set out in Section 1.8.

The Supplementary ESIA has been prepared in accordance with the following frameworks:

- the environmental and social legislation of the Republic of Kazakhstan, including the Environmental Code, the Land Code, the Labor Code, the Water Code, and related sectoral legislation and subordinate acts;
- the ADB Safeguard Policy Statement (SPS, 2009), including Safeguard Requirements 1 (Environment), 2 (Involuntary Resettlement), and 3 (Indigenous Peoples), and associated good practice guidance;
- the IFC Performance Standards on Environmental and Social Sustainability (2012);
- the AIIB Environmental and Social Framework (ESF, 2024) and associated Environmental and Social Standards;

- the World Bank Group Environmental, Health and Safety Guidelines (general and sector-specific, including the EHS Guidelines for Railways); and
- relevant good international industry practice, including ILO core conventions and applicable IFC and EBRD guidance notes.

The three Lenders have not formally adopted a Common Approach for the Project. In the absence of formal harmonization, this Supplementary ESIA applies the most stringent or most protective requirement where Lender standards diverge, consistent with international good practice. Where this approach has determined the applicable benchmark for a specific topic — for example, noise criteria, biodiversity offset requirements, public consultation timing, or grievance redress provisions — the underlying choice is identified in the relevant chapter. Disclosure timelines are aligned to the most demanding Lender requirement (ADB SPS 2009: 120 calendar days before Board consideration for Category A projects).

The scope of the Supplementary ESIA, including the priority environmental and social topics to be addressed, was confirmed at the inception stage in consultation with the Lenders. The priority topics comprise: biodiversity, critical habitat and ecosystem services; occupational health and safety (OHS) and worker accommodation; community health and safety, including security personnel arrangements where applicable; hydrology, flood risk and water resources; air quality, noise and vibration; climate change, including greenhouse gas (GHG) emissions and climate resilience; land use change, agricultural severance and irrigation; cultural heritage; labour management, gender-based violence and harassment (GBVH) and supply-chain labour; cumulative environmental and social impacts; and stakeholder engagement and grievance redress. Land acquisition and involuntary resettlement are addressed in the parallel Land Acquisition and Resettlement Plan (LARP).

Indigenous Peoples requirements (SPS SR3, IFC PS7, AIIB ESS3) have been screened against the demographic and cultural composition of the corridor districts. The Project is Category C for Indigenous Peoples under SPS; the standard is not triggered under IFC PS7 or AIIB ESS3. The screening determination is documented in Section 2 (Table 3 — Lender E&S Categorizations and Triggered Standards) and elaborated in Chapter 3 (Policy and Regulatory Context) and Chapter 7 (Social Baseline).

1.2 Roles and Responsibilities

The Supplementary ESIA has been undertaken by an independent multidisciplinary consultant team led by Vista Environment AB (VEAB), engaged directly by Kazakhstan Temir Zholy Finance B.V. acting on behalf of KTZ as Project implementer under a services contract dated 19 December 2025. The Consultant team brings expertise in environmental management, biodiversity, occupational and community health and safety, labour and working conditions, social impact assessment, and stakeholder engagement. The Consultant has prepared this Supplementary ESIA in accordance with its Terms of Reference, exercising professional judgement independently of the Client and the Lenders, and is responsible for the technical content, conclusions and recommendations of this report. The Lenders have been engaged throughout preparation for confirmation of scope and review of interim deliverables, but have not directed the technical content. The findings of this Supplementary ESIA, the parallel ESCA and the LARP have been subject to independent review by the Lenders' E&S due diligence advisors.

KTZ, as the Project developer and implementing entity, is also responsible for providing access to corporate and project-level documentation, facilitating site visits and stakeholder interviews, and coordinating engagement with the Engineering, Procurement and Construction (EPC) contractor (Integra Construction KZ LLP, hereafter “Integra”), subcontractors, and relevant public authorities.

Land acquisition and compensation activities for the Project are being implemented as a government-led process, coordinated primarily by the Akimats (local executive authorities) of Turkistan Region and the affected districts under national legal procedures, with KTZ playing a coordinating and financing

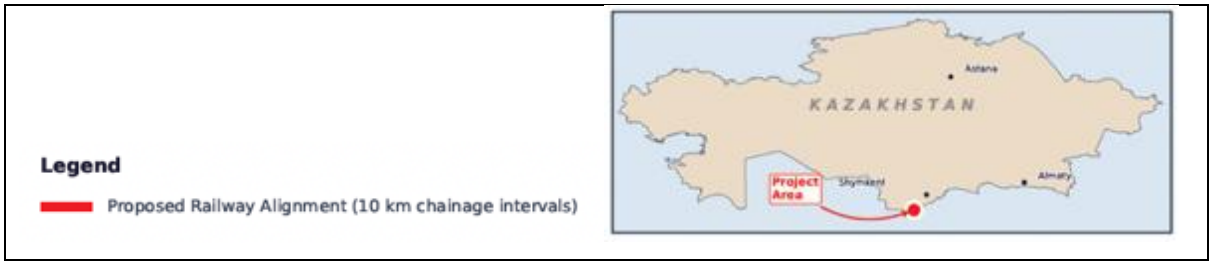
role. The Akimats are therefore key stakeholders for the LARP workstream and have been engaged accordingly.

1.3 Project Overview

The Project is a strategically significant, greenfield railway infrastructure development located in the Turkistan Region of southern Kazakhstan (see Figure 1). It is intended to relieve capacity constraints on the existing Kazakhstan–Uzbekistan rail corridor, enhance regional freight connectivity, and support growing international and transit trade flows across Central Asia. At full operation, the line will accommodate approximately 46 trains per day – 23 each way (predominantly freight, diesel-hauled; the line is not electrified for traction) and is expected to eliminate the need for KTZ trains to transit through Uzbekistan.

Figure 1: Project Location





The Project comprises approximately 115 km of new single-track railway, together with an additional 45 km of sidings and passing loops, and associated railway, civil, and electrical infrastructure across five rayons (districts) of Turkistan Oblast. Key components include:

- construction of the main rail alignment, comprising earthworks, track formation, ballast, sleepers, and rails;
- reconstruction or extension of three stations and two passing loops, including associated depots, maintenance, servicing, and operational facilities;
- 33 structures crossing the alignment — comprising 25 bridges (including the 500 m crossing of the Syr Darya River and four bridges combined with agricultural or cattle underpasses), two road overpasses, five railway overpasses (some combined with underpasses), one tunnel, and approximately 130 drainage culverts;
- provision of two 10 kV overhead distribution lines through the Shardara IBA/KBA for signalling and communications purposes (train traction is diesel-powered; the line is not electrified), fitted with bird flight diverters and bird-safe pole-top design, together with diesel fuel storage and supply arrangements for construction plant and rail traction;
- development of temporary and permanent access roads, borrow pits, material storage and laydown areas, concrete batching plants, and other construction support facilities; and
- establishment of worker accommodation camps and associated welfare, sanitation, and utility services.

The Project is being delivered under an EPC contract with Integra, supported by multiple subcontractors operating concurrently across different work fronts.

The detailed working design assessed through the national environmental assessment has been developed by KSD Engineering LLP and Integra Construction KZ LLP on behalf of KTZ.

Construction activities are distributed along the full length of the alignment and include high-risk activities typical of large linear infrastructure projects — including heavy lifting, work at height, deep excavations, bridge construction over watercourses, and interfaces with public roads and nearby communities.

Key project parameters are summarised in Table 1. A detailed description of the Project, including alternatives considered, ancillary and associated facilities, construction activities, and operational arrangements, is provided in Chapter 2.

Table 1: Key Project Parameters

Parameter	Description
Project Name	Darbaza–Maktaaral Railway Expansion Project
Project Implementer	Kazakhstan Temir Zholy JSC (KTZ)
Contracting Entity (Borrower)	Kazakhstan Temir Zholy Finance B.V.

Parameter	Description
EPC Contractor	Integra Construction KZ LLP (“Integra”)
Location	Turkistan Region, southern Kazakhstan; five rayons (districts) crossed by the alignment
Project Type	Greenfield single-track railway expansion with associated stations, sidings, and ancillary infrastructure
Main Alignment	Approximately 115 km of new single-track railway, with an additional 45 km of sidings and passing loops
Major Structures	33 structures including bridges and underpasses (25 bridges, 2 road overpasses, 5 railway overpasses and 1 tunnel), together with approximately 130 drainage culverts. The crossing provision includes designated livestock and agricultural passages and larger box culverts that may also provide cross-corridor access.
Stations and Depots	Reconstruction or extension of three stations and two passing loops, with associated depots and operational facilities
Operational Throughput	Approximately 46 trains per day at full operation, predominantly freight (23 journeys in each direction)
Construction Commencement	2024 (commenced in advance of completion of lender-aligned environmental and social documentation)
Planned Completion	December 2026

1.4 Strategic Significance and National Policy Context

The Project is identified by KTZ and the Government of the Republic of Kazakhstan as an urgent and important step in the development of the transit, transport and republican rail potential of Kazakhstan, of high political, economic, and social significance. The strategic case is anchored in the present-day operational position of the existing Arys–Saryagash–Tashkent line, which serves as the principal corridor for freight movement between Kazakhstan and the countries of Central Asia, as well as for export–import freight movement between Kazakhstan, China, Russia, the Middle East, and the wider region. Freight throughput across the Saryagash MGSP (international rail border crossing) averaged 22.0 million tons per year over the period 2018–2021, with international movements running at approximately 22 train pairs per day, and was projected to rise to 25.4 million tons per year by 2023. The capacity of Saryagash station and the Tashkent rail node has been identified as the principal bottleneck in the corridor, with Saryagash operating at near full capacity.

The Project is incorporated into multiple national strategic frameworks: the National Project "Strong Regions — Driver of Country Development" (Government Resolution № 729 of 12 October 2021); the President of the Republic of Kazakhstan's instruction on the development of transport-transit potential (Presidential meeting of 5 July 2022); and the Concept for the Development of Transport-Logistics Potential of the Republic of Kazakhstan up to 2030 ("Measures in the sphere of railway transport and infrastructure 2024–2025", Ministry of Industry and Infrastructure Development, 2022). The Project's strategic functions, as articulated in TEO Volume 1 section2, include: (i) creation of a direct shorter rail route from southern Turkistan Region to Uzbekistan, Afghanistan and beyond, bypassing the Saryagash and Tashkent rail nodes; (ii) extension of transit-freight pathway over Kazakhstan territory, increasing transit revenue captured by KTZ; (iii) creation of throughput surplus

on the corridor, supporting future regional economic growth; (iv) social benefit through direct and indirect employment creation in southern Kazakhstan; (v) improved local mobility and goods access for the corridor districts; (vi) reduction in regional cost of consumer goods through reduced transport costs; and (vii) improved environmental position of the region through the partial transfer of freight from road to rail.

1.5 Project Status and Phasing

At the time of preparation of this Supplementary ESIA (September 2026), construction is advanced. More than 100 km of the railway alignment have been levelled and approximately 90 km of track has been laid. Works are ongoing concurrently at three new stations, two sidings, and the 500-metre bridge crossing of the Syr Darya River. Approximately 800 specialists and 350 units of heavy machinery are currently mobilised on the Project. Overall completion of construction is planned for early 2027, after which the Project will transition to the operational phase under KTZ rail network management arrangements.

The national environmental assessment process has progressed in parallel with preparation of this Supplementary ESIA. The National EIA (OVOs) has been prepared for the detailed working design of the Project in accordance with the Environmental Code of the Republic of Kazakhstan. The OVOs incorporates the developed Project design and provides detailed assessment of emissions, waste, physical impacts, environmental risks and mitigation requirements. Relevant information from the completed OVOs has been incorporated into this Supplementary ESIA where it provides more recent or detailed information than the earlier feasibility-stage environmental documentation. The status of the national environmental assessment and permitting process, and its relationship to the requirements of the Lenders, is summarized in Chapter 3 and elaborated in the parallel ESCA.

Given the advanced status of construction at the time of assessment, this Supplementary ESIA focuses primarily on:

- residual environmental and social risks associated with the remainder of the construction phase;
- the design and implementation of forward-looking management measures, including a construction-phase ESMP that integrates verified ESCA findings; and
- Arrangements for environmental and social management during the operational phase, to be progressively elaborated by KTZ as the operator.

1.6 Project Risk Classification

For the purpose of Lender appraisal, the Project is classified as follows: ADB SPS 2009 — Category A for Environment and Category A for Involuntary Resettlement; Category C for Indigenous Peoples (Safeguard Requirement 3 not triggered). IFC PS; Performance Standards 1, 2, 3, 4, 5, 6 and 8 triggered; PS7 not triggered. AIIB ESF — Category A; ESS1 and ESS2 triggered; ESS3 (Indigenous Peoples) not triggered. The basis for the classifications and the determinations on SR3 / PS7 / ESS3 is set out in Section 2 (Table 3 — Lender E&S Categorizations and Triggered Standards) and Chapter 3 (Policy and Regulatory Context).

1.7 Scope, Boundaries and Limitations

The Supplementary ESIA has been prepared based on the information available at the time of preparation. The most material limitation, which frames all others, is that construction of the Project commenced in 2024, in advance of the preparation of this Supplementary ESIA. As a consequence:

(a) pre-construction baseline conditions along the alignment — including ambient air quality, baseline noise and vibration, undisturbed habitat extent within the Shardara Reservoir IBA/KBA, and the pre-disturbance condition of community receptors — could not be measured directly. These conditions have been reconstructed from the national EIA (OVOS) baseline studies, prior project-related

environmental and social documentation, secondary data sources (Kazhydromet meteorological and air-quality records, satellite-derived land-cover analysis, national biodiversity datasets), targeted 2025 field studies (winter waterbird transects in February 2025, biodiversity studies in the Shardara IBA/KBA in 2025), and the May 2026 community consultations. Where uncertainty in reconstructed baseline conditions affects impact significance, this is identified in the relevant impact assessment and addressed through conservative assumptions and adaptive management commitments;

(b) construction-phase compliance with applicable national requirements and Lender standards during the works already undertaken is assessed separately, through the parallel Environmental and Social Compliance Audit (ESCA). Verified ESCA findings are integrated into the construction-phase ESMP of this Supplementary ESIA;

(c) certain remedial or mitigation measures that would normally be specified at the detailed design stage — for example, the design of bird flight diverters, noise barrier specifications, trackform mitigation specifications, and the final design of cross-corridor structures — are addressed as design verifications and forward-looking commitments in the ESMP, rather than as ex-ante design controls.

- Additional limitations include: the snapshot nature of construction-phase observations, given that conditions on site evolve as work fronts progress;
- seasonal constraints affecting biodiversity field verification at the time of assessment, which are addressed through a phased approach to biodiversity studies; ongoing design refinement of certain Project components which may give rise to incremental environmental and social considerations to be managed through the construction-phase ESMP;
- and reliance on documentation provided by public authorities for land acquisition, compensation and permitting matters.

These limitations have been considered in the formulation of findings and the prioritization of mitigation and management measures. Where residual uncertainty remains, the Supplementary ESIA identifies follow-up requirements and adaptive management measures to be implemented through the relevant management plans and the GRM.

1.8 Relationship with the ESCA and Other Concurrent Studies

In parallel with the preparation of this Supplementary ESIA, an Environmental and Social Compliance Audit (ESCA) has been undertaken under the same overall assignment to assess compliance of ongoing construction activities with national regulatory requirements and applicable Lender standards. The ESCA is backward-looking in nature: its purpose is to verify compliance during the construction works to date, identify non-conformances, and define a time-bound Corrective Action Plan (CAP) to address identified gaps.

The Supplementary ESIA, by contrast, is forward-looking. It focuses on residual risks and impacts not fully assessed in prior documentation, on strengthening mitigation and monitoring measures for the remainder of construction and for operation, and on developing the management instruments required to support implementation. The two workstreams are coordinated to ensure consistency and to avoid duplication, while maintaining clear differentiation of scope and accountability:

- verified findings from the ESCA inform the refinement of mitigation measures and monitoring commitments in the construction-phase ESMP;
- corrective actions identified under the CAP are reflected in the implementation schedule of the construction-phase ESMP where relevant; and
- the Supplementary ESIA does not re-audit past compliance, but incorporates verified ESCA findings into forward-looking management planning.

This coordinated approach ensures that retrospective compliance verification (under the ESCA) and prospective impact management (under the Supplementary ESIA) are fully aligned.

The Supplementary ESIA is prepared in coordination with the following concurrent workstreams and supporting deliverables, each of which is referenced where relevant in the body of this report: (i) the parallel Environmental and Social Compliance Audit (ESCA) and its Corrective Action Plan (CAP); (ii) the Land Acquisition and Resettlement Plan (LARP), addressing land acquisition, compensation, livelihood restoration and the project-level grievance redress mechanism; (iii) the Critical Habitat Assessment (CHA) and Preliminary Biodiversity Action Plan (BAP), presented as Annex B and the draft CHA Annex F; (iv) the Preliminary Climate Risk Assessment (CRA), presented as an Annex E; (v) the Environmental Project Information Brochure (ePIB) and the LARP information brochure, prepared in English, Kazakh and Russian for disclosure; and (vi) the corporate ESMS audit and ESMS strengthening activities undertaken by KTZ. The findings of these workstreams inform, and are informed by, this Supplementary ESIA.

1.9 Structure of the Report

This Supplementary ESIA report is structured in accordance with the report outline set out in Annex A of the Contract.[2] The chapters and their content are summarised in Table 2.

Table 2: Structure of the Supplementary ESIA Report

Chapter	Title	Content Summary
1	**Introduction**	Purpose and scope of the Supplementary ESIA, roles and responsibilities, project overview, scope and limitations, and report structure (this chapter).
2	**Project Description and Alternatives**	Detailed description of the Project, associated and ancillary facilities, construction activities, project alternatives considered, and operational arrangements.
3	**Policy and Regulatory Context**	National legal framework of the Republic of Kazakhstan; ADB SPS (2009), IFC Performance Standards (2012), AIIB ESF (2024); applicable WBG EHS Guidelines; gap analysis approach.
4	**Assessment of Alternatives**	Including the no project option and routing alternatives.
5	**Assessment Methodology**	Impact assessment methodology, screening and scoping, identification of receptors, characterisation of impacts, significance evaluation, and the mitigation hierarchy.
6	**ESIA Scope**	Describes the physical, spatial and temporal scope, and summarises the activities scoped in and out of the study.
7	**Baseline Environmental and Social Conditions**	Physical, biological, and socio-economic baseline along the Project alignment, drawing on existing studies, secondary data, and targeted verification.
8	**Impact Assessment and Mitigation and Management Measures**	Assessment of construction- and operation-phase environmental and social impacts by topic area, including significance evaluation and mitigation measures.
9	**Stakeholder Engagement and Grievance Mechanism**	Provides the findings of the stakeholder consultations completed to date and a mechanism for registering project related grievances.

[2] A separate Non-Technical summary forms part of the ESIA package.

Chapter	Title	Content Summary
10	**Environmental and Social Management Plan**	Provides the requirements for implementation of the mitigation and management measures
11	**Conclusions and Recommendations**	Summarises the findings of the report.
—	**Appendices**	Including: • Detailed ESMP Tables • Preliminary BAP • Critical Habitat Assessment • Preliminary Climate Change Risk Assessment

2. Project Description

2.1 Preamble

This section of the ESIA provides information on the Project with respect to its potential interactions and effects on the receiving environment. An overview of the need for the Project, the Project setting, design, construction processes and activities, organisational responsibilities, resource requirements, and consideration of alternatives is provided.

The aim of this section is to provide both general information on the Project and specific information which is relevant to potential impacts and risks that the Project, its implementation and operation, pose to the receiving environment. Where necessary the location of structures along the route is provided in terms of approximate kilometre post. The chainage origin (KM 0) is located at the northern end of the new formation near Darbaza and the line terminates at approximately KM 115 near Maktaaral.

2.2 Need for the Project

The Project is a strategically significant greenfield railway development in the Turkistan Region of southern Kazakhstan. The Project is intended to relieve capacity constraints on the existing Kazakhstan–Uzbekistan rail corridor, enhance regional freight connectivity, and support growing international and transit trade flows across Central Asia.

Kazakhstan has a significant reliance on national rail transport, particularly for freight within the country. Use of efficient rail transport reduces movements of heavy goods vehicles on national roads, supporting reduction in environmental issues such as emissions to air, noise and localised road congestion. Additionally, Kazakhstan plays an important role in regional transportation of goods within the Caucasus and Central Asia. In 2006 the Central Asia Regional Economic Cooperation (CAREC) project was established by ADB and other lenders. This aims to improve the flow of goods trade across the region and further afield. The development of effective rail transport is included within the scope of CAREC.

Kazakhstan rail links the Russian Federation to the north, and from Ukraine, crossing the Russian Federation land to the west, to southern central Asian countries such as Uzbekistan and Kyrgyzstan and further afield to the People's Republic of China.

As shown in Figure 2, the existing main cross-border rail line (in blue) runs from Saryagash through Tashkent, with trains crossing the Kazakhstan–Uzbekistan border at the constrained urban interface between the two cities. Rail infrastructure within both cities is constrained by adjacent urban development and therefore the number of train paths along this alignment is restricted. Improvements on the existing alignment would require significant land take from developed areas, including commercial and residential land uses. The proposed Project alignment (in green) provides a domestic bypass that connects to the existing network at the Konysbayeva crossing into Uzbekistan, opening additional train paths and improving regional connectivity in alignment with the objective of CAREC.

At full operation, the line is expected to accommodate approximately 46 trains per day, predominantly freight, eliminating the need for trains to transit through Uzbekistan.

Box 1: KTZ Company Overview

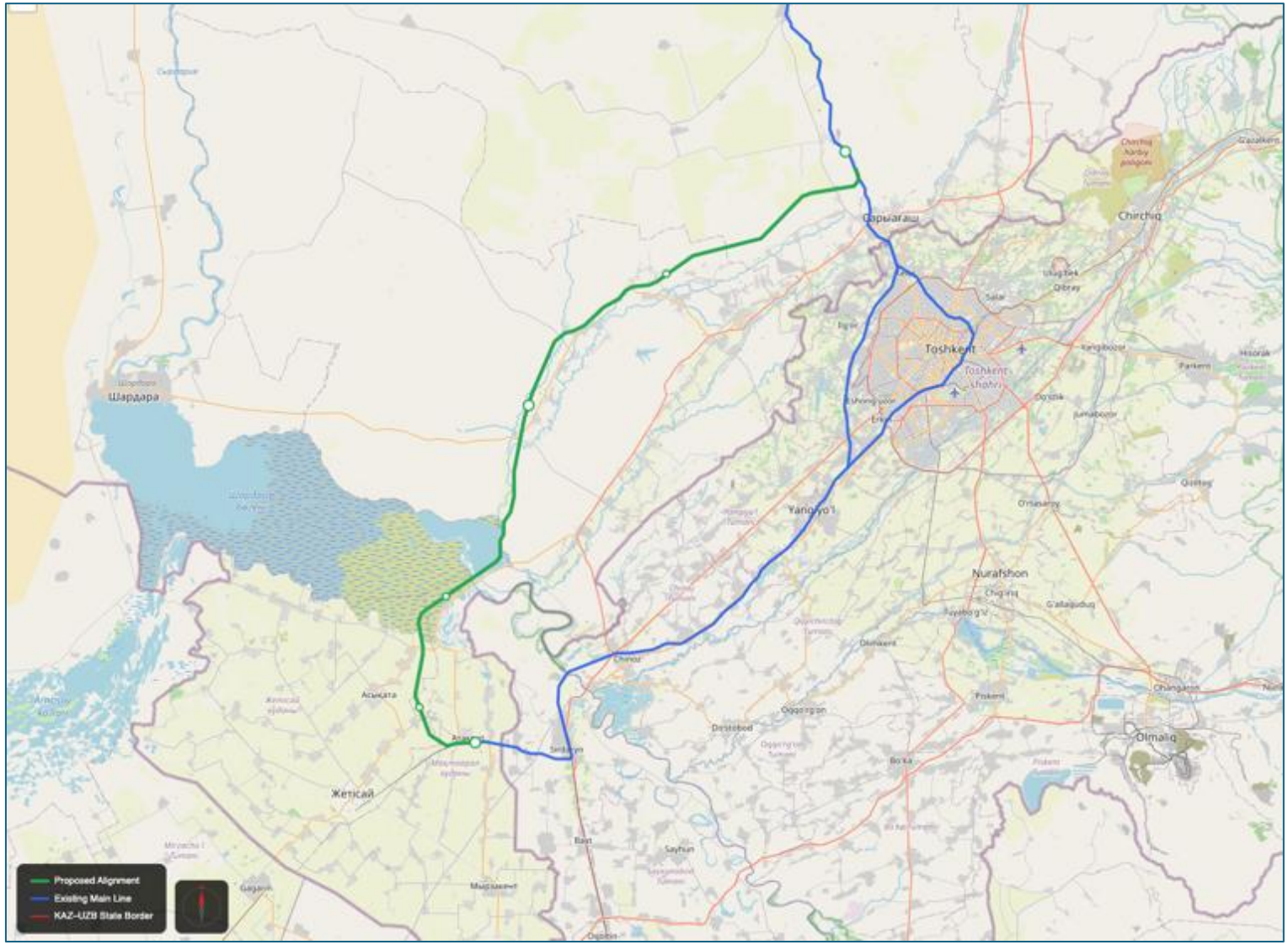
KTZ is the national railway company of Kazakhstan and one of the country's largest enterprises. Originally founded as a state enterprise on 31 January 1997 through the merger of the Almaty, Tselinny, and West Kazakhstan railway administrations, it was reorganized in 2002 into National Company Kazakhstan Temir Zholy Joint Stock Company (NC KTZ JSC), the form in which it operates today. The company is headquartered in Astana and 100% of its shares are held by the state through the Samruk-Kazyna Sovereign Wealth Fund.

KTZ operates as a vertically integrated transport and logistics holding rather than a single railway operator. In scale, KTZ operates roughly 21,100 km of main track and 16,000 km of operational track, connecting all 17 regions of Kazakhstan and reaching 16 cross-border junction points with its five neighbors: Russia, China, Uzbekistan, Kyrgyzstan, and Turkmenistan. Kazakhstan ranks third among CIS and Baltic countries by 1,520 mm gauge network length. The group is the country's largest owner of rolling stock, with around 1,800 locomotives, 40,400 freight cars, and 2,300 passenger cars, and employs roughly 117,700 people — making it among the largest employers in Kazakhstan. KTZ accounts for around 64% of national freight turnover and 14% of passenger turnover, and ranks among the world's 15 largest railways by freight turnover.

The company serves three broad customer groups. The first is domestic freight shippers — particularly in coal, iron ore, oil products, grain, chemicals, and other strategic and socially significant cargoes — for whom rail is the dominant mode of bulk transport and the backbone of Kazakhstan's export logistics. The second is passengers, where KTZ holds a near-monopoly on long-distance rail travel within Kazakhstan. The third, and increasingly strategic, is international transit traffic: KTZ is a central player in the Eurasian land bridge between China and Europe and a principal implementer of Kazakhstan's New Silk Road and Nurly Zhol initiatives, with a growing role in the Trans-Caspian International Transport Route (the "Middle Corridor") via the Caspian ports of Aktau and Kuryk.

Looking forward, KTZ's direction is set by its Development Strategy 2032, organized around six goals: enhancing transportation efficiency, expanding transit, improving customer satisfaction, digitalization, integrating ESG principles, and ensuring railway safety. Major capital programmes are in flight, including the Mainline Railway Network Development Programme to 2029 — which envisages 5,000 km of new construction and 11,000 km of track repair — alongside locomotive and passenger fleet renewals (notably 117 Alstom freight locomotives and 557 Stadler-technology passenger wagons).

Figure 2: Existing Main Cross-Border Rail Lines and the Proposed Darbaza–Maktaaral Alignment



2.3 Summary Project Setting

This sub-section is intended to provide a high-level summary of the project setting to help put the project description section into context, it is not intended to replace the detailed environmental and social baseline section of the report.

2.3.1 Rail Infrastructure in Kazakhstan and the Middle Corridor

The Project corridor commences at Darbaza in northern Turkistan Oblast and terminates at Maktaaral close to the international border with Uzbekistan. It traverses a predominantly rural landscape characterised by agricultural land (irrigated and non-irrigated fields), grazing areas, scattered rural settlements, and linear infrastructure corridors. The Project alignment connects to the existing national railway network at both ends and provides a direct rail corridor towards the state border with Uzbekistan, bypassing existing capacity constraints at Saryagash.

2.3.2 Land Use and Socio-Economic Setting

The Project alignment passes through five rayons (districts) of the Turkistan Oblast. In order along the alignment from north to south these are: Saryagash, Keles, Shardara, Zhetysay, and Maktaaral. Land use along the corridor is predominantly agricultural. In Zhetysay and Maktaaral districts plots are generally smaller and intensively cultivated, primarily for cotton, with crops including alfalfa, clover, melons and watermelons also recorded during site visits. In Keles and Saryagash districts plots are larger and include both farming/agriculture and agricultural production land.

Rural communities along the alignment are characterised by small, dispersed settlements with livelihoods predominantly based on irrigated agriculture, livestock grazing, and associated seasonal employment. Land tenure includes a mix of household plots, leased agricultural land, and state-allocated land managed through Akimat processes. Vulnerable groups potentially present within the Project area include elderly land users, female-headed households, and households with limited alternative income sources. Access to irrigation water and transport infrastructure is a key determinant of local livelihoods.

2.3.3 Project Geography and Natural Habitat

The Project area lies within a continental, arid to semi-arid climate zone, characterised by hot summers, cold winters, and low annual precipitation. Climatic conditions influence construction-phase risks, particularly related to dust generation, water availability, and seasonal constraints on in-river works. Topography along the alignment is generally flat, with localised embankments required to raise the railway formation above surrounding agricultural land and flood-prone areas. Near the Shardara Reservoir, local elevation changes of approximately 35 m require substantial embankment and fill works. Soils in the region are predominantly alluvial and loess-like, commonly used for agriculture but susceptible to erosion and compaction when disturbed.

The alignment crosses or runs adjacent to several rivers, irrigation canals, and drainage channels, including the Syr Darya River, the Keles River, and a network of aryk and canal systems supporting regional agriculture. The Project sits within the Syrdarya Basin; the main source of river feeding in the basin is melt water from seasonal snow cover, with glacier and rainwater contributing smaller shares.

The Shardara Reservoir, located on the Syr Darya River, is a major hydrological feature in the Turkistan Region and represents a strategic national water resource. The reservoir supports irrigation, hydropower generation, and water supply, and is managed by the regional water authority (Kazsushar). While the reservoir is not designated as a specially protected natural area under national legislation, it is an Important Bird Area (IBA) and a Key Biodiversity Area (KBA), internationally recognised for its importance for biodiversity. The IBA boundary includes approximately 960 km² of land area, much of which is open water with marginal vegetation.

Outside the main reservoir and floodplain environment, biodiversity values decline rapidly. Upland agricultural areas and grazing land along the alignment provide limited habitat for native flora and fauna but may be used opportunistically by migratory birds during passage. Smaller watercourses, irrigation channels, and riparian strips provide localised habitat for amphibians and common bird species but are typically fragmented and subject to ongoing disturbance.

2.4 Project Categorization

The Project's National EIA (OVOs) has been prepared for the detailed working design in accordance with the Environmental Code of the Republic of Kazakhstan. The OVOS incorporates the developed Project design and provides detailed assessment of emissions, waste, physical impacts, environmental risks and mitigation requirements. The status of the national environmental assessment and permitting process is described further in Chapter 3.

The Project has been categorized as Category A by ADB and AIIB. The Project has been categorized as Category A by ADB and AIIB and is considered Category A under the IFC Sustainability Policy (2012), against which the IFC Performance Standards are applied. Categorizations and the standards triggered under each framework are summarized in Table 3 below; the substantive grounds are common across the three frameworks and are set out in the paragraphs that follow.

Table 3: Lender E&S Categorisations and Triggered Standards

Lender	Framework	Categorization	Standards triggered	Standards not triggered
ADB	Safeguard Policy Statement (2009)	A for Environment; A for Involuntary Resettlement; C for Indigenous Peoples	SR1 (Environment); SR2 (Involuntary Resettlement)	SR3 (Indigenous Peoples)
IFC	Performance Standards (2012)	A (Sustainability Policy, 2012)	PS1, PS2, PS3, PS4, PS5, PS6, PS8	PS7 (Indigenous Peoples)
AIIB	Environmental and Social Framework (2024)	A	ESS 1, ESS 2; IFC PS and WBG EHS Guidelines applied for topics not covered by a dedicated ESS	ESS 3 (Indigenous Peoples)

ADB Safeguard Policy Statement (2009): Category A. The Project is likely to have significant adverse environmental impacts that are diverse, irreversible, or unprecedented, on the basis of (i) the linear nature of a 115 km greenfield railway crossing five rayons of Turkistan Region; (ii) the presence of designated Critical Habitat for the Dalmatian Pelican (Pelecanus crispus, supporting 2–6 % of the global population) and other priority biodiversity values associated with the Shardara Reservoir Important Bird Area / Key Biodiversity Area; and (iii) the scale of the Syr Darya bridge crossing and associated in-channel works. Category A is also assigned for Involuntary Resettlement, given that over 371 land plots across four districts — affecting over 390 households and more than 23 legal entities — are subject to acquisition. The Project is Category C for Indigenous Peoples — screening confirms that no Indigenous Peoples as defined under SR3 are present in the Project Area of Influence.

IFC Performance Standards (2012): Category A. Consistent with the ADB determination and on the same substantive grounds. Seven of the eight Performance Standards are triggered (PS1, PS2, PS3, PS4, PS5, PS6, PS8); PS7 is not triggered, on the grounds set out above. Specific applicability of each PS is addressed in Chapter 3 (Policy, Legal and Administrative Framework).

AIIB Environmental and Social Framework (2024): Category A. The Project meets the ESF criteria for Category A under ESS 1 — likely significant adverse environmental and/or social impacts that are

diverse, irreversible, or unprecedented. Of the three Environmental and Social Standards, ESS 1 (Environmental and Social Assessment and Management) and ESS 2 (Land Acquisition and Involuntary Resettlement) are triggered; ESS 3 (Indigenous Peoples) is not triggered. Consistent with the ESF approach to topics not covered by a dedicated ESS, the IFC Performance Standards and the WBG EHS Guidelines are applied for biodiversity (PS6), labor and working conditions (PS2), resource efficiency and pollution prevention (PS3), community health and safety (PS4), and cultural heritage (PS8).

Where requirements differ between the three frameworks, the more stringent or more comprehensive provision is applied, consistent with international good practice and with the AIIB ESF provisions on co-financing. The Gap Analysis presented in section3.14 sets out the specific differences and the resulting requirements applied across the Project.

The Category A determinations confirm the requirements that this Supplementary ESIA and the parallel LARP have been designed to meet, including: a full Supplementary ESIA; a Critical Habitat Assessment and Net Gain / No Net Loss outcomes under PS6, addressed through the parallel CHA workstream and the preliminary Biodiversity Action Plan; meaningful consultation with affected communities, with disclosure of the draft ESIA at least 120 calendar days before ADB Board consideration and 60 calendar days before IFC and AIIB Board consideration; a project-specific Land Acquisition and Resettlement Plan prepared in accordance with SR2, PS5, and ESS 2; a project-level Grievance Redress Mechanism accessible to all affected persons; and ongoing E&S monitoring and reporting through both construction and operational phases, integrated into the construction- and operational-phase ESMPs.

2.5 Alignment Overview and Project Components

2.5.1 Overview

The Project consists of a single heavy rail line which connects Darbaza and Maktaaral, both in Kazakhstan, with the latter being close to the international border with Uzbekistan. The line is a non-electrified [3] single track with passing loops, new and upgraded stations, and sidings. Locomotive units are diesel powered. For the most part traffic will be goods related, with approximately 46 trains per day, predominantly freight, with any passenger trains continuing along existing lines to Saryagash and Tashkent. At stations, sidings allow rolling stock to wait for customs clearance and trains to be assembled. A train and rolling stock maintenance area is being developed as part of the Project.

The key Project components are:

- Construction of the main rail alignment, comprising earthworks, track formation, ballast, sleepers, and rails;
- Reconstruction or extension of three stations and two passing loops, comprising associated depots, maintenance, servicing, and operational facilities;
- Construction of 33 alignment-crossing structures, including 25 bridges (18 standalone bridges, 6 bridges combined with agricultural or cattle underpasses, and the Syr Darya bridge);
- Installation of auxiliary-power transformer substations, 10 kV overhead distribution lines, and signalling and communications systems;
- Development of temporary and permanent access roads, borrow pits, material storage and laydown areas, concrete batching plants, and other construction support facilities; and
- Establishment of worker accommodation camps and associated welfare, sanitation, and utility services.

Related infrastructure also includes communication cables, drainage and access to the rail line from nearby roads. A summary of the Project elements is provided in Table 4.

[3] A 10kV line will be provided for communications, but not for train power units.

Table 4: Summary of Project Elements

Item #	Item Description	Measurement
1	Operational track length	114.88 km
2	Total length of main tracks to be laid (Main tracks / Main tracks including crossovers and loop / Stations and sidings)	172.84 km / 127.63 km / 45.21 km
3	Sub-grade width at single-track sections — top of embankments and base of cuttings	6.6 – 7.3 m
4	Earthworks: Total / Embankment / Cutting / Cut–Fill Balance (import)	12,339,249 m³ / 8,415,139 m³ / 3,924,110 m³ / 4,491,029 m³ import
5	Track ballasting: crushed stone 25–60 mm / sand ballast / crushed stone 5–25 mm	295,872 m³ / 43,152 m³ / 65,380 m³
6	Cabling: Signalling cable / 10 kV OHL for ABS / 10 kV OHL for LPS	450 km / 85.3 km / 224.1 km
7	Volume of service and technical buildings	166,900 m³
8	Culverts: New / Extended	130
9	Bridges (watercourse and major span crossings, including combined agricultural/livestock passage structures)	25
10	Road overpasses	2
11	Railway overpasses	5
12	Reinforced concrete tunnel	1
13	Total alignment-crossing structures (Table 13)	33
14	Stations / Passing loops	3 stations (Yerdaut, Promezhutochnaya, Maktaaral) / 2 passing loops (PL2, PL5)

2.5.2 Right of Way

The Project Right of Way (RoW) is a permanent land-take corridor that accommodates the rail formation, drainage, signalling and longitudinal-power-supply OHL, access tracks, and the Sanitary Protection Zone (SPZ) provisions required under national legislation. The RoW width is 60 m. The SPZ overlays the RoW where station design has applied the reduced 50 m SPZ under Section 9 of KR DSM-72 with integrated acoustic screening (Yerdaut, Maktaaral).

2.5.3 Horizontal Alignment

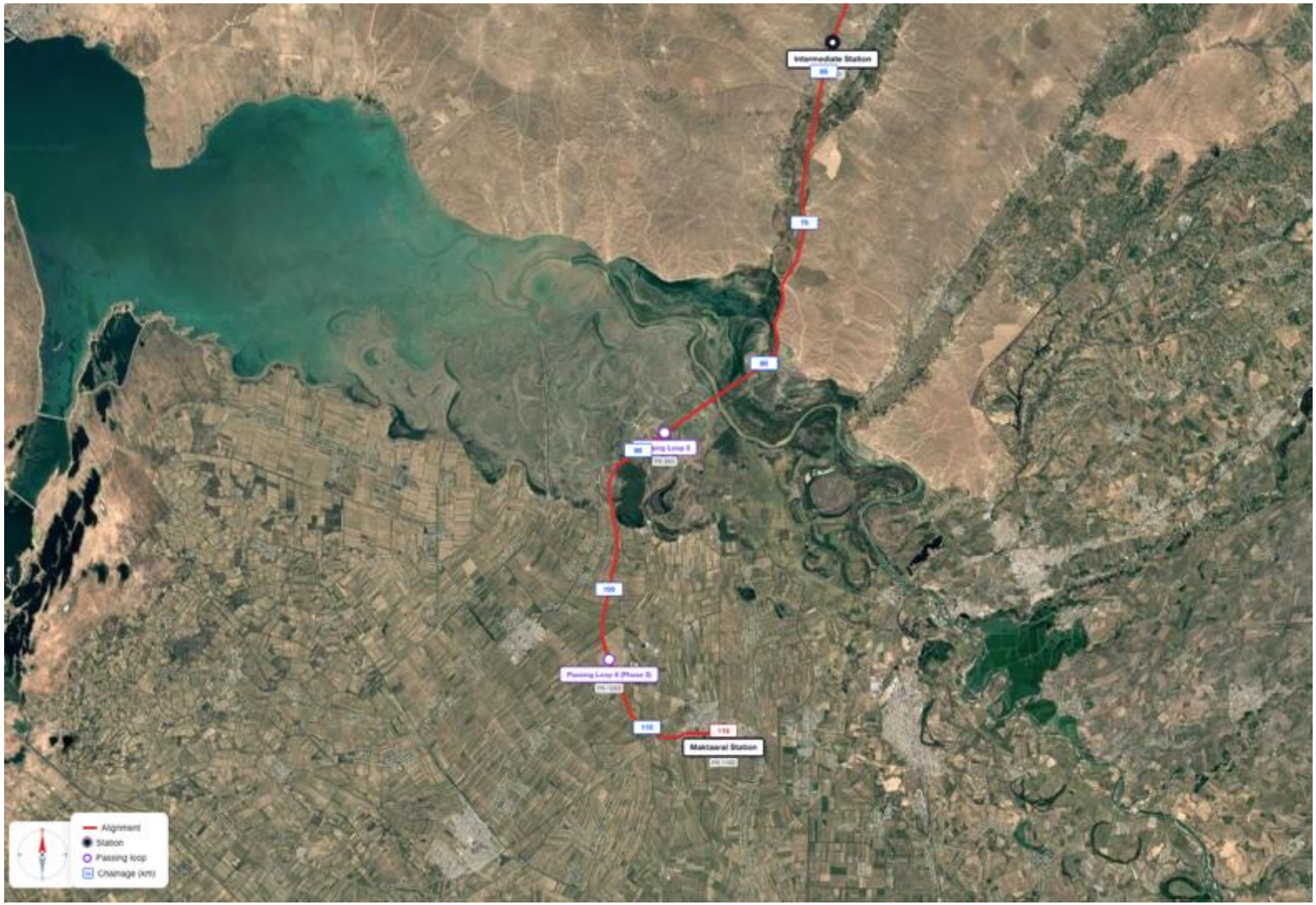
The alignment of the Project is shown in Figure 3 and Figure 4. Approximate KM posts are shown every ten kilometres along the route, with KM 0 located at the northern end of the new formation near Darbaza and KM 115 at the southern end near Maktaaral.

At Darbaza (KM 0), heading south, the Project includes works along an existing stretch of line, with a turnout (switches) on the west side being the start of the new formation. The alignment then follows a south-westerly direction, crossing areas with two dominant land uses of intensive arable land and open steppe-type landscape, which is heavily grazed by sheep, cattle and occasionally horses. The new track also passes close to some existing clusters of housing including the village of Konyrtobe (around KM 30) and Ordzhonikidzje (around KM 40)

Figure 3: Diagram of Stations and Passing Loops along the Project Alignment



Figure 4: Diagram of Stations and Passing Loops along the Project Alignment (extract from KSD Engineering General Plan, Sheet 5800-1-ГП-002)


Intermediate Station
Maktaaral Station
Alignment
Station
Passing loop
Chainage (km)

Along the alignment a number of watercourses, ditches etc. are crossed. The major crossing is at the Shardara Reservoir, in the vicinity of KM 80. This is a manmade feature created through the damming of the Syr Darya River. The extent of the open water within the reservoir varies seasonally, being highly dependent upon snow melt from nearby mountains. In spring the reservoir area of open water is at its maximum. Additionally, and likely due to climate change, the area seasonally inundated has been reducing over a period of decades. Previous consultations with local people for a nearby project indicate that the areal extent of the open water is much reduced.

After crossing the reservoir, the alignment heads southwards through Azattıq (around KM 100) and Asykata, then turns eastwards to join an existing line just before the town of Maktaraal. The scheme is completed with a tie-in of the new line with the existing line on the north side of the existing line. At this location the station at Maktaaral is to be redeveloped along with sidings for assembling and storing trains.

2.5.4 Vertical Alignment

Due to potential high-water tables and flood risk during snow-melt periods, the alignment is mainly raised above the surrounding grade. The formation is mainly in embankment with some limited sections of cutting. As noted in Table 4, the volume of material for embankment is 8,415,139 m³ and for cutting is 3,924,110 m³. The section across the Shardara Reservoir and river is significantly raised above existing ground level.

2.5.5 Stations and Passing Loops

The Project comprises three stations and two passing loops, distributed along the alignment as shown in Figure 3 and Figure 4. Within the bridge and culvert schedules (Table 11, Table 12) the alignment is divided into four sections defined by these facilities: Section 1 from Yerdaut Station to Passing Loop No. 2; Section 2 from Passing Loop No. 2 to Intermediate ("Intermediate") Station; Section 3 from Intermediate Station to Passing Loop No. 5; and Section 4 from Passing Loop No. 5 to Maktaaral Station.

2.5.5.1 Yerdaut Station (northern terminus, KM 0)

Yerdaut Station is the northern terminus of the alignment and is located in Saryagash District immediately south of Darbaza village and adjacent to the existing settlement of Yerdaut. Site footprint and layout key parameters are summarized in Table 5 below.

Table 5: Yerdaut Station Characteristics

Parameter	Unit	Main Station Site
Total area within the conditional boundary of works	m²	339,056
Building footprint area (incl.)	m²	33,938
Area under railway tracks	m²	96,734
Coverage area (paving / hardstanding)	m²	54,204
Greenery area	m²	18,123
Area free from buildings and coverings	m²	136,057
Building density	%	10.00
Greening percentage	%	5.34

(Source: KSD Engineering, General Plan 5800-1-ГП-001, Almaty, 2025.)

The main station site has a total footprint of approximately 33.9 hectares, of which approximately 9.7 hectares are formed of railway tracks and 3.4 hectares is built up with operational buildings and structures. A separate, smaller parcel of 0.71 hectares accommodates the locomotive crew rest house. The principal buildings and structures at Yerdaut Station are:

- Operational and traffic control: Electric Centralisation (EC) post for 60 turnouts; signalman's post combined with the carriage inspector's control post; service and production building.
- Passenger facilities: passenger platform; pedestrian bridge; food point / canteen.
- Locomotive operations: locomotive crew rest house on a separate adjacent parcel.
- Track and signalling maintenance: track maintenance/foreman point; repair-operational point of the track maintenance section; inventory and tools storage combined with the heating station for track and signalling workers.
- Heating: two boiler houses; fuel tanks for the boiler houses and a reserve fuel tank.
- Diesel and lubricant storage: two 1,000 m³ diesel-fuel storage tanks; diesel-oil storage; container oil warehouse; and four fuel-and-lubricant stores of 7 m³ capacity each.[4]
- Compressed air supply: modular compressor station BKK-15/8-2 with UZOT; modular compressor station.
- Fire protection and emergency response: fire-fighting water reserve tank; administrative-amenity building of the fire-recovery train; garage for the fire-recovery train.
- Security: paramilitary security building.
- Drainage and utilities: drainage tank; product pump station. The working design incorporates dedicated containment and drainage infrastructure associated with the fuel-storage and unloading facilities, including an enclosing containment wall and drainage collection arrangements. It also provides separate domestic, stormwater and process wastewater systems, including wastewater pumping stations, local treatment facilities and evaporation/storage ponds for treated effluent
- Water supply is via an existing piped water supply to the town. The completed OVOS confirms that the station is designed to connect to the existing potable-water network for domestic and fire-fighting supply. Separate potable and fire-water distribution systems, fire-water storage and associated pumping infrastructure are provided. The design-stage maximum potable-water demand for Yerdaut is approximately 48.1 m³/day, excluding replenishment of dedicated fire-water storage

The Sanitary Protection Zone shown on the Yerdaut general plan is 50 m on each side of the outermost track, rather than the standard 100 m. This is permitted under Section 9 of the Sanitary Rules approved by Order of the Ministry of Health KR DSM-72 of 3 August 2021, where the railway is in cutting or where special acoustic shielding measures are implemented (in this case acoustic screens — "GeoTechExpert" type — are designed along the section adjacent to Yerdaut settlement to maintain the gigienic norms). The plan notes: "residential development should not be carried out within this SPZ boundary; the sanitary protection zone is maintained."

Track development scheme

A Track Development Scheme for Yerdaut Station has been prepared. The most recent revision reviewed in preparation of this section is dated May 2025. An earlier revision of the same drawing dated November 2024 was previously reviewed for the inception-stage baseline; the May 2025 revision supersedes it and is used as the authoritative source. The drawing's preliminary works bill records the totals shown in Table 6 below.

[4] The completed OVOS provides additional detail on the locomotive fueling and servicing facilities. The fuel installation includes two 1,000 m³ diesel-storage tanks, a fuel unloading gantry, diesel-oil storage, packaged oil storage, a drainage collection tank, product pumping station and associated operator facilities. The locomotive servicing area also includes sand-dispensing and dry-sand storage facilities and compressor installations.

Table 6: Yerdaut Station: Track Volumes, May 2025 revision

Track designation	length laid (m)	Existing length dismantled (m)
Main I	3,779	3,614
Main II	3,775	3,473
Main IV	2,038	—
Station tracks, all categories	13,038	—
Total	22,630	7,087

(Source: KSD Engineering, Drawing 5800-1-ПЖ, Schema of Track Development of Yerdaut Station with Construction Stages, May 2025 revision.)

Track inventory

The May 2025 station layout comprises 25 numbered tracks (numbered I, II, IV and 3, 6, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 36, 38, 40, 42, 44, 46, 48, 50, 52). Useful track lengths are summarised below.

Main running tracks — useful length 1,050 m each:

- Track I — 1,050 m.
- Track II —1,050 m.
- Track IV —1,050 m.

Reception-departure tracks — useful length 1,050 m each:

- Track 3, Track 6, Track 12, Track 14 — 1,050 m each.

Specialist operational tracks:

- Track 16 — Locomotive supply / equipping track, primary — useful length not stated on drawing.
- Track 18 — Locomotive supply / equipping track, secondary — 50 m.
- Track 20 — Dry sand unloading track — 70 m.
- Track 22 — Fuel storage unloading track — 60 m.
- Track 24 — Pull-out / shunting neck, primary — 450 m
- Track 26 — Turning triangle, first — useful length not stated.
- Track 28 — Electric locomotive siding — 250 m.
- Track 30 — Diesel locomotive siding — 250 m.
- Track 32 — Repair-Operational Point.
- Track 36 — Current detached carriage repair
- Track 38 — Running track, first.
- Track 40 — Turning triangle, second
- Track 42 — Turning triangle siding — 250 m.
- Track 44 — Pull-out / shunting neck, secondary — 1,050 m.
- Track 46 — Running track, second.
- Track 48 — Fire-train siding — 250 m.
- Track 50 — Recovery / breakdown train siding — 250 m.
- Track 52 — TOR siding — 250 m.

The presence of dedicated sidings for electric and diesel locomotives, fire-recovery (breakdown) trains, and the TOR detached-repair facility, together with the locomotive supply, sand and fuel unloading tracks, confirms Yerdaut's role as a major operational node —and not solely a passenger / passing facility. The electric-locomotive siding (Track 28) is notable given the line is non-electrified for traction;

this is most likely an interface provision with the existing Darbaza–Saryagash line, which carries electric services, though confirmation is requested.

Construction phasing

The Project will be built in a three-stage construction sequence.:

- Stage 1 (dashed pink): temporary bypass tracks installed to maintain rail traffic on the existing line during reconstruction works at the station. These tracks are removed after the permanent works are commissioned.
- Stage 2 (red, solid): the principal new permanent station tracks, with concurrent dismantling of redundant existing tracks.
- Stage 3 (green): additional facilities and remaining track works, with further dismantling of redundant existing tracks.
- Black (existing) and blue (perspective / future) tracks complete the legend.

This phased delivery is a material consideration for the construction-phase ESIA because (i) the temporary bypass tracks themselves involve land take, ballast, formation works during Stage 1 that are subsequently removed, generating their own waste streams; (ii) live rail traffic operates within the construction site throughout, requiring strict interface controls (the ESCA OHS findings already cite rail-laying with live train movements as a high-risk activity); and (iii) the staged dismantling of 7,087 m of existing tracks generates a secondary materials stream (used ballast, sleepers, rails) that requires segregation, reuse where possible, and licensed disposal for the residual.

Figure 5: Yerdaut Station general layout

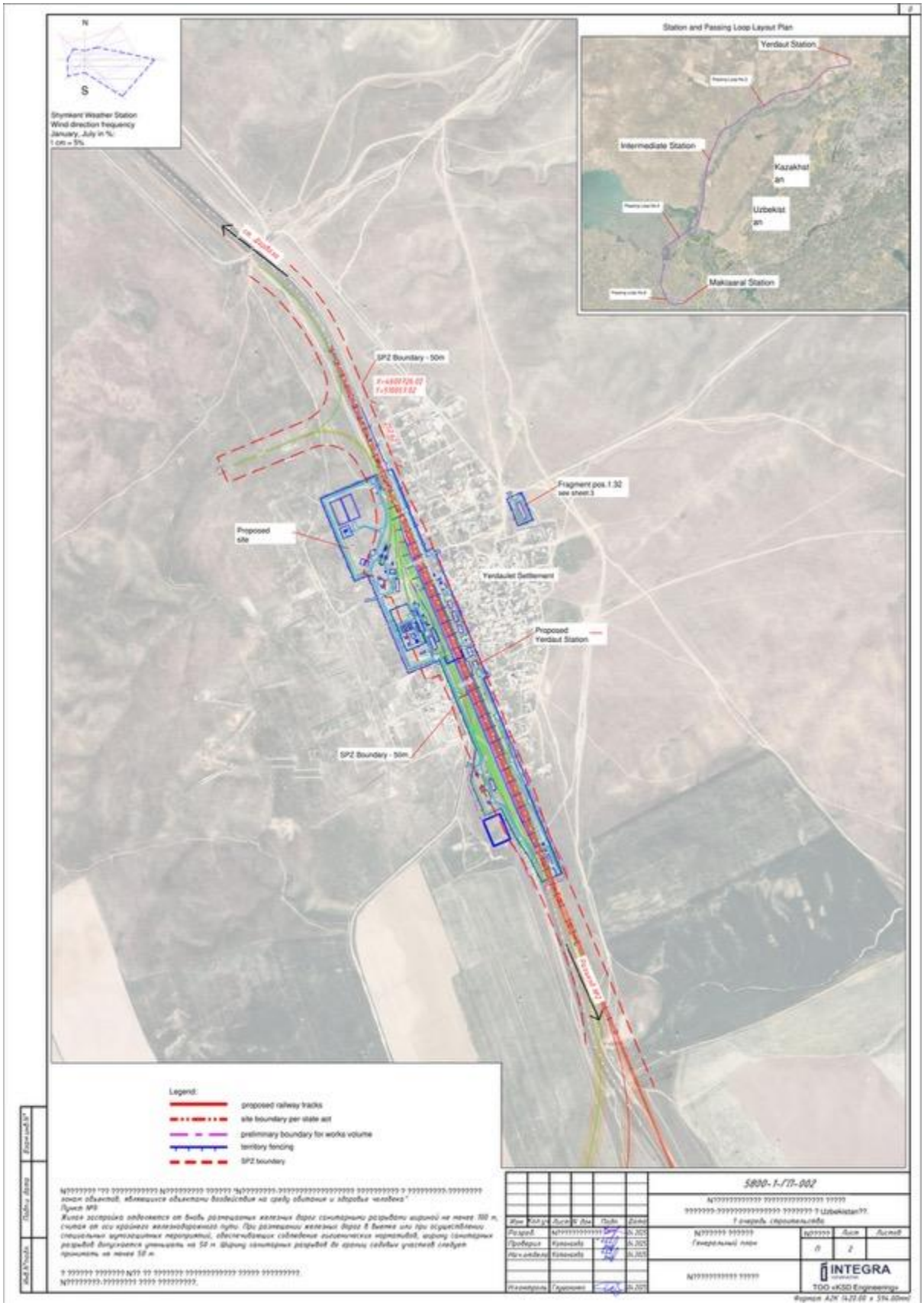


Figure 6: Yerdaut Station Track Layout



Turnout Schedule

Set	Type	Mark	Turnout No.	Control	Qty
P-65	Single	1/11	Centralised 4,6,7	2,4,8,12,16,18	3
P-65	Single	1/11	Non-centralised	22,24,26,32,34,28	2
P-65	Double	1/9	Non-centralised	4,8,12,16,38,44,48	5
P-65	Single	1/9	Trailing	6,22,34,24,28,53,52	3

Railway Track Schedule

No.	Track Name	Useful Length (m)	Full Length (m)	Type of Turnout
I	Main	2400	3685	—
II	Passing	2040	2640	P-65
3	Siding	850	1050	P-65
4	Siding	700	900	P-65
5	Dead-end	550	650	P-65
6	Loading	450	550	P-65
	TOTAL	—	9134	

2.5.5.2 Intermediate Station

Intermediate Station is the central / intermediate station of the Project, located approximately mid-way along the alignment between Yerdaut and Maktaaral, north of the Shardara Reservoir. It serves as a freight assembly and operational facility along the bypass.

The station axis is fixed at chainage KM 57-58, placing the station approximately at the centre of the four-section bridge / culvert schedule (mid-way between Passing Loop No. 2 to the north and Passing Loop No. 5 to the south). The full station footprint is bounded by the Track 1 (Main) extents at KM 57.2 to KM 58.7, giving a station-axis spread of approximately 1,530 m along the alignment.

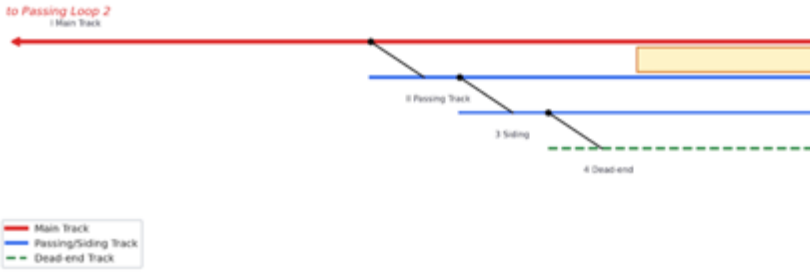
Intermediate is a substantially smaller facility than Yerdaut, comprising 7 numbered tracks: a main running track, three reception-departure tracks, two maintenance tracks for the Permanent Way and one operational pit track for the local foreman's station. The full track inventory is summarized in Table 7 below. All tracks are Р-65 profile.

Table 7: Intermediate Station: Track Inventory

Track No.	Designation	Boundary (chainage / turnout)	Full length (m)	Useful length (m)	Laid length (m)
1	Main	KM 57.2 - KM 58.7	1,530.3	1,085	1,397
2	Reception-departure	from turnout 6, via 8, to turnout 5	1,238.99	1,050	1,139
3	Reception-departure	from turnout 4, to turnout 3	1,213.68	1,061	1,147
5	Reception-departure	from turnout 2, via 4,3, to turnout 1	1,331.18	1,084	1,198
8	Operational pit, foreman's section	from turnout 10, to buffer	186	1,165	153

(Source: KSD Engineering, Drawing 5800-1-ПЖ, Sheet — Track Development Scheme of Intermediate Station, September 2024.)

Figure 7: Intermediate Station Track Layout



Turnout Schedule

Set	Type	Mark	Turnout No.	Control	Qty
P-65	Single	1/11	2 & 4	Centralised	2
P-65	Single	1/9	1 & 3	Non-centralised	2

Railway Track Schedule

No.	Track Name	Grade	Turnout Sect.	Length (m)
I	Main	1325.34	2, 4, 5, 7	--
II	Passing	--	2	1258.99
3	Siding	--	1	1210
4	Dead-end (wagon)	--	--	506

2.5.5.3 Maktaaral Station (southern terminus, KM 115)

Maktaaral Station (also referred to as Atakent Station after the adjacent town), is the southern terminus of the new alignment. The station is being upgraded and expanded with additional sidings to support freight assembly and storage, and a tie-in to the existing line on its north side. The feasibility study for Maktaaral Station was, at the time of the ESCA, ongoing due to design refinements; however, all necessary permits and licences for the station have been obtained.

Maktaaral Station is the southern terminal facility of the Project and serves as the international border crossing inspection station between Kazakhstan and Uzbekistan. The station accommodates passenger and freight services, with a small passenger terminal building sized for 25 passengers, and includes the full suite of customs, biosecurity, and inspection infrastructure required for cross-border rail traffic. The station's useful track length is designed for 200 m / 12-wagon train sets. Life and fire safety provisions at the station include manual and automatic fire detection and alarm systems, fire hydrants and extinguishing equipment sized to Kazakhstan national fire code and WBG EHS Guideline requirements, designated emergency assembly points, and coordination with the on-site National Security Committee and paramilitary security post; a detailed fire and life-safety strategy for the station will be finalised at EPC stage. Equivalent fire and life-safety provisions apply at the other Project stations and passing loops.

Main running tracks at Maktaaral use Р-65 rail (65 kg/m profile); sidings use Р-50 rail (50 kg/m). The station is laid out as a multi-track yard with passenger platforms, freight assembly sidings, customs inspection bays, and a separate sidings/loop area to the south of the main station body, connected to the existing KTZ network on the north side.

Station auxiliary power is supplied from a 10 kV three-phase overhead line; the line is not electrified for traction. The site is also crossed by telecommunications cabling (buried, 1 m depth).

The principal buildings and structures shown on the General Plan are listed below, organised by function. The Maktaaral building inventory differs materially from that of Yerdaut Station because it includes the full border crossing inspection suite (customs zone, biosecurity, radiation monitoring, KNB presence) appropriate to its role at the international frontier.

Operations and traffic control:

- EC (Electric Centralisation) post for 60 turnouts, combined with the service point.
- Signalman's post combined with the carriage inspector's control post.
- Service and production buildings.
- Diesel generator (back-up power, with an associated diesel fuel storage tank sized to the required backup runtime).
- Power supply point for 10 kV ABS and PE overhead lines (5.17).

Passenger facilities:

- Passenger terminal building sized for 25 passengers.
- Passenger platform.
- Pedestrian bridge.
- Canteen/amenity and service building for housing, guard and sanitary services workers.

Locomotive crew amenities:

- Locomotive crew rest house.

Customs Inspection Zone (Зона таможенного досмотра):

- Inspection platform with gantry crane.
- Customs inspection area.
- Heated temporary cargo storage.

- Unheated temporary cargo storage.
- Customs terminal weighbridge / scales.

Train inspection and biosecurity systems:

- Pit for under-train inspection from below.
- Automatic radiation monitoring system — radiation portal for cross-border freight.
- Automatic Carriage Inspection System— automated rolling stock inspection.
- Inspection complex.
- Disinfection complex comprising a service building, disinfection barrier, and disinfection reservoir.

Carriage maintenance:

- Carriage technical maintenance point
- Detached carriage current repair area
- Transverse watchman's catwalk

Track and signalling maintenance:

- Repair-operational point of the track maintenance section.
- Track maintenance/foreman point ECH.
- Inventory and tools storage combined with track and signalling workers' heating point.

Heating and fuel storage:

- Boiler house.
- Fuel storage for the boiler house.
- Fuel and lubricants stores 7 m³.

Fire protection:

- Fire depot for 2 vehicles.
- Fire-fighting water reserves V = 400 m³ each.

Security:

- Paramilitary security building.
- National Security Committee station house and KNB vehicle facility on site.

Water and waste:

- Water reserve tank, capacity 50 m³.
- Solid municipal waste area.

Site enclosure:

- Site fencing.

The presence of automatic radiation monitoring, automatic carriage inspection, the disinfection complex, customs terminal facilities, and the on-site KNB (National Security Committee) presence reflects the station's role as the principal inspection and clearance point on the new alignment for cross-border freight and passenger movements. This functional differentiation from Yerdaut Station has direct implications for impact assessment in subsequent chapters — notably for community health and safety (secured perimeter, restricted access, security personnel), labour and working conditions (multiple agencies on site including KNB and customs), biosecurity (disinfection facility wastewater management), and radiological safety (operation of the Yantar radiation portal).

Acoustic noise mitigation is integrated into the station design: 1,965 metres of "ГеоТехЭксперт" (GeoTechExpert) type acoustic screens are specified for installation along the station, in accordance

with ГОСТ 33929-2015 (acoustic screens for railway transport). This is the same screen type and specification applied at Yerdaut Station.

As at Yerdaut Station, the Sanitary Protection Zone shown on the Maktaaral General Plan is 50 m on each side of the outermost track, justified under Section 9 of KR DSM-72 by the integrated acoustic screening. The reduction from the standard 100 m SPZ is therefore being applied at both stations on the same regulatory basis.

Track inventory

Maktaaral Station has a total of 26 numbered tracks, organised into general operational tracks (numbered I, II and 3–24) and dedicated border-crossing function tracks (numbered 101–126 in a separate series). The full track inventory is summarised in Table 8 below. All tracks are P-65 profile.

Functional grouping of the track inventory:

- Main running tracks — 2 (Tracks I and II) at 1,050 m useful, providing through-running capacity in both directions.
- Reception-departure tracks — 8 (Tracks 3, 4, 5, 6, 8, 10, 12, 14) at 1,050 m useful, providing simultaneous holding capacity for up to 8 trains awaiting customs / biosecurity clearance or onward dispatch. This is the largest reception-departure capacity at any facility on the new alignment, consistent with the station's role as a major border-crossing yard.
- Pull-out tracks — 5 (Tracks 7, 11, 13, 18, 20) of varying lengths (140, 200, 200, 550, 550 m), used for shunting and rake assembly.
- Catch sidings — 2 (Tracks 9, 15) at 50 m, designed to safely arrest runaway wagons / trains. The presence of dedicated catch sidings reflects the operational risk profile of a heavy-freight border yard.
- Customs inspection tracks — 5 (Tracks 101–105) at 250 m each. Tracks shorter than the main reception-departure length means inspection takes place on broken-down rakes (sub-strings of approx. 12 wagons) rather than full 1,050 m trains.
- Sanitary inspection / quarantine tracks— 2 (Tracks 112–113) at 350 m, used for biosecurity / phytosanitary inspection separately from customs.
- Dangerous goods siding (Track 111) — 350 m, dedicated to wagons carrying dangerous goods AND used for accident / emergency response.
- Defective wagon siding (Track 126) — 200 m, for parking wagons identified as faulty during customs / inspection.
- Carriage repair tracks (TOR) — 2 (Tracks 122, 123) at 75 m, supporting the carriage technical maintenance function (5.32) and detached current repair.
- Maintenance and operations support — Track 124 at 60 m, Track 125 at 60 m, Tracks 22 and 24 of unstated length.

Table 8: Comparative scale of the three stations and two passing loops

Facility	Numbered tracks	Turnouts	Reception-departure tracks @ 1,050 m	Specialist function notes
Yerdaut Station	25	51	4 (Tracks 3, 6, 12, 14) + 3 main (I, II, IV)	Junction with existing electrified Darbaza–Сарыагаш line; depot facilities (locomotive supply, sand/fuel unloading, fire/recovery train sidings, TOR, electric and diesel loco sidings)
Intermediate Station	7	9	3 (Tracks 2, 3, 5)	Mid-alignment crossing point only; minimal

Facility	Numbered tracks	Turnouts	Reception-departure tracks @ 1,050 m	Specialist function notes
				maintenance pit and PCh/ECh tracks
Maktaaral Station	26	58	8 (Tracks 3, 4, 5, 6, 8, 10, 12, 14)	Border-crossing yard with 5 customs tracks, 2 sanitary/quarantine tracks, dangerous-goods siding, defective-wagon siding, catch sidings, TOR
Passing Loop No. 2	4 + crossover	4	2 (Tracks 2, 3)	Standardised passing loop design; 1 maintenance siding; crossover between Yerdaut and Promezhutochnaya
Passing Loop No. 5	4 + crossover	5	2 (Tracks 2, 3)	Identical standardised design to PL2; in vicinity of Shardara KBA

Maktaaral is the largest single facility on the new alignment by both track and turnout count, reflecting its role as the principal border-crossing inspection station. Yerdaut, although smaller, is operationally complex due to its junction role with the existing electrified line and its depot facilities.

Figure 8: Maktaaral (Atakent) Station general layout



Source: extract from KITNG situational scheme, drawing 5800-5-ГП Sheet 1, December 2024

2.5.5.4 Passing Loops

Passing loops along the alignment provide the means for trains travelling in opposite directions to pass on the single-track main line. Each loop typically comprises two additional through tracks alongside the main line, connected by turnouts at each end. The operational characteristics suggest standing time at passing loops of around 32 minutes, with a maximum of 40 minutes per train.

Table 9: Passing Loops within the Project Alignment

Loop	Approximate location	Section context
No. 2	~KM 30.9; between Yerdaut and Intermediate Station	Boundary between Bridge / Culvert Section 1 and Section 2
No. 5	~KM 88.0; between Intermediate Station and Maktaaral, in vicinity of the Shardara Reservoir crossing	Boundary between Bridge / Culvert Section 3 and Section 4
No. 6	South of Maktaaral Station, near Asyk-Ata	South of Section 4 terminus

(Source: existing PD draft Section 1.3.5 for chainages of Loops 2 and 5; KSD Engineering Sheet 5800-1-ГП-002)

Track Development Schemes for Passing Loops No. 2 and No. 5 have been prepared by KSD Engineering LLP. Both loops are designed to a single standardised configuration, with identical track layouts and identical track lengths — they differ only marginally in turnout count (4 turnouts at PL2; 5 turnouts at PL5). The standardised configuration comprises: one main track; two reception-departure tracks; one maintenance siding for permanent-way machinery; and one crossover for switching between sides. All tracks are P-65 profile with concrete sleepers.

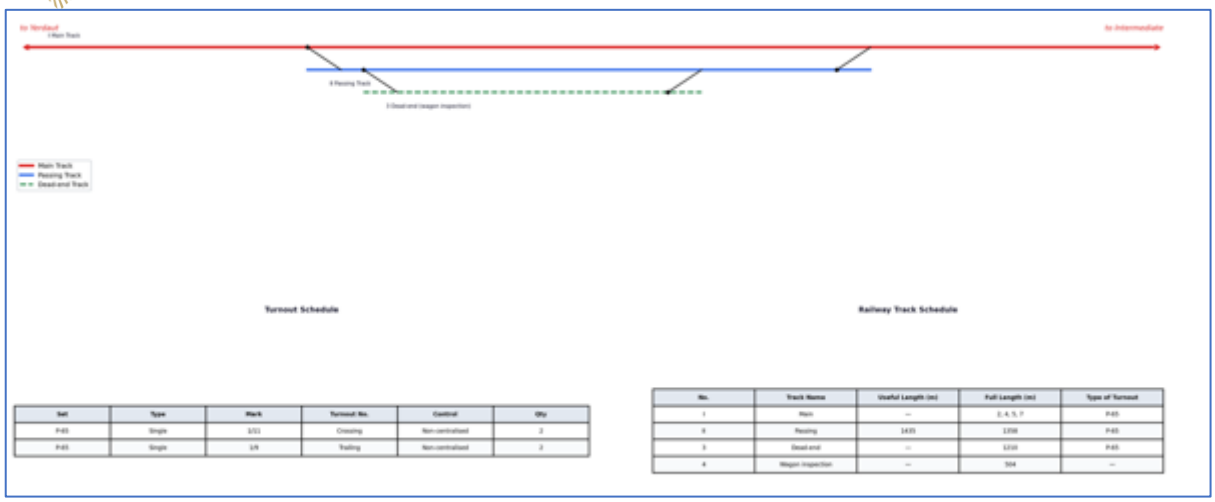
Passing Loop No. 2

Passing Loop No. 2 is positioned on Section 1 of the alignment between Yerdaut Station and Intermediate Station. The loop axis is at chainage KM30.9, and the Track 1 (Main) extents are KM30.1 to KM 31.6 — a station-axis spread of approximately 1,495 m along the alignment.

Table 10: Passing Loop No. 2: Track Inventory

Track No.	Designation	Boundary	Full length (m)	Useful length (m)
1	Main	KM 30.1 via 2,4,3,1 to KM 31.6	1,495	1,050
2	Reception-departure	from turnout 4, to turnout 5	1,117	1,052
3	Приёмо-отправочный	from turnout 2, to turnout 1	1,295	1,165
4	Permanent-way machinery siding	from turnout 4, via 104, to buffer	186	108
—	Crossover	from turnout 3, to turnout 5	86.7	20

Figure 9: Passing Loop No. 2 Track Layout

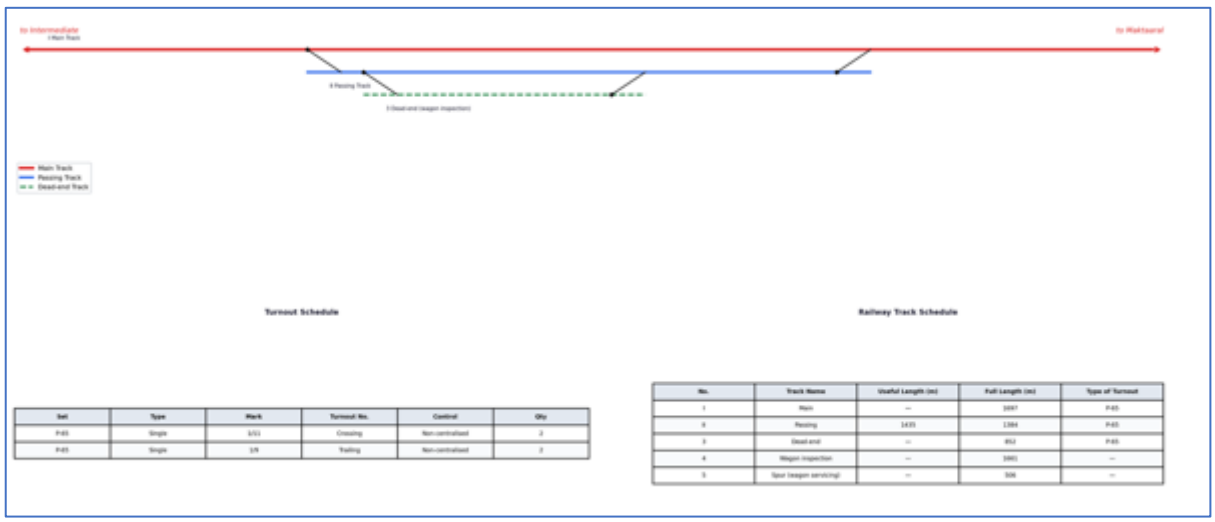


Passing Loop No. 5

Passing Loop No. 5 is positioned on Section 3 of the alignment between Intermediate Station and Maktaaral Station, in the immediate vicinity of the Shardara Reservoir crossing. The loop axis is at chainage KM 88.0, and the Track 1 (Main) extents are KM 87.2 to KM 88.7 — the same station-axis spread of approximately 1,495 m as PL2.

Track configuration and dimensions at PL5 are identical to PL2 — same Track 1 / 2 / 3 / 4 / lengths, all P-65 profile, concrete sleepers.

Figure 10: Passing Loop No. 5 Track Layout



PL5 is the most environmentally sensitive of the three loop locations because it sits within the area of influence of the Shardara Reservoir Important Bird Area (IBA) and Key Biodiversity Area (KBA), which the Project's Critical Habitat Assessment confirms as Critical Habitat.

Status of Passing Loop No. 6

PL6 is located at approximately KM 104 in the agricultural area, to the south of Shadara reservoir. No track development scheme has been provided for Passing Loop No. 6. However, it is assumed it will take the same format as those above.

2.5.6 Structures

The Project includes a range of required structures that take the new line over existing features such as roads, rivers, irrigation and drainage ditches.

2.5.6.1 Culverts

Along the route 130 culverts will be constructed to allow movement of surface water according to existing surface flow patterns such as drainage and irrigation channels and ditches. Of most importance are the culverts located within the Shardara reservoir to allow adequate passage of water to this Critical Habitat. These culverts are shown in the following table:

Table 11: Culvert Specification, Shardara Reservoir Area

№	Chainage	Type	Configuration No./ size (m)	Length (m)
Section 3: Intermediate Station – Passing Loop 5				
3.43	KM 76.1	RC Pipe Culvert	2,0x2,0	54.81
3.44	KM 77.1	RC Pipe Culvert	4,0x2,50	13.2
3.45	KM 77.5	RC Pipe Culvert	2,0x2,0	10.15
Section 4: Passing Loop 5 – Maktaaral Station				
4.1	KM 94.6	RC Box Culvert	1.0	9.49
4.2	KM 94.6	RC Pipe Culvert	1,0x1,5	10.15

2.5.6.2 Bridges

The Project includes 33 major alignment-crossing structures, comprising bridges, overpasses, combined crossing structures and a tunnel, as summarized in Table 12. Of these, the most significant bridge is the crossing of the Shardara Reservoir and Syr Darya River in the vicinity of KM 83.5. The bridge has a total length of 505 m.

Table 12: Bridge Schedule

№	Location Chainage	Type of Structure	Quantity	Structural Scheme (m)	Bridge Length (m)
Yerdaut Station					
1.1	KM 6+17.32	Bridge + cattle underpass	1	4x16.5	74.21
Section 1: Yerdaut – Passing Loop 2					
1.2	KM 1.06	Bridge	1	3x16.5	57.62
1.3	KM 2.3	Bridge	1	4x27.6	122.04

№	Location Chainage	Type of Structure	Quantity	Structural Scheme (m)	Bridge Length (m)
1.4	KM 2.8	Railway overpass	1	1x16.5	27.2
1.5	KM 4.9	Bridge + agricultural underpass	1	4x16.5	74.21
1.6	KM 5.0	Railway overpass	1	1x27.6	38.44
1.7	KM 8.8	Railway overpass + cattle underpass	1	2x16.5	40.96
1.8	KM 14.0	Bridge + cattle underpass	1	23.6+27.6+23.6	86.02
1.9	KM 19.5	Railway overpass + agricultural underpass	1	1x16.5	27.22
1.10	KM 25.9	Bridge + agricultural underpass	1	2x23.6	
Section 2: Passing Loop 2 – Intermediate Station					
2.1	KM 32.1	Bridge	1	1x16.5	27.22
2.2	KM 33.7	Bridge	1	9.3+2x16.5	50.34
2.3	KM 35.3	Bridge	1	6x16.5	107.22
2.4	KM 46.3	Railway overpass	1	3x16.5+13.5 2x16.5	104.22
2.5	KM 47.4	Bridge	1	9.3+3x16.5+9.3	76.26
2.6	KM 51.2	Bridge	1	9.3+16.5+9.3	43.14
2.7	KM 52.3	Bridge + agricultural underpass	1	9.3+2x16.5+9.3	59.7
2.8	KM 55.9	Bridge	1	5x16.5	90.66
Section 3: Intermediate Station – Passing Loop 5					
3.1	PK 62.8	Road overpass	1	1x.24.0	30.1
3.2	PK 63.3	Bridge	1	11.5+3x16.5+11.5	79.26

№	Location Chainage	Type of Structure	Quantity	Structural Scheme (m)	Bridge Length (m)
3.3	PK 68.9	Bridge	1	4x16.5	74.1
3.4	KM 71.9	Bridge + agricultural underpass	1	3x9.3	32.94
3.5	KM 76.3	Tunnel + cattle underpass	1	11+10.2x2+11	42.5
3.6	KM 79.3	Bridge	1	23.75x4	104.24
3.7	KM 81.5	Bridge	1	23.75x3	80.44
3.8	KM83.5	Major bridge over the Syr Darya River	1	2x66+4x88	505
3.9	KM 86.2	Bridge	1	3x23.6	79.84
Section 4: Passing Loop 5 – Maktaaral					
4.1	KM 91.1	Bridge	1	4x23.6	103.5
4.2	KM 96.4	Road overpass	1	1x24.0	30.1
4.3	KM 103.0	Bridge	1	1x34.2	45.6
4.4	KM 104.6	Bridge	1	6+16.5+6	33.54
4.5	KM 109.6	Bridge	1	16.5+66+16.5	108.048
4.6	KM 112.9	Bridge	1	1x16.5	23.02
	Total		33		

2.5.6.3 Typical bridge design — worked example at KM 25.9

A complete detailed design package has been issued for the bridge at KM 25.9 — the railway bridge over the natural watercourse on the Yerdaut–Passing Loop 2 section. The package comprises 21 sheets covering general data, layout, foundations, abutments, intermediate piers, reinforcement schedules, monolithic sections, locker blocks, stair access, construction organisation, and the engineering-geological passport.

This bridge is presented in this section as a worked example of the typical bridge design used along the alignment. While bridge spans, foundation depths, and exact configurations will vary site-by-site

(notably for the Shardara Reservoir / Syr Darya crossing with its 505 m total length, see Table 33), the design standards, span series, materials, foundation methodology and construction sequence documented for this bridge are representative of the generic approach applied to all bridges in the Project.

2.5.6.4 Design parameters and reference standards

The principal design parameters of the typical bridge are summarised below.

Table 13: Principal Design Parameters

Parameter	Value
Drawing reference	5800-7-ИС1-19, Vol. 8, Album 1 (KSD Engineering, November 2024)
Location	KM 25.9 (mid-bridge); KM 25.8 (Abutment №1) / KM 25.9 (Abutment №3)
Section context	Section 1: Yerdaut Station — Passing Loop No. 2
Bridge scheme	2 × 23,74 m (twin-span)
Span type	Steel beam composite spans, deck-type ballasted
Standard span project	Type 17586РМ-СК3-КМ2 (typical project; 18,2–33,6 m design range; tangent and curved alignments R≥300 m; seismic up to 9 points)
Plan geometry	On tangent
Vertical alignment	5‰ (0,5%) gradient
Live load class	К14 (Russian/CIS heavy haul standard)
Design seismicity	8 points (MSK-64 scale)
Bearings	ШСОЧ-К2 elastomeric: 2 linear-displacement, 2 fixed, 4 all-displacement
Cable trough	Metal trough each side per Series 3.501.1-113, Inv. № 1176

The design references the following Republic of Kazakhstan and CIS norms: SP RK 3.03-112-2013 (Bridges and pipes); SN RK 3.03-22-2013 and SP RK 3.03-114-2014 (Railways); VSN 56-78. Standard-project series referenced for individual elements are: Series 3.501.1-146 (typical reinforced-concrete spans, used for the soft-entry plates here); Series 3.501-79, Inv. № 828/1 (typical pier project); Series 3.501.1-156 (slope and embankment reinforcement); Series 3.503.1-96 (typical stair access).

2.5.6.5 Substructure: foundations and piers

The bridge sits on bored-pile foundations with monolithic reinforced-concrete pile caps, columns, and crossheads. The foundation arrangement is as follows.

Table 14: Bridge Foundation Arrangement

Element	Configuration	Pile depth	Reinforcement (per pile)	Concrete (per pile)
End abutments	9 × Ø1500 mm bored piles in 3×3 grid; pile cap 7000 × 7000 mm; 2 columns Ø1500 mm L=2,0 m; monolithic (pier crosshead with bearing seat)	25.0 m	A400 (AIII) Ø18: 1,040 kg; A240 (AI) Ø8: 226 kg; A400 (AIII) Ø16: 178 kg = 1,445 kg total	44.3 m³ B22,5 W6
Intermediate pier	6 × Ø1500 mm bored piles in 2×3 grid; pile cap 4500 × 6500 mm; 2	21.0 m	A400 (AIII) Ø22: 329 kg + Ø16: 50 kg; A240 (AI) Ø8:	37.3 m³ B22,5 W6 per pile;

	columns Ø1500 mm L=4,0 m; monolithic		52 kg = 437 kg per column; pile reinforcement 1,221 kg per pile	47.3 m³ for pile cap

Frost resistance F200 and water resistance W6 / W8 are specified throughout. All buried concrete uses sulphate-resistant Portland cement and exposed surfaces in contact with soil are coated with hot bituminous-mastic non-reinforced waterproofing.

2.5.6.6 Geotechnical context

Site investigation for the bridge was conducted by KSD Engineering in August 2024, with two test boreholes. The engineering-geological profile identifies seven distinct strata along the line of the bridge:

- ИГЭ 1 — Light loams, hard and semi-hard, collapsible (просадочные суглинки) — top stratum.
- ИГЭ 1а — Light loams, hard and semi-hard, non-collapsible.
- ИГЭ 2 — Loams, stiff- to soft-plastic.
- ИГЭ 7 — Gravelly sand.
- ИГЭ 9 — Heavy loams, hard and semi-hard.
- ИГЭ 10 — Light clays, hard and semi-hard.
- ИГЭ 11 — Stiff-plastic clays.

Two findings from the geotechnical report are material for the wider Project ESIA, not just for this bridge:

- Collapsible loess loams feature in the upper strata. These soils undergo settlement on wetting, which has design implications for surface drainage and embankment stability across the wider alignment in Saryagash District. The bridge design accommodates this by founding piles into stable strata at 21–25 m depth, well below the collapsible upper layers.
- Sulphate aggressivity of soils to concrete varies between (weak) and (strong) for W4–W6 grade Portland cement concrete. The design therefore mandates sulphate-resistant Portland cement (per ГОСТ 22266-2013) for all buried concrete.

Groundwater was encountered at varying depths in the test boreholes (water table level approximately 3,6 m below ground surface in the bridge footprint area). Pile caps therefore require sheet-pile cofferdams and tamponage concrete B15 (lean mix) for the dry-pour environment.

2.5.6.7 Construction methodology and equipment

The typical sequence of works for a bridge of this scale, together with the principal plant is:

- Set-out of the site, marking pile axes (longitudinal and transverse), and consolidation of the working platforms with crushed stone (15 cm thickness, ≥3 m wide) for crane mobility.
- Construction of bored piles using a "Bauer BG-25" or equivalent boring rig with steel casing (Ø1500 mm); the rig's exclusion zone is approximately 8,7 m radius.
- Reinforcement cage installation using the РДК-250 crane (gantry-track crawler crane); cage exclusion zone is approximately 7,5 m radius during transport and 12,5 m during placement.
- Pile concrete placement (sub-piling) using buckets (vibrators on pile cap, ½ m³ buckets).
- Pile cap excavation and reinforcement; tamponage concrete B15 placed first to seal the bottom; main pile cap concrete (B25 F300 W6) poured by 2 m³ bucket using the РДК-250 crane.
- Column / pier construction using a 40 t boom crane.
- Pier crosshead construction.

- Cabinet block installation by crane; monolithic infill of the joint between cabinet block; soft-entry plate installation.
- Span installation by twin-crane lift using crawler crane (boom L=80 m; load chart provided on Sheet 20). The twin-crane operation is required because the steel composite span weight (~47,4 tonnes per span) is at the upper limit for single-crane handling at the operational radius.
- Backfill of pile cap and embankment construction, in accordance with the slope reinforcement provisions.
- Track laying with continuous welded rail and ballast.

Table 15: Principal plant on a typical bridge site

Equipment	Type / model	Quantity
Boring rig	Bauer BG-25 (or equivalent)	1
Crawler crane (cage / cap / piers)	gantry track, boom 40 m	1
Crawler crane (span lifting)	XCMG QUY50, boom L=80 m	2 (twin-lift)
Flatbed truck (segments / materials)	KAMAZ-54112	1+

2.5.6.8 Indicative material and excavation quantities

Table 16: Indicative material and excavation quantities (per typical bridge)

Item	Per end abutment	Per intermediate pier
Excavation of pile cap pit (shoring)	92 m³	150 m³
Concrete B15	81,0 m³ (h=1,0 m)	60,0 m³ (h=1,0 m)
Hydroinsulation (smearing)	135 m²	66 m²
Backfill with compaction	56,0 m³ (soil class №8a)	103 m²
Bored pile concrete	~400 m³ (9 piles × 44,3 m³)	~225 m³ (6 piles × 37,3 m³)
Pile cap concrete	73,5 m³	47,3 m³
Reinforcement (total)	~13 t (piles 9 × 1,445 kg = 13 t; plus pile cap)	~10 t (piles 6 × 1,221 kg = 7,3 t; plus pile cap and columns)

Multiplying these representative figures across the 33-bridge inventory in Table 12 (noting that the Shardara Reservoir / Syr Darya bridge at 505 m total length is substantially larger and not directly representative) gives an indicative order-of-magnitude estimate for the bridge program as a whole — well in excess of 20,000 m³ of structural concrete and several hundred tons of reinforcement steel across the 17 bridge structures (or 33, per the existing bridge schedule.

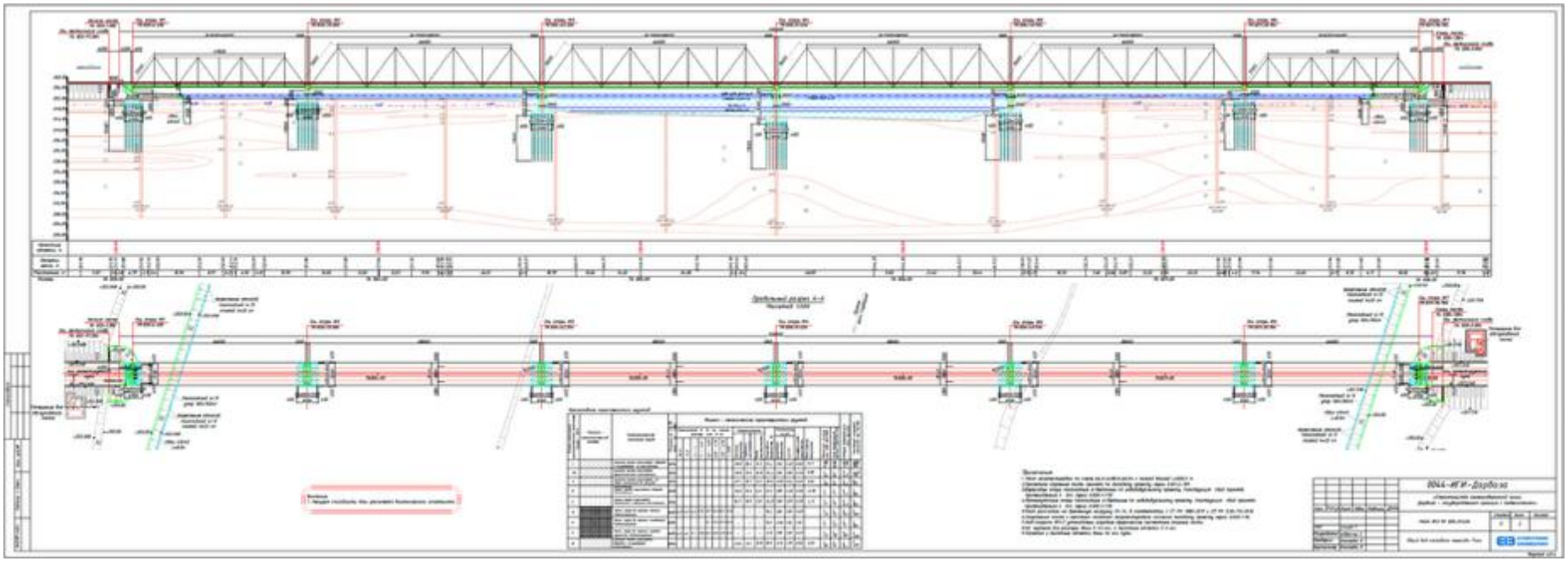
2.5.6.9 Bridge access — staircases and inspection arrangements

Each typical bridge incorporates pedestrian staircase access for maintenance personnel, and a 5 m staircase are provided, one at each abutment.

2.5.6.10 Bridge over the Syr Darya River at KM 83.5

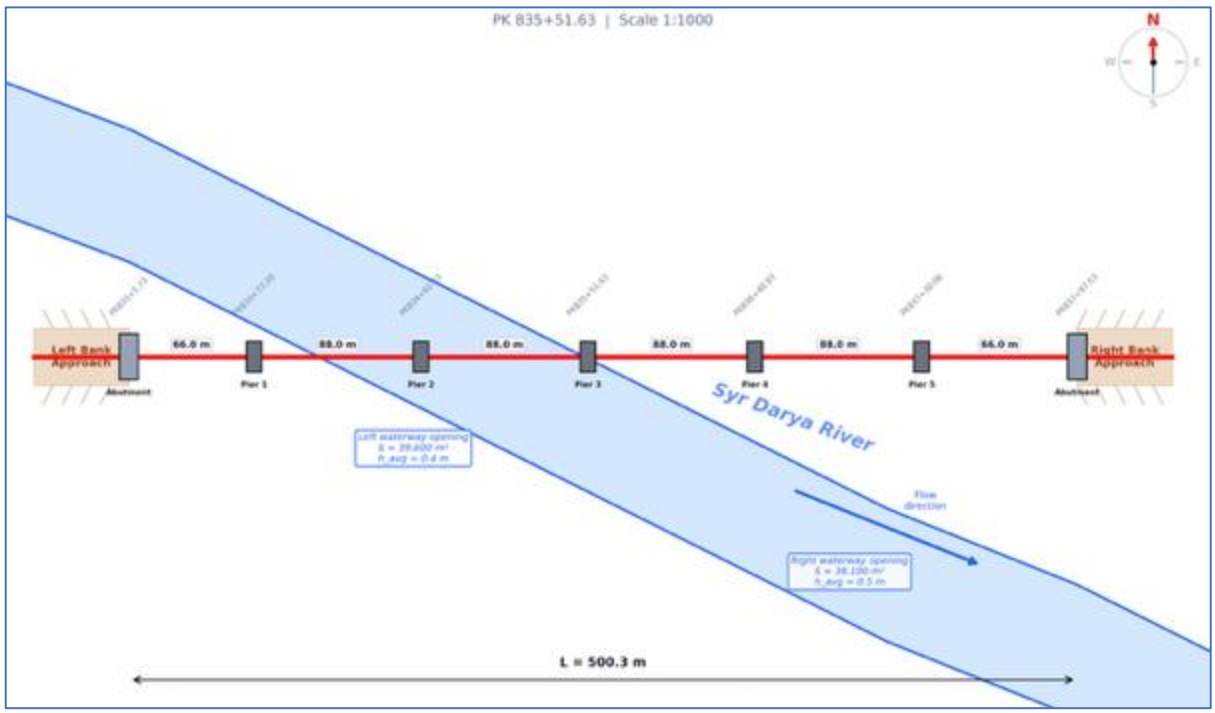
The single most significant structure on the alignment is the railway bridge across the Syr Darya River Section 3 of the alignment, between Intermediate Station and Passing Loop No. 5. This bridge differs materially from the typical design described above. It is a six-span steel through-truss bridge — the only such structure on the alignment — and it crosses the Syr Darya River within the area of influence of the Shardara Reservoir Important Bird Area / Key Biodiversity Area (IBA / KBA).

Figure 11: Bridge over Syr Darya, General View / Façade



Source: 5800-9-200-ИС1.8, Sheet 2 "Общий вид моста. Схема расположения элементов"

Figure 12: Bridge over Syr Darya



Source: KTZ / VEAB, 2026

2.5.6.11 Bridge configuration

Table 17: Bridge Configuration

Parameter	Value
Drawing reference	5800-9-200-ИС1.8, Vol. 12.2 (KSD Engineering, September 2025)
Location	PK 83.5 (mid-bridge)
Section context	Section 3: Intermediate Station — Passing Loop No. 5
Span configuration	6 spans: 66,0 + 4 × 88,0 + 66,0 m
Total length	L = 500,3 m
Span type	Steel through-truss spans, single-track, ballastless reinforced-concrete deck slab
Standard span project	Series 3.501.2-139, Inv. № 1293/К — typical project for railway bridges with deck-bottom configuration, 33–110 m spans; Series 3.501.2-139.2-2 for the 88,0 m spans; Series 3.501.2-139 for the 66,0 m spans
Truss height (88,0 m spans)	15 000 mm
Truss height (66,0 m spans)	11 250 mm
Truss centreline spacing	5 800 mm (88,0 m spans); 5 700 mm (66,0 m spans)
Truss elements	Top and bottom chords; closed-box section diagonals; H-section verticals and hangers
Bearings	Spherical-segment ball type
Live load class	СК-14 (per SP RK 3.03-112-2013)
Anti-corrosion protection	SNiP 2.03.11-85*; STP-001-95 ("Corrosion protection by painting of metal bridge structures"). Internal AND external surfaces protected.

(Source: 5800-9-200-ИС1.8, General Explanatory Note, "Сводная ведомость принятых гидравлических характеристик", page 7.)

The design references the following regulatory framework: SP RK 3.03-114-2014 (Railways); SP RK 3.03-112-2013 (Bridges and pipes); SP RK 5.03-107-2013 (Load-bearing and protective structures); SP RK 5.01-103-2013 (Pile foundations); SNiP II-7-81* (Construction in seismic areas); SNiP RK 2.01-01-2013 (Protection against corrosion); SP RK 2.04-01-2017 (Climatology / geophysics); SP RK 3.04-102-2014 (Concrete and reinforced concrete); SNiP RK 1.03-05-2011 (Labour protection in construction); GOST 26633-2015 (Heavy concretes); GOST 380-2015 (Carbon steel of ordinary quality); GOST 8736-2014 (Construction sand).

2.5.6.12 Substructure: abutments, piers, and pile foundations

The bridge sits on seven supports: two end abutments and five intermediate piers. All foundations are bored-pile with monolithic reinforced-concrete pile caps and columns. The configuration is differentiated by location, with deeper piles at the central in-channel piers reflecting the greater scour and load demands.

Table 18: Substructure Configuration

Element	Configuration	Pile depth	Concrete (sulphate-resistant)
End abutments №1, №7	Backfill abutments, individual design; columns, crossbeam, wing walls, shaft wall, soft-entry plate; pile cap height 2,0 m	Ø1 500 mm × L = 36 m	Body, wing walls: B30 F200 W8; Pile cap: B25 F200 W8 (sulphate-resistant); Piles: B25 F200 W8 (sulphate-resistant)
Intermediate piers №2, №6	Individual design; pier body, насадка with bearing platform; pile cap height 2,5 m	Ø1 500 mm × L = 36 m	Body, : B30 F200 W8; Pile cap: B25 F200 W8 (sulphate-resistant); Piles: B25 F200 W8 (sulphate-resistant)
Intermediate piers №3, №5 (in main channel)	Individual design; pier body, насадка with bearing platform	Ø1 500 mm × L = 38 m (deepest)	As pier №2/№6
Intermediate pier №4 (centre, deepest water)	Individual design; pier body, насадка with bearing platform	Ø1 420 mm × L = 36 m (smaller diameter)	As pier №2/№6

(Source: 5800-9-200-ИС1.8, General Explanatory Note, "Сводная ведомость принятых гидравлических характеристик", page 7.)

All piles use sulphate-resistant Portland cement per ГОСТ 22266-2013, consistent with the wider alignment's soil-aggressivity profile.

2.5.6.13 Hydrology and hydraulic characteristics

The Syr Darya at the bridge crossing is a major regional river — the longest in Central Asia and the second-most water-rich after the Amu Darya. The basin covers 462,000 km² across Kyrgyzstan, Tajikistan, Uzbekistan and Kazakhstan. At the bridge crossing the river flows across a flat plain at 250–255 m elevation; the main channel is approximately 175 m wide at low water with a fairly even bed and the deepest section near the channel centreline. The crossing has a bilateral floodplain, with the right (eastern) side significantly more developed. Last upstream tributary is the Arys; small rivers from the Karatau range do not reach the Syr Darya, which forms a delta of distributaries, lakes and wetlands at its lower reaches.

Table 19: The hydraulic design parameters adopted at the bridge crossing

Parameter	Unit	Value
Design flow (0,33 % probability)	m^3/s	3 991
Design flow (10 % probability)	m^3/s	2 371

Design water level (0,33 %)	m a.s.l.	253,05
Design water level (10 %)	m a.s.l.	252,18
General scour coefficient	—	1,9
Average flow velocity	m/s	0,77
Maximum flow velocity	m/s	2,23
Maximum design depth	m	9,5
Average design depth	m	3,9

(Source: 5800-9-200-ИС1.8, General Explanatory Note, "Сводная ведомость принятых гидравлических характеристик", page 7.)

2.5.6.14 Flow-guiding dykes — major in-channel works

A pair of flow-guiding dykes is constructed at the bridge crossing — one upstream and one downstream of the bridge — to regulate water flow, protect the piers from scour, prevent backwater flooding of adjacent floodplain, and stabilise the river channel at the crossing. These regulatory works have five specific design functions per the Working Documentation:

- Smoothly introducing floodplain water flows from upstream into the bridge opening.
- Smoothly extracting the constricted flow from the bridge opening and ensuring safe spreading across the downstream floodplain.
- Maintaining uniform flow velocities under the bridge to prevent concentrated scour at piers.
- Preventing erosion-dangerous longitudinal currents along the embankment slopes.
- Eliminating harmful erosion (scour-driven) changes in the main channel and active branches.

Dyke geometry: top elevation 254,50 m a.s.l. (i.e. 0,25 m above the design high-water level, accounting for backwater rise and wave run-up); top width 3,0 m, increasing to 4,0 m at the head section; top platform sloped at 0,03 toward the floodplain. Side slopes: 1:2 on the river-facing side, 1:1,5 on the back side and on the head sections (the more gentle 1:1,5 head-slopes provide hydraulic transition into the channel). The river-facing slopes are reinforced from crest to toe with reinforced-concrete revetment along their entire length, including head sections. At the toe of the river-facing slope, scour-protection aprons — ditches infilled with stone — protect against undermining.

2.5.6.15 Construction methodology

The construction sequence is:

- Preparation: temporary access roads and on-site logistics; office and welfare buildings, materials laydown, plant area, and on-site batching plant.
- Temporary access roadway constructed along the bridge axis to allow rig and crane movement to each pier location.
- Bored piles Ø1 420 / Ø1 500 mm installed by drilling rig from the temporary roadway down to design depth.
- Pile heads cut down to design level after pile completion; concrete blinding placed at pile-cap base.
- Monolithic pile caps and pier bodies cast on the prepared bases; monolithic reinforced-concrete crossbeams cast on top of the piers.
- Steel main girders erected by cantilever construction — i.e. spans extended out from already-completed piers, then closed at the next pier.
- Track formation and ballastless slab installed on the assembled string.
- Final stage: cone embankments at the abutments and channel-bed reinforcement.

Sheet-pile cofferdams are required around the in-channel piers to permit dry construction of the pile caps; sheet pile is driven into the river bed using low-noise equipment as specified in the environmental protection clauses below.

2.5.7 Level Crossings

There are 13 at-grade level crossings along the Project alignment. Nine serve roads of local significance and are identified in the Project level-crossing register as agricultural crossings. The remaining four serve public roads under the relevant road authorities, with design traffic intensity reported at up to 8,000 vehicles/day. The crossing design provides asphalt-concrete road surfacing, with rubber-cord crossing decks at eight locations and reinforced-concrete slab (PZh-1) decks at five locations. Information on the location, access function and crossing arrangement is provided in Table 20.

Table 20: Level-crossing Locations

No.	Section	Chainage (PK)	Road balance holder / classification	Access function / traffic	Crossing deck
1	Yerdaut Station – Siding 2	PK 323+96	Roads of local significance	Agricultural crossing	Rubber-cord deck
2	Yerdaut Station – Siding 2	PK 360+58	Roads of local significance	Agricultural crossing	Rubber-cord deck
3	Siding 2 – Intermediate Station	PK 427+20	Roads of local significance	Agricultural crossing	Reinforced-concrete slab deck (PZh-1)
4	Siding 2 – Intermediate Station	PK 479+66	Roads of local significance	Agricultural crossing	Rubber-cord deck
5	Intermediate Station – Siding 5	PK 598+00	Roads of local significance	Agricultural crossing	Reinforced-concrete slab deck (PZh-1)
6	Siding 5 – Maktaaral Station	PK 941+73.4	Roads of local significance	Agricultural crossing	Rubber-cord deck
7	Siding 5 – Maktaaral Station	PK 980+13	Roads of local significance	Agricultural crossing	Reinforced-concrete slab deck (PZh-1)
8	Siding 5 – Maktaaral Station	PK 992+77*	Roads of local significance	Agricultural crossing	Reinforced-concrete slab deck (PZh-1)
9	Siding 5 – Maktaaral Station	PK 1020+96.70	Roads of local significance	Agricultural crossing	Reinforced-concrete slab deck (PZh-1)
10	Siding 5 – Maktaaral Station	PK 1062+92.47	Ontustik Zholdary	≤8,000 vehicles/day	Rubber-cord deck
11	Siding 5 – Maktaaral Station	PK 1101+57.51	Ontustik Zholdary	≤8,000 vehicles/day	Rubber-cord deck
12	Maktaaral Station	PK 1129+39	Ontustik Zholdary	≤8,000 vehicles/day	Rubber-cord deck
13	Maktaaral Station	PK 1171+65	KazAvtoZhol	≤8,000 vehicles/day	Rubber-cord deck

Note: The Project level-crossing register identifies nine crossings on roads of local significance as agricultural crossings and four crossings serving public roads, for which design traffic intensity is reported at up to 8,000 vehicles/day. The separate crossing-deck schedule dated 27 March 2026 provided by KTZ identifies rubber-cord decks at eight crossings and reinforced-concrete slab (PZh-1) decks at five crossings. The agricultural designation confirms the access function of these crossings but does not, by itself, establish their suitability for livestock movements.

2.5.8 Lighting

Lighting is provided at all stations and passing loops, at level crossings on the open alignment, and at ancillary facilities in accordance with СТ РК 1475-2005 "Norms of artificial lighting of railway transport objects", which is the Kazakhstan national standard governing railway lighting design. The lighting design is summarized below.

Technology. All lighting on the Project uses light-emitting diode (LED) technology, providing energy consumption approximately 2.5 to 3.5 times lower than the equivalent mercury vapor (ДРЛ) installations used on older KTZ infrastructure. The LED luminaires and floodlights are supplied by a domestic Kazakhstan manufacturer, PROLUX LED LLP, Karaganda.

Station and passing loop lighting. Stations and passing loops are lit by a combination of:

- Pole-mounted LED luminaires on reinforced concrete poles, providing area lighting at platforms, accesses, sidings, and station yards; and
- LED floodlights on masts for higher-elevation illumination of station yards, loading and inspection tracks, and operational areas requiring vertical-plane lighting.

Level crossing lighting. Level crossings on the perekhons (open alignment between stations) are lit by console-type LED luminaires on brackets mounted on reinforced concrete poles, providing illumination of the crossing surface, approach signals, barrier mechanisms, and warning signage.

The LED technology and full-cut-off / console-type optic configurations are consistent with current good international industry practice for the management of light pollution at biodiversity and community receptors. The automatic photo-relay control ensures lighting is operated only during periods of insufficient natural illumination, and remote control from the EC post enables operator-managed reduction at locations of particular sensitivity.

2.5.8.1 Power Supply, Signalling and Communications

The Project line is non-electrified. Traction is provided by diesel locomotives only, and no overhead contact line, traction substation, or catenary system is included in the Project scope. The auxiliary electrical infrastructure provided under the Project supports trackside signalling and communications equipment, station services, and longitudinal power supply to ancillary facilities along the alignment. The principal electrical and communications components are summarized below.

Power Supply (Auxiliary). Auxiliary power for the Project is supplied at 10 kV from the regional electricity distribution network operated by ТОО Оңтүстік Жарық Транзит ("Southern Light Transit"), the regional distribution licensee for southern Turkistan Region. Three connection permits were issued by the operator on 16 June 2023 covering the three new transformer substations established under the Project: №00-00-01-2918 (Maktaaral), №00-00-01-2919 (Passing Loop 2), and №00-00-01-2920 (Intermediate).

The upstream grid connection points are:

Project transformer substation	Upstream source substation
Passing Loop 2	PS-110/35/10/6 kV **Abay-Bazar**
Intermediate station	PS-220/110/10 kV **Kyzyl-Asker**

Maktaaral station	PS-110/10 kV **Pakhtaaral**

At each upstream source substation, two additional 10 kV linear cells are added at the RU-10 kV switchgear to accommodate the Project's connections. From the three transformer substations the Project distributes auxiliary power along the alignment by two parallel 10 kV overhead-line systems: the Automatic Block Signaling (ABS) feeder line of approximately 85.3 km supplying trackside signaling, switch-control and block-section equipment; and the Longitudinal Power Supply (LPS) line of approximately 224.1 km supplying ancillary power along the alignment to stations, sidings, ancillary buildings, lighting, and operational facilities.

Signaling. Train movements along the Project line are controlled by Microprocessor Automatic Block-signaling, which divides the alignment into discrete block sections and prevents more than one train from occupying a single block section. The system is powered from the 10 kV ABS feeder OHL described above and is supported by approximately 450 km of signalling cable providing trackside connectivity for switch control, signal aspects, level-crossing protection and auxiliary control circuits.

Switch and signal control. Station and passing-loop turnouts and signals are controlled by Microprocessor Centralization (МС) — a modern, software-controlled successor to the older relay-based electric centralization (EC) used on the existing Arys–Saryagash line. МС provides centralized control of turnouts, signals, and routing at the station and passing-loop scale, integrated with the dispatcher-centralization system at the network scale. The МПЦ post (post-EC building) at each station and passing loop is constructed as a containerized modular installation.

Yerdaut station is equipped with an МС post sized for 60 turnouts, providing centralized control of station and adjacent perehon turnouts. Equivalent МПЦ arrangements are provided at Intermediate, Maktaaral, PL2 and PL5, scaled to the local turnout count.

Communications. A communications backbone is provided along the alignment to support train operations, dispatch, station administration, and security. The backbone is provided by a fibre-optic cable laid within the RoW alongside the alignment, supporting: train radio communication; station administrative telephone communication; two-way loudspeaker (PA) systems at stations and platforms; local network connectivity; CCTV at platforms, level crossings, and other security-sensitive locations; and dispatcher-centralization telecommunications.

Rolling-stock condition monitoring. КТСМ-03 (Комплекс технических средств модернизированный, modernised version 03) automatic rolling-stock condition monitoring posts are deployed at every separation point on the new line, providing automatic monitoring of axle-box overheating, drag detection, hot-wheel detection, and dynamic-load monitoring. The deployment comprises: Yerdaut (1 kit), PL2 (2 kits), Intermediate (2 kits), PL5 (2 kits), and Maktaaral (1 kit) — totaling 8 КТСМ-03 kits within Stage 1. Additional kits are deployed at Kalash station on the existing Arys–Shymkent line in conjunction with the Project (2 kits), reflecting the Project's role within the wider KTZ network.

2.5.9 Design Life and Renewals

The Project's principal infrastructure components are designed to the following indicative service lives, in line with KTZ and Kazakhstan railway practice: track formation, embankments and cuttings — effectively permanent, with maintenance cycles in perpetuity; ballast and sleepers — 25–40 years to major renewal under freight loading; rail (CWR, R-65 profile) — 25–35 years to major renewal under the design tonnage of 22 MGT/year, accelerated by curvature and the cumulative tonnage of dangerous-goods traffic where applicable; bridges and major structures — 100 years design life for the steel through-truss superstructure of the Syr Darya bridge and for the reinforced-concrete substructure across the bridge inventory, subject to scheduled inspection and rehabilitation; signaling and communications equipment — 15–20 years to major upgrade; rolling stock (KTZ-owned, not provided under the Project) — 25–30 years.

2.6 Associated Facilities

No associated facilities have been identified on the basis of the information currently available. Temporary access roads, borrow pits, batching plants and other construction support facilities established for the Project are treated as Project ancillary facilities and are included within the scope of this ESIA. Existing railway infrastructure to which the Project connects is not treated as an associated facility because it has an established function and can operate independently of the Project.

2.7 Construction

2.7.1 Main Construction Activities

Construction of a major greenfield railway is a sequence of interlocking civil, structural, mechanical, and electrical activities executed across an extended linear corridor. The dominant pattern is one in which the linear works — those activities that progress along the alignment, kilometer by kilometer — proceed concurrently with point works at stations, passing loops, and major structures. This concurrency is necessary to deliver the Project within the contracted program, and means that, at any given point in the construction period, multiple types of activity — earthworks, piling, concreting, vehicle movements, and welding — occur simultaneously at dispersed locations along the corridor. The principal construction activities are described below in the typical sequence in which they commence, together with the plant and equipment deployed.

Site establishment. Construction commences with the establishment of project sites: contractors' storage areas, access routes, work sites, office locations, concrete batching plants, fuel storage, and worker accommodation camps along the alignment. The Project has been organized into four construction lots, each managed by a separate subcontractor team under the overall direction of Integra Construction KZ LLP, with approximately 10 subcontractors active across the four lots.

Long-lead structures: bridge works. The bridge construction sequence comprises: (i) site establishment and access, including barge- or pontoon-mounted plant for in-channel piers; (ii) vegetation grubbing and soil clearance at the bridge footprints and approaches; (iii) construction of approach embankments where needed; (iv) excavations for structure foundations, with sheet-piled cofferdams driven by vibratory sheet-pile drivers and dewatered by submersible pumps to enable dry-conditions construction below the watercourse; (v) installation of bored or driven piles, using large rotary bored piling rigs (typically capable of piles of 1.0–2.5 m diameter and depths of 20–60 m) or hydraulic and vibratory pile hammers; (vi) formwork construction for abutments and piers, using modular climbing or jump formwork systems for tall piers; (vii) placement of reinforcement and pouring of concrete for structural elements, with ready-mix or on-site batched concrete delivered by truck mixer and placed by concrete pump (booms typically 30–60 m reach) or by skip-and-crane; (viii) deck erection by mobile or crawler crane lift (large bridges may require twin-crane lifts using crawler cranes in the 250–600 ton class), or by incremental launching for long viaducts; and (ix) construction of the bridge deck (ballasted or open-deck), bearings, parapets and finishes. Steel bridge components are typically pre-fabricated off-site and assembled on site by bolting or site-welding, with manual welders (arc, MIG/MAG or submerged-arc processes) and non-destructive testing equipment for weld inspection. River bridges are scheduled around the low-water season to manage hydrological constraints.

Linear works along the alignment. Along the route, the main works entail construction of the formation — the level, stable platform on which the line runs. For the Project, with much of the route on embankment and 4.5 million m^3 of imported fill required (see Section 2.8), the linear-works sequence comprises:

Vegetation grubbing and soil clearance, using chainsaws and brush cutters for smaller material, tracked mulchers or dozer-mounted clearance attachments for larger stands, and tracked bulldozers

and motor graders for topsoil stripping. Topsoil is conserved in long stockpile bunds along the working strip for later use in reinstatement.

Formation of embankment or cutting by mass earthworks, executed by large hydraulic excavators (30–50 ton class), wheel loaders, and tracked bulldozers, with material hauled by articulated or rigid dump trucks (15–30 ton payload). Material is placed and spread in successive layers (200–400 mm thick) and compacted to specified density by self-propelled vibratory rollers (15–25 ton single-drum class for granular material; padfoot or sheepsfoot rollers for cohesive soils), with water bowsers controlling material moisture content and providing dust suppression. Where rock is encountered, drilling and blasting may be used under licensed shotfirer supervision.

Installation of sub-grade and sub-ballast — a prepared subgrade or capping layer of well-graded, frost-insensitive material overlain by a sub-ballast layer of crushed rock or aggregate, which together provide load distribution, drainage, and filtration functions necessary to protect the underlying ground and the overlying ballast bed.

Installation of permanent way — sleepers, rails, ballasting and welding. The pre-assembled panel method (rail-sleeper grid, RShR in Russian practice) is used for the bulk of the open alignment, with track panels assembled at a centralized production base and transported by rail to the work front, where a specialized rail-mounted track-laying gantry advances along the newly laid track lifting each panel into position. The separate-component method is used at stations and complex layouts. Once track is in place, ballast is delivered by rail using bottom-discharge ballast hopper wagons, distributed and shaped by a ballast regulator, and tamped by self-propelled multi-sleeper tampers. After tamping, a dynamic track stabilizer consolidates the bed by simulating traffic loading. Ballast quantities are substantial — on the order of 2,000 m^3 per kilometer of track — driving construction-stage haulage volumes for the Project.

Rail welding to produce continuous welded rail (CWR), using self-propelled mobile flash-butt welding machines for the bulk of the welding work and portable thermite welding for closure welds and locations where the mobile welder cannot operate. Flash-butt welding is typically used as the primary method, with thermite welding used for final-stage and closure welds in the field. Rail welding is temperature-sensitive — neutral rail temperature must be controlled to manage thermal stress in service — and welded sections are dressed by rail grinders.

Drainage structures. As the formation is constructed, the alignment is interrupted at regular intervals by approximately 130 drainage culverts, conveying natural surface flow beneath the embankment. Smaller culverts are constructed from precast concrete elements placed by mobile crane; larger box culverts are cast in situ using modular formwork, ready-mix concrete delivered by truck mixer, and concrete pumps. Excavation uses smaller hydraulic excavators (8–25 ton class) working within trench-boxed excavations; backfill uses small excavators and plate or trench-roller compactors. Culvert construction is closely sequenced with the surrounding earthworks: culverts are installed before the embankment is brought to formation level.

Power infrastructure. The Project is non-electrified and traction is by diesel locomotive only; the power infrastructure provided is limited to auxiliary supply for signaling, station services, and operational facilities — comprising approximately 85.3 km of 10 kV ABS feeder overhead line and approximately 224.1 km of 10 kV LPS overhead line, together with transformer substations at intervals along the alignment. Pole foundations are excavated by truck-mounted or excavator-mounted augers (600–1200 mm diameters); poles (reinforced concrete, prestressed concrete, or steel lattice) are erected by mobile cranes (25–60 ton); conductor stringing is performed by tensioner-puller machines. Transformer placement at substations uses cranes for transformer placement (30–100 ton) with heavy-haulage transport on multi-axle low-loaders. Energization occurs progressively as sections are completed, with final energization timed to enable signaling and station commissioning.

Signaling, communications and operational systems. The final principal construction activity is the installation and commissioning of signaling, telecommunications and operational systems. This activity comprises: laying of approximately 450 km of signaling cable, using trenchers, cable ploughs, or excavator-dug trenches with manual cable installation; installation of signal masts and gantries by mobile cranes (25–50 ton); installation of point machines, axle counters or track circuits, and level-crossing protection; installation of the fibre-optic communications backbone using cable-blowing equipment and fusion splicers; installation of Electric Centralization (EC) posts at stations and passing loops (Yerdaut sized for 60 turnouts) as prefabricated containerized units; integration with dispatcher centralization; and installation of rolling-stock condition monitoring (KTSM or equivalent). Commissioning unfolds in a structured sequence — design verification, pre-installation check-out, principles testing, functional testing, integrated testing, and Site Acceptance Testing — and the signaling test and commissioning process is the last line of validation before the system is turned over for train running and is almost always on the critical path of any rail delivery program. Trial running at restricted speed using a test locomotive typically precedes commercial operation.

Station works in parallel. Throughout the linear-works program, station and passing-loop works proceed in parallel at the three Project stations (Yerdaut, Intermediate, Maktaaral) and the two passing loops (PL2, PL5). Station construction uses conventional building plant — tower cranes where station buildings are large or multi-storey, mobile cranes (25–100 ton), concrete batching plants, concrete pumps, scaffolding and access platforms, telehandlers, and conventional carpentry and finishing trades. Stations are typically the most labor-intensive locations on a railway project and the most concentrated sources of construction-phase noise, dust, traffic and labour-influx impacts on adjacent communities.

2.7.2 Camps and Facilities

The Project requires temporary land take during the construction period for a network of construction support facilities — including construction compounds and laydown areas, contractors' offices, concrete batching plants, fuel and chemical storage, plant workshops, worker accommodation camps, borrow pits, haul roads, and material storage areas. Construction support facilities have been established under the EPC arrangement with Integra Construction KZ LLP, with the alignment organized into four construction lots, each managed by a separate subcontractor team operating from its own set of work fronts and worker accommodation facilities. Approximately 10 subcontractors are active across the four lots, including KazStroi, KSD, NMS, EST Construction (active at Akuy Station), and Syganak Group (active at Maktaaral Station). The total number of active construction camps is approximately 10, ranging from small subcontractor-managed facilities to larger camps. Each subcontractor is contractually responsible to Integra for establishing and managing its temporary accommodation and welfare facilities.

The Project's construction workforce peaks at approximately 800 personnel across Integra and its approximately 10 subcontractors, distributed across the four construction lots and worker accommodation camps described above (see also the Executive Summary and the ESCA Corrective Action Plan). A full breakdown of workforce composition by skill category, contract duration and source (local, regional, national and international hire) is being compiled by Integra and its subcontractors and will be documented in the construction-phase Workforce Management Plan and Labour Management Procedures under the ESMP. The Project has committed, through the Labour Management Procedures, to prioritize local and regional hiring for unskilled and semi-skilled positions where suitably qualified candidates are available, consistent with IFC PS2 and AIIB ESS2; specific local-content targets and hiring procedures are to be confirmed and disclosed as part of that Plan.

Site offices. Site offices for Integra, its subcontractors, and the project owner's site supervision are provided in prefabricated modular cabins or container-converted offices, located at the principal compounds at the station work fronts and at intermediate locations along the alignment. Site offices accommodate management, planning, document control, HSE, quality control and surveying functions;

larger compounds include meeting rooms, an emergency operations center, visitor briefing facilities, and a project-level worker grievance intake point. On-site materials testing laboratories are established at the principal compounds for concrete cube testing, soil compaction, aggregate grading, and similar routine tests.

Concrete batching plants. Concrete is produced for the Project at multiple on-site batching plants established at strategic locations along the alignment, in particular at the major bridge and station work fronts where concrete demand is concentrated. The plants are of the conventional mobile or semi-mobile type, with production capacities ranging from approximately 30 m³/hour for smaller installations to 100–120 m³/hour for plants serving large bridge or station works. Principal components are aggregate storage bins, cement and supplementary cementitious materials silos (50–100 ton capacity each), a weigh-batching system, a mixing unit, a water dosing system with admixture lines, an automated control cabin, and dust collection and water recycling systems. Aggregate is delivered by tipper truck from local quarries; cement is delivered by bulk tanker; concrete is delivered to the point of placement by truck mixers with capacities in the 6–10 m³ range. Water is delivered via water trucks.

Figure 13: Location of Construction Camps



Source: Integra, 2026

Worker accommodation. Worker accommodation on the Project takes three forms used in combination:

- **Purpose-built construction camps** of varying size, managed by individual subcontractors within their assigned lot, comprising prefabricated modular dormitory blocks and, at some Project locations, **converted rail wagons** repurposed for sleeping accommodation, sanitation, and kitchen / canteen use, reflecting the rail-borne logistics of the Project. One such camp at the Akuy Station work front accommodates approximately 180 subcontractor workers.

- **Rented private accommodation** in nearby settlements, where subcontractor workers are housed in private dwellings under temporary rental agreements between the subcontractor and individual landlords.
- **Daily commuting** for workers whose home communities are close to the work fronts, with transport provided by the subcontractor.

The applicable international good-practice benchmark for worker accommodation under IFC PS2, ADB SR1, and AIIB ESS 1 is the IFC/EBRD Workers' Accommodation: Processes and Standards (2009) guidance, which sets requirements for room occupancy, floor area per worker, sanitation provision, food preparation, ventilation, fire safety, and welfare. The construction-phase ESMP requires that all worker accommodation on the Project meet this benchmark, supported by a Camp Management Plan submitted by each subcontractor and approved by Integra, with routine internal inspections and periodic third-party audits. The Camp Management Plan addresses room occupancy and space standards; sanitation, washing and laundry provision; food storage, preparation and waste management; fire detection, suppression, alarm, and evacuation arrangements; ventilation and lighting; potable water supply and quality; medical and first-aid provision; recreation and welfare facilities; security and access control; worker grievance procedures; and emergency response.

Storage and laydown areas. Storage facilities include rail and sleeper storage yards, aggregate stockpiles, steelwork and reinforcement storage, precast culvert and pipe storage, bulk fuel storage, hazardous materials storage, and waste storage.

Plant workshops and maintenance. Construction camps include mechanical workshops for routine maintenance, servicing and minor repair of the construction plant fleet, with adjacent areas for tire storage and replacement, used oil and lubricant storage, and parts storage. Specialist plant maintenance — for tamping machines, rail welding machines, piling rigs, large cranes, and similar — is undertaken by the original-equipment supplier's field service teams.

Utilities provision. Camp utilities are typically provided in a staged manner. Power supply is initially provided by diesel generators sized to total camp demand, with later connection to the local medium-voltage distribution network where this is available. Water supply for potable and process needs is provided through a combination of municipal supply connection, on-site groundwater wells equipped with electric submersible pumps, and tanker delivery, with potable water chlorinated and quality-monitored to applicable standards. Wastewater from the camps is managed through on-site package wastewater treatment plants (typically modular biological treatment units), septic tanks with regular pump-out and tanker disposal to licensed off-site facilities, or full tanker-collection-and-disposal, with documented effluent quality monitoring where on-site treatment is used and discharge to surface water occurs. Solid waste is segregated at source (general, recyclable, hazardous), stored in covered skips, and removed by licensed contractors for disposal at a permitted facility.

2.8 Earthworks and Track Materials

The working design seeks to maximize reuse of suitable material excavated from cuttings in order to balance earthworks volumes. Where excavated material is insufficient or unsuitable, fill is sourced from concentrated soil reserves and nearby quarries. In areas requiring free-draining material, including sections with shallow groundwater and weaker foundations, suitable draining material is imported from appropriate quarry sources. Geosynthetic reinforcement is incorporated where required to improve formation stability.

The total profile earthworks volume identified in the completed OVOS is approximately 12.31 million m^3, comprising approximately 5.13 million m^3 of embankment using ordinary soil, 3.25 million m^3 of embankment using free-draining soil, and 3.92 million m^3 of excavation. The railway formation is therefore predominantly constructed in embankment. Approximately 523,600 m^2 of geogrid and 468,030 m^2 of non-woven geotextile are also specified for sections requiring ground improvement.

Track construction requires approximately 295,872 m³ of crushed-stone ballast, 43,152 m³ of sand ballast, and a further 65,380 m³ of 5–25 mm crushed-stone ballast for station and other track works.

2.9 Manpower

Construction is delivered by Integra under the EPC arrangement, with approximately 10 subcontractors across four lots. The total construction workforce is Approximately 800 at the current stage, alongside ~350 units of heavy machinery, and varies over the program to December 2026, peaking during the concurrent embankment/formation, bridge and station seasons. The indicative composition by skill category and source is summarized in Table 21. Skilled and specialist roles — rail-laying, welding, piling, bridge and crane operations — are predominantly sourced from outside the corridor districts, reflecting limited local availability of these skills (see Section 7.5: agriculture-dominated economy, out-migration of working-age men, limited formal employment). Semi-skilled, unskilled, plant-support, security and ancillary roles offer the principal scope for local hire from the affected districts.

For comparison, the completed OVOS prepared for the working design assumes a total construction workforce of 1,211 personnel, comprising approximately 339 personnel for construction of the main railway alignment, 254 for Yerdaut Station, 169 for Intermediate Station, 218 for Maktaaral Station and 145 for bridge and associated watercourse/rail-interface works. This represents the design-stage workforce assumption used for the national environmental assessment; actual mobilization at the time of the Supplementary ESIA/ESCA investigations was approximately 800 personnel.

Table 21: Manpower Summary

Category	**Indicative share**	**Typical source**	**Notes**
Skilled / specialist (rail, welding, piling, bridge, crane, M&E)	40%	Predominantly non-local / national / foreign specialists	Limited local availability
Semi-skilled (plant operators, formwork, general construction)	30%	Mixed national + local	
Unskilled / ancillary (labour, security, camp & catering, traffic)	30%	Predominantly local (affected districts + Turkistan Oblast)	Principal local-hire opportunity
Total	~800 at peak		

The Project commits to maximizing local hire from the affected districts and Turkistan Oblast for roles where the required skills are available, and to recording and reporting the proportion of local hire, through the Labour Management Plan (CESMP-03) and the monthly / semi-annual EMR cycle. The socio-economic implications of the workforce — local employment and procurement benefit, and the influx-related community-interface and SEA/GBVH risks of a predominantly male, multi-subcontractor, partly non-local workforce housed across approximately 10 camps — are assessed in Section 8 (community health and safety; labour; GBVH) and managed through CESMP-03, the Worker Accommodation and Camp Management Plan (CESMP-09) and the GBVH and Gender Action Plan (CESMP-17).

2.10 Equipment

Approximately 360 units of heavy machinery are currently deployed across the Project across the four construction lots.

Table 22: Indicative Plant and Equipment Inventory — Construction Phase

#	Plant category	Typical use	Indicative units	Indicative engine power range (kW)	Indicative emissions tier (typical fleet)	Fuel
Earthworks and material handling						
1	Hydraulic excavators (30–50 t class)	Mass earthworks, embankment construction, cuttings, bridge and culvert foundation excavation	35–45	150–300	Stage III A / Tier 3	Diesel
2	Hydraulic excavators (8–25 t class)	Culvert foundations, drainage trenches, signalling cable trenches, OHL pole foundations, station works	30–40	50–150	Stage III A / Tier 3	Diesel
3	Tracked bulldozers (D8–D10 class)	Cut-and-fill spreading, embankment formation, formation grading	20–25	200–450	Stage III A / Tier 3	Diesel
4	Tracked bulldozers (D6–D7 class)	Topsoil stripping, site clearance, access road construction	15–20	100–200	Stage III A / Tier 3	Diesel
5	Wheel loaders (3.5–6 m^3 bucket)	Aggregate handling, material loading at borrow pits and laydown areas	20–25	150–300	Stage III A / Tier 3	Diesel
6	Articulated / rigid dump trucks (15–30 t payload)	Earthworks haulage, ballast haulage to railhead, borrow-pit transport	60–75	250–400	Stage III A / Tier 3	Diesel
7	Self-propelled vibratory rollers (15–25 t single-drum, smooth & padfoot)	Embankment and sub-grade compaction	18–22	100–180	Stage III A / Tier 3	Diesel
8	Pneumatic-tyred rollers	Capping layer and sub-ballast compaction	4–6	80–120	Stage III A / Tier 3	Diesel

#	Plant category	Typical use	Indicative units	Indicative engine power range (kW)	Indicative emissions tier (typical fleet)	Fuel
9	Motor graders	Formation finishing, capping layer, access road grading	8–10	130–220	Stage III A / Tier 3	Diesel
Bridge and structures plant						
10	Rotary bored piling rigs (large, crawler-mounted)	Syr Darya bridge piers, typical bridge foundations	2–4	250–500	Stage III A / Tier 3	Diesel
11	Driven piling rigs / hydraulic pile hammers	Smaller bridges, culvert sheet piling	2–3	100–300	Stage III A / Tier 3	Diesel
12	Vibratory sheet-pile drivers	Cofferdam installation at bridge piers	2–3	80–200	Stage III A / Tier 3	Diesel-hydraulic
13	Mobile cranes (25–80 t)	Precast culvert placement, bridge components, station structures, OHL pole erection, signal mast erection	12–15	150–350	Stage III A / Tier 3	Diesel
14	Crawler cranes (100–250 t)	Bridge deck erection (mainline bridges)	3–5	250–500	Stage III A / Tier 3	Diesel
15	Crawler cranes (250–600 t)	Syr Darya bridge span erection (twin-crane lifts)	1–2	500–800	Stage III A / Tier 3	Diesel
16	Telehandlers	Materials handling at stations, camps, bridge sites	8–10	50–100	Stage III A / Tier 3	Diesel
Concrete production and placement						
17	Concrete batching plants (mobile / semi-mobile, 30–120 m^3/h)	On-site concrete production at bridges, stations, batching plant compounds	4–6	n/a (plant-mounted; mains or generator power)	n/a	Electric / diesel generator
18	Truck mixers (6–10 m^3)	Concrete delivery from batching plant to point of placement	15–20	250–350	Stage III A / Tier 3	Diesel

#	Plant category	Typical use	Indicative units	Indicative engine power range (kW)	Indicative emissions tier (typical fleet)	Fuel
19	Concrete pumps (truck-mounted, 30–60 m boom)	Concrete placement at bridge piers, abutments, station foundations	4–6	200–350	Stage III A / Tier 3	Diesel
20	Drill rigs (rock drilling, where required)	Drilling for blasting in rock cuttings	0–4	80–200	Stage III A / Tier 3	Diesel
Permanent way and rail-mounted plant						
21	Track-laying gantries (rail-mounted)	Pre-assembled track panel placement	1–2	100–250	Stage III A	Diesel
22	Ballast hopper wagons (bottom-discharge)	Ballast delivery along newly laid track	20–30	n/a (locomotive-hauled)	n/a	n/a
23	Ballast regulators (self-propelled, rail-mounted)	Ballast distribution and profiling	1–2	150–300	Stage III A	Diesel
24	Tamping machines (self-propelled multi-sleeper, rail-mounted)	Track lifting, lining and tamping	1–2	200–400	Stage III A	Diesel
25	Dynamic track stabilisers (rail-mounted)	Track-bed consolidation post-tamping	1	150–300	Stage III A	Diesel
26	Mobile flash-butt welding machines (self-propelled, rail-mounted)	Continuous welded rail production	1–2	100–250	Stage III A	Diesel + electric weld head
27	Rail grinders (self-propelled or hand-held)	Rail surface dressing after welding	2–4	50–200 (self-propelled); manual (hand-held)	Stage III A	Diesel
Signalling, communications and OHL						

#	Plant category	Typical use	Indicative units	Indicative engine power range (kW)	Indicative emissions tier (typical fleet)	Fuel
28	Trenchers (chain or wheel)	Signalling cable, fibre-optic cable trench excavation	4–6	80–200	Stage III A	Diesel
29	Cable ploughs	Direct-burial cable installation	2–3	80–150	Stage III A	Diesel
30	Cable-blowing rigs	Fibre-optic installation through duct	2–3	30–60	n/a	Diesel-driven compressor
31	Auger rigs (truck or excavator-mounted)	OHL pole foundation drilling (600–1200 mm)	4–6	80–200	Stage III A	Diesel
32	Tensioner-puller machines	OHL conductor stringing	2–3	80–150	Stage III A	Diesel
Heavy haulage and station / camp logistics						
33	Multi-axle low-loaders (heavy-haulage tractors)	Transformer placement, large precast component movement	4–6	350–500	Stage III A	Diesel
34	Tipper trucks (general logistics)	Aggregate, sand, concrete reinforcement delivery	30–40	250–400	Stage III A	Diesel
35	Flatbed trucks	Reinforcement, prefabricated components	8–12	250–400	Stage III A	Diesel
36	Bulk fuel and water bowsers	Mobile refuelling, dust suppression, concrete curing water, camp water delivery	12–16	150–250	Stage III A	Diesel
Ancillary plant						
37	Mobile diesel generators (50–1,000 kVA range)	Camp power, work-front power, concrete batching plant, OHL energisation phase	30–40	40–800 (mech.)	Stage III A	Diesel
38	Air compressors (towable or	Pneumatic tools, sandblasting,	12–16	50–200	Stage III A	Diesel

#	Plant category	Typical use	Indicative units	Indicative engine power range (kW)	Indicative emissions tier (typical fleet)	Fuel
	fixed, 100–400 cfm)	concrete spraying, OHL tensioning				
39	Welding plant (engine-driven, portable)	Steel erection at bridges and stations, miscellaneous on-site welding	12–20	10–40	n/a	Diesel
40	Light vehicles (4x4 site vehicles, pickups, minibuses)	Personnel transport, supervision, materials handling	25–35	80–200	Euro IV / Euro V (typical regional fleet)	Diesel / petrol
41	Plant transport trucks (low-loaders for plant relocation)	Plant transfers between work fronts	4–6	350–500	Stage III A	Diesel
	Indicative total		~360 units			

The emissions tier shown in Table 22 reflects the EPC contract specification for new-purchase plant (Stage III A / Tier 3 equivalent or better) and the typical age profile of the regional contractor fleet active on the Project. The actual emissions tier of any given plant unit varies according to year of manufacture and emissions control fitment, and Stage I / II equipment remains in commercial use in Kazakhstan.

2.11 Access Roads

There is a need for construction access roads to be constructed and used on a temporary basis to provide access to work fronts that are otherwise inaccessible by the public road network, and to convey materials between the principal staging base at Yerdaut and the dispersed work fronts along the alignment. Temporary access roads are constructed using graders, compact rollers, and water bowsers, with compacted granular surfacing and stormwater drainage provision. Where temporary access roads cross watercourses, scour-protected temporary crossings or culverts are used and removed at program completion. A commitment to fully reinstate lands to their former use and condition forms part of the EPC contract; reinstatement comprises removal of surfacing material, scarification of the underlying ground, replacement of topsoil from conserved stockpiles, and re-vegetation.

2.12 Water Supply & Waste Water

Water demand for the Project is summarized below; further detail and source-by-source allocation is in the Construction Water Management Plan. See also Section 7 (Baseline Conditions) for the hydrological and water-stress baseline, and Section 8 (Impact Assessment and Mitigation and Management Measures) for the construction- and operational-phase water impact assessment.

Construction phase. The completed national EIA provides quantified construction water demand for the main railway construction works based on a workforce of 339 personnel and 298 working days. Total domestic and potable water demand for this work package is estimated at approximately 7,684

m^3 , including worker domestic and drinking-water requirements, showers, catering and medical facilities. This equates to an average of approximately 25.8 m^3 /day over the stated working period.

The national EIA additionally estimates approximately 8,419 m^3 of process water for concrete preparation and placement, equivalent to approximately 28.3 m^3/day over the same period. Combined construction water demand for the assessed work package is therefore approximately 16,103 m^3, or 54 m^3/day. These figures do not represent the total water demand across all Project construction activities, as additional water is required for activities including dust suppression, equipment washing and other construction uses. Actual abstraction and consumption across the remaining construction program will therefore be recorded and monitored through the Construction Water Management Plan.

The national EIA provides a more detailed design basis for station water demand. At Yerdaut, the maximum potable-water demand is approximately 48.1 m^3 /day and supply is designed to be provided from the existing potable-water network. Across the Project facilities, the OVOS estimates total operational water consumption at approximately 48,625 m^3 /year, with an equivalent design wastewater volume. Water supply arrangements differ by facility and include connection to existing networks and tanker-delivered water where network supply is unavailable.

Water sources comprise: (i) on-site groundwater wells equipped with electric submersible pumps where local conditions and abstraction permits allow; (ii) tanker-delivered supply from licensed off-take points operated by Kazsushar (the Syr Darya basin water organization) where local sources are inadequate; and (iii) municipal supply connection at stations where available and capacity permits. All abstraction is subject to permits issued by the Syr Darya basin authority. The Project is registered as a water user and reports abstraction volumes to the basin organization in accordance with the Water Code of Kazakhstan.

The Syr Darya basin is identified as chronically water-stressed under multiple national and international assessments. The Project's construction-phase consumption is small relative to the basin's irrigation abstractions but is concentrated in the peak cropping season (May–September); the Construction Water Management Plan therefore commits to (i) preference for tanker supply from licensed off-takes during the peak agricultural-irrigation period, (ii) minimization of leakage and re-use of cofferdam dewatering water where suitable, and (iii) coordination with Kazsushar on abstraction timing.

2.13 Construction Waste

The national EIA estimates total construction-phase waste generation at approximately 84,613 tons. The principal waste streams comprise mixed municipal waste, welding waste, contaminated absorbents/filter materials and protective clothing, paint and solvent containers/residues, and mixed construction and demolition waste.

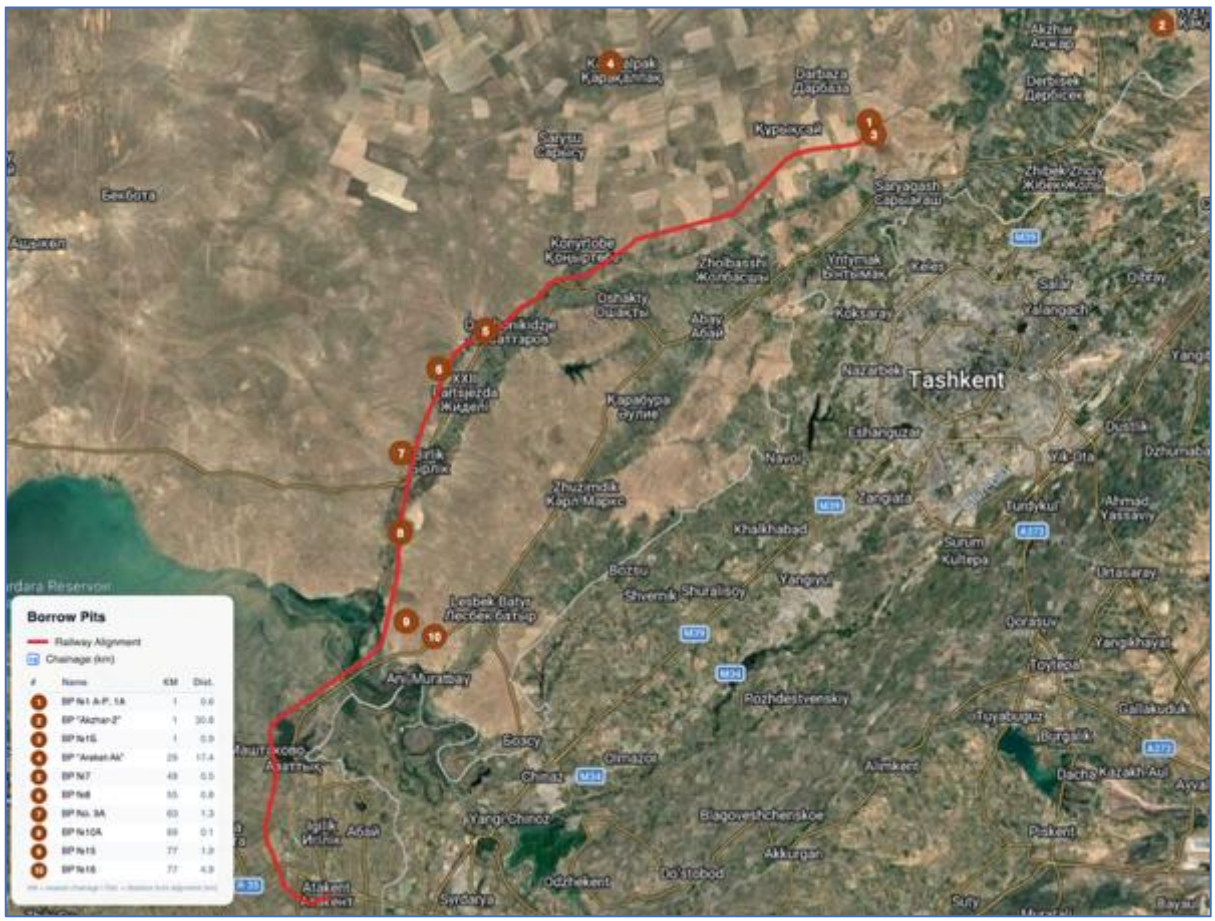
Construction and demolition waste accounts for approximately 84,509 tons of this total and comprises principally residual concrete, soil, sand, crushed stone and other construction materials arising from construction and dismantling works. The OVOS requires these materials to be collected and temporarily stored before transfer to authorized waste-management organizations.

2.14 Borrow Pits

The working design prioritizes reuse of suitable excavated soil within the Project earthworks. Where the earthworks balance cannot be achieved through reuse, ordinary fill is obtained from concentrated soil reserves and nearby quarries. Free-draining material required for sections with shallow groundwater or weaker ground conditions is supplied from quarries providing material of the required engineering specification.

The Project's net fill requirement of approximately 4.5 million m³ (see Section 2.8) is met by extraction from borrow pits along and adjacent to the alignment. As at the date of this Supplementary ESIA, three borrow pit permits have been issued for the Project, with one additional permit pending approval. All borrow pits used by the Project will be covered by valid permits prior to material extraction, with permit conditions and rehabilitation obligations communicated to the EPC contractor and subcontractors and tracked through site inspections. Borrow pit operations are subject to dust suppression, sediment control, slope stability and access control requirements, and progressive rehabilitation of completed pits is undertaken in accordance with the permit conditions, with restoration to either agreed beneficial after-use or to a near-natural state appropriate to the local landscape.

Figure 14: Location of Borrow Pits



Source: Intergra, 2026

2.15 Batching Plant

Concrete for the Project is produced at multiple on-site batching plants established by Integra and its subcontractors at strategic locations along the alignment, at the major bridge and station work fronts where concrete demand is concentrated.

2.16 Project Operations

2.16.1 Operational Parameters

Hours of operation. The Project line is designed for 24-hour operation, throughout the year. There are no planned daytime-only operating windows or seasonal restrictions on freight movement. Routine maintenance is undertaken in scheduled possessions arranged between train movements and is typically programmed during night-hours of lower traffic density (see Section 2.16.2).

Traction. All trains operating on the Project line are hauled by diesel locomotives; the line is non-electrified and no overhead contact line is provided. Locomotives are drawn from KTZ's existing diesel fleet, with locomotive servicing, fueling, sand supply, and crew turnover at Yerdaut Station (which functions as the principal operational depot for the new line — see Section 2.5.5 and Section 2.16.2).

The working design further indicates that KTZ diesel locomotives will operate between Yerdaut, the intermediate passing loops and Maktaaral. For the Maktaaral – Uzbekistan state-border interface, Uzbekistan railway locomotives are intended to be used, with technical and commercial transfer of trains undertaken at Maktaaral Station.

Locomotive types. The locomotive types operating on the Project line are:

- 2TE33A — paired-unit "Evolution"-series diesel-electric mainline freight locomotive, manufactured at the Electric Locomotive Construction Plant (EKZ) in Astana, Kazakhstan, under a technology license agreement with General Electric Transportation. Operating in paired-unit configuration (two coupled sections), the 2TE33A is the principal mainline freight locomotive on the Project line, deployed across the Yerdaut–Maktaaral section and the Maktaaral–state border section. The single-unit TE33A has a calculated traction force of 44,500 kgf and locomotive mass of 138 tonnes.
- ТЭМ2 (TEM2) — single-unit diesel shunting locomotive, used for short-haul, yard movements, and trip working in the Maktaaral–state border area and at Yerdaut yard.

Train operations. The Project is designed for approximately 46 train movements per day at full operation, comprising 23 train pairs, of which 22 train pairs are freight and 1 train pair is passenger. Traffic is distributed approximately evenly across the 24-hour cycle, giving an average single-direction train every approximately 31 minutes and an average movement (in either direction) every approximately 15 minutes. Train movements in the loaded direction (towards Uzbekistan) are dominated by export freight including coal, chemicals, mineral-chemical fertilizers, and container traffic formed at Arys station and reformed at Yerdaut to fit the Project line useful length of 1,050 m. Movements in the reverse direction are dominated by empty wagons returning from the same commodity streams.

Train weight and length. The line is designed for freight trains with:

- Train weight norm: 5,890 tons in both loaded and reverse directions, limited by the useful length of receiving-departure tracks rather than by locomotive traction (which permits substantially heavier trains with the 2TE33A paired unit).
- Train length: up to 72 conditional wagons (formed at Yerdaut), fitting within the 1,050 m useful length of receiving-departure tracks at stations and passing loops, with a 50 m operational reserve.

Maximum design grade (ruling grade): 7.5 ‰ in both directions.

Dwell times at passing loops. Trains stop at passing loops (PL2, PL5) for crossing movements with oncoming traffic. The expected dwell time is approximately 34 minutes typical, with a maximum of approximately 40 minutes depending on traffic management arrangements. These dwell times provide the design input for the operational-phase noise, vibration, idling-emissions, and locomotive standing-emissions assessment at the passing loops.

Operational Waste. The completed OVOS estimates total operational waste generation across the stations and passing loops at approximately 587 t/year, comprising principally municipal waste, maintenance-related metal and welding wastes, contaminated absorbents and, at Maktaaral and Yerdaut, wastes associated with wastewater treatment and operational servicing activities. The OVOS gives operational waste totals by facility:

- Yerdaut: 234.59 t/year

- Passing Loop 2: 61.28 t/year
- Intermediate Station: 78.97 t/year
- Passing Loop 5: 63.02 t/year
- Maktaaral: 148.82 t/year.

Hazardous cargo. The Project line is designed to carry, and is intended to serve as the primary regional corridor for, freight categorized as dangerous goods under the Republic of Kazakhstan railway transport regulations and the international RID/COTIF framework. This is a fundamental distinguishing feature of the Project from comparable projects such as the Almaty Bypass, which expressly excludes the carriage of hazardous cargo.

Based on the freight pattern of the existing Saryagash–Tashkent corridor that the Project relieves, the anticipated dangerous-goods cargoes on the new line comprise: UN Class 2 (compressed and liquefied gases — primarily LPG and industrial gases); UN Class 3 (flammable liquids — primarily refined petroleum products); UN Class 5.1 (oxidizing substances — including mineral chemical fertilizers such as ammonium nitrate, which is subject to additional handling restrictions under both national regulation and the international AN-3 / RID Special Provision 645 regime); UN Class 6 (toxic substances — limited volume); UN Class 8 (corrosives — primarily acids and alkalis associated with industrial supply chains); and UN Class 9 (miscellaneous dangerous substances). The Project does not anticipate the carriage of UN Class 1 (explosives), UN Class 7 (radioactive — except for the cross-border radiation portal screening at Maktaaral, which detects rather than handles such material) or live carriage of UN Class 4.1/4.2/4.3 (flammable solids and water-reactive substances) in significant volume.

At full operation (approximately 22 freight train-pairs per day), dangerous-goods wagons are expected to constitute approximately 5 % of total wagons in service on the line.

Operational controls for the carriage of dangerous goods on the Project line are set out in Section 8 (Impact Assessment — Operational phase), in the Operational Pollution Emergency Response Plan, and in Annex A-3 of the ESMP. The customs, biosecurity, radiation and disinfection facilities at Maktaaral are described in Section 2.5.5.

The Maktaaral track layout includes a dedicated dangerous-goods siding (Track 111), a defective-wagon siding (Track 126), and catch sidings (Tracks 9 and 15). These facilities are provided specifically to manage operational risks associated with dangerous goods and defective rolling stock, allowing trains or wagons to be segregated and controlled. Together with KTZ's operational controls for the carriage and handling of dangerous goods, these facilities form part of the Project's overall hazardous-cargo risk-management measures.

Operational signalling and control. Train movements are controlled by Microprocessor Automatic Block-signaling under dispatcher-centralization oversight. Train speed limits, signal aspects, and routing at stations and passing loops are controlled by the MC-based station infrastructure.

2.16.2 Maintenance

For the safe and effective operation of the railway, ongoing inspection, monitoring and maintenance is required across the alignment, structures, permanent way, signaling and communications, and station infrastructure. Maintenance is delivered through KTZ's network-wide infrastructure organization (Directorate of Infrastructure), with specialist activities procured from third-party contractors as required. Maintenance operations are conducted 24 hours per day to support the continuous operation of the line.

Yerdaut — principal operational depot. Yerdaut station functions as the main operational depot for the Project line, with a comprehensive suite of locomotive and wagon servicing facilities provided under the TEO design:

- **Locomotive operational depot** — the headquarters for locomotive operations on the Project line.
- **Locomotive servicing point** on open tracks, comprising:
    - **Inspection pit on 2 open tracks** for daily locomotive inspection and routine maintenance
    - **Dry sand store** for locomotive sand supply
    - **Sand supply and air supply pipelines**
    - **Sand distribution devices** on open tracks
    - **Compressor station** providing compressed air to the servicing point
    - **Fuel storage, 1,000 m³ capacity**, for diesel locomotive refueling
- **Wagon Technical Inspection point** with adjacent Current Detached Repair (TOR) facility, established at Yerdaut because all trains undergo locomotive change at Yerdaut (electric to diesel) and full technical inspection is required at the change-of-traction point.
- **Brake test air supply pipelines** with compressor.
- **Safety islands** — 2 kits at Yerdaut for personnel protection during inspection of standing trains.
- **Locomotive crew quarters** integrated within the station precinct.

Maktaaral — cross-border inspection point. Maktaaral station functions as the cross-border inspection and reception point for trains crossing to and from Uzbek Railways, with:

- **Control Point** for receiving and transferring trains to/from another railway (the Uzbek railway network).
- **Brake test air supply pipelines** with compressor.
- **Safety islands** — 6 kits at Maktaaral, reflecting the more intensive inspection workload at the border interface.
- **Locomotive crew rest house** providing accommodation for crews on layover.

Passing loops and Intermediate station. Each passing loop and intermediate station is equipped with:

- **Control Point (KP)** for routine wagon inspection.
- **КТСМ-03** automatic rolling-stock condition monitoring posts from both directions of approach (2 kits per passing loop and intermediate station; 1 kit each at Yerdaut and Maktaaral).
- **Safety islands** — 4 kits at PL2, Intermediate and PL5.

КТСМ-03 monitoring deployment. The 13 КТСМ-03 monitoring kits (8 within the Stage 1 Project line; 5 at Kalash and adjacent locations on the existing network in conjunction with the Project) provide continuous automated monitoring of axle box overheating, drag detection, hot-wheel detection, and dynamic-load monitoring. Detection of out-of-tolerance condition triggers an alarm in the dispatcher-centralization system and at the next-ahead station, where the affected train is stopped for inspection.

Routine inspection and maintenance. Routine inspection and maintenance comprises track inspection (visual, geometry, ultrasonic) at intervals consistent with KTZ network standards; ballast tamping, lifting and lining; periodic re-ballasting and rail replacement; vegetation control within the RoW (with particular attention to fire-risk management in the steppe corridor during summer months); turnout inspection and maintenance; level-crossing inspection and maintenance; signaling and communications equipment maintenance; routine inspection of bridges and culverts in accordance

with the SP RK structural inspection cycle, including underwater inspection of the in-channel piers and channel-protection works at the Syr Darya bridge; and drainage culvert and channel clearance, particularly after the spring snowmelt period and high-flow events on the Syr Darya / Shardara Reservoir system.

Heavy maintenance and renewals are programmed in periodic cycles and are typically undertaken at night during scheduled possessions, in accordance with KTZ network practice. Night maintenance is identified as a potential operational-phase noise source for sensitive receptors along the alignment and is addressed in the operational-phase noise management plan.

Dispatcher centralization and remote monitoring. Operational dispatching and remote monitoring of train movements, infrastructure status, and rolling-stock condition is provided through KTZ's dispatcher-centralization system.

Operational staffing. Operational staffing for the Project at full operation comprises personnel across the following functions: locomotive crew (drivers and assistants), locomotive servicing point at Yerdaut, locomotive crew rest house at Maktaaral, wagon technical inspection (PTO/TOR at Yerdaut, KP at Maktaaral and passing loops), signalling and communications maintenance, station operations, track maintenance distance staff, signaling distance staff, and security.

The completed OVOS identifies an overall KTZ operational staffing complement of approximately 166 personnel across the Project facilities, including approximately 69 personnel at Yerdaut and 73 at Maktaaral, with smaller staffing complements at Intermediate station and the passing loops. In addition, Maktaaral is designed to accommodate approximately 172 personnel associated with border-control functions, comprising border, customs, veterinary-sanitary, phytosanitary and sanitary-epidemiological services.

2.17 Organizational Responsibilities

The parties responsible for the Project are set out below across three categories — (1) Developer / Operations and Maintenance, (2) Construction, and (3) Project Approvals.

(1) Developer / Operations and Maintenance:

- Kazakhstan Temir Zholy JSC (KTZ) — developer of the Project and future operator. State-owned national rail operator. KTZ Project Manager: Nurlan Nurabaev. (Source: ESCA; Inception Report Annex C.)
- Kazakhstan Temir Zholy Finance B.V. — contracting entity for this Supplementary ESIA and the LARP, acting on behalf of KTZ. (Source: Inception Report Section 1.)

(2) Construction:

- Integra Construction KZ LLP ("Integra") — appointed Engineering, Procurement and Construction (EPC) contractor for the Project. Integra Chief Engineer: Darkhan Alzhanov. Integra Environmental and Health and Safety Specialist: Gulzat Kusainova. (Source: Inception Report Annex C; ESCA Section 1.)
- Multiple subcontractors operating concurrently across dispersed work fronts, responsible for earthworks and linear construction works under Integra. (Source: ESCA Section 1; Inception Report.)
- Chief Design Engineer: Zhanserkeyev Askar. (Source: Inception Report Annex C.)

(3) Project Approvals:

- Committee for Environmental Regulation and Control (CERC), Ministry of Ecology and Natural Resources of the Republic of Kazakhstan — environmental approvals and permits.
- Akimat of Turkistan Region — overall coordination of the land acquisition process (Decrees No. 127 of 24 June 2024; No. 209 of 10 October 2024; No. 147 of 30 June 2025). (Source: ESCA Annex A.)

- District Akimat — Saryagash District — local execution of land acquisition (Decrees No. 134, 323, 324, 214, 349).
- District Akimat — Keles District (Decrees No. 79, 215, 226, 92).
- District Akimat — Shardara District (Decree No. 229).
- District Akimat — Zhetysay District (Decree No. 625).
- District Akimat — Maktaaral District (Decrees No. 597, 593).
- RSE GOS Expertiza — state non-departmental examination of projects, responsible for State Ecological Expertise of the OVOS submission.

3. Policy, Legal and Administrative Framework

3.1 General

This chapter sets out the policy, legal, and administrative framework applicable to the Project. It describes the national environmental, social, and land-related legislation of the Republic of Kazakhstan, the institutional architecture for environmental and social management, the national environmental impact assessment (OVOS) process, applicable environmental and social standards, sanitary protection zone and electromagnetic-field requirements relevant to the railway and its electrification infrastructure, tree-cutting requirements, project permits and licenses, and international conventions to which Kazakhstan is a party. It then sets out the Lender frameworks applied to the assignment — the ADB Safeguard Policy Statement (SPS, 2009), the IFC Performance Standards (PS) on Environmental and Social Sustainability (2012), and the AIIB Environmental and Social Framework (ESF, 2024) — together with the World Bank Group (WBG) Environmental, Health and Safety (EHS) Guidelines (general and sector-specific, including the EHS Guidelines for Railways) applied as good international industry practice. A gap analysis between the national and Lender requirements is provided in Section 3.14 to identify a harmonized compliance framework for the Project.

3.2 National Environmental Legislation

Kazakhstan has a developed legal framework for environmental protection, natural resource management, public health, and labour, anchored in the 1995 Constitution (Article 31, right to a favorable environment) and operationalized through codified laws and a wide body of subordinate regulation. The framework was substantially modernized by the adoption of the Environmental Code of 2021, which entered into force on 1 July 2021 and replaced the 2007 Code. The 2021 Environmental Code aligns Kazakhstan's system more closely with EU and international good practice and introduced a four-tier project categorization system (Categories I–IV), the Comprehensive Environmental Impact Permit, the principle of best available techniques (BAT) and strengthened provisions on public participation and access to environmental information.

The principal items of national environmental legislation relevant to the Project are set out in Table 23. Social, labour, and gender-related legislation of particular relevance is set out in Table 24.

Table 23: Key National Environmental Legislation Relevant to the Project

Year	Law / Regulation	Status	Summary / Relevance
1995	Constitution of the Republic of Kazakhstan	Amended 2022	Establishes the right of every citizen to a favorable environment (Art. 31) and the State's duty to protect the environment, manage natural resources sustainably, and ensure ecological well-being. Provides the constitutional basis for all subordinate environmental legislation.
02.01.2021	Environmental Code of the Republic of Kazakhstan (Code No. 400-VI ZRK)	In force since 1 July 2021; periodic amendments	Principal framework law for environmental protection in Kazakhstan, replacing the 2007 Code. Establishes the OVOS/EIA system, project categorization (Categories I–IV), State Ecological Expertise, Environmental Impact Permits, ambient quality standards, environmental monitoring (production environmental control – ПЭК), waste management, polluter-pays principle, and access to environmental information. Central instrument for the Project.

Year	Law / Regulation	Status	Summary / Relevance
20.06.2003	Land Code of the Republic of Kazakhstan	Amended periodically	Governs land ownership, allocation, lease, withdrawal, categories of land use, and compensation. Sets procedures for land acquisition for state needs (Articles 84–87), responsibilities of Akimats at oblast and district levels, valuation, and dispute resolution. Primary framework for land acquisition for the Project.
09.07.2003	Water Code of the Republic of Kazakhstan	Amended periodically	Regulates water use, protection of water bodies, water-use permits, in-river works, and water-protection zones. Of particular relevance for the Syr Darya River bridge crossing and works near other surface water bodies along the alignment.
08.07.2003	Forest Code of the Republic of Kazakhstan	Amended periodically	Regulates the protection, use, and reproduction of forests, including procedures for the cutting of trees and shrubs and compensation for forest resource losses. Applies where the alignment, access roads, borrow pits, or laydown areas affect forested land or trees outside the State Forest Fund.
23.11.2015	Labour Code of the Republic of Kazakhstan	Amended periodically	Comprehensive regulation of labour relations, employment contracts, working time, wages, occupational health and safety obligations of employers, and worker rights. Applies to all workers engaged in the Project, whether directly by KTZ or through Integra and subcontractors.
07.07.2020	Code on Public Health and Healthcare System	Amended periodically	Establishes the framework for sanitary and epidemiological well-being of the population, including sanitary-protection zones (SPZ), drinking-water and food-safety standards, occupational hygiene, and worker accommodation standards. Implemented through the system of Sanitary Rules (SanPiN) and the State Sanitary-Epidemiological Service.
27.12.2017	Code on Subsoil and Subsoil Use	Amended periodically	Governs the use of subsoil resources, including extraction of common mineral resources for construction (sand, gravel, stone) used in borrow pits and quarries. Sets requirements for permits, rehabilitation, and reporting.
07.07.2006	Law on Specially Protected Natural Areas (No. 175-III)	Amended periodically	Defines categories of protected areas (state nature reserves, national parks, sanctuaries), permitted/prohibited activities, buffer zones, and management responsibilities. Relevant for screening of the alignment and associated facilities against protected areas and Key Biodiversity Areas, including the Shardara Reservoir.
09.07.2004	Law on Protection, Reproduction and	Amended periodically	Regulates conservation, protection, and sustainable use of fauna, including rare and endangered species listed in the Red Book of Kazakhstan, hunting and fishing, and habitat management. Relevant for biodiversity baseline and impact

Year	Law / Regulation	Status	Summary / Relevance
	Use of Animal World		assessment along the alignment and at the Syr Darya crossing.
02.07.1992	Law on Protection and Use of Objects of Historical and Cultural Heritage (No. 1488-XII)	Replaced /superseded by 2019 Law (see below); historical reference	Historical framework law on cultural heritage protection (referenced in older project documentation).
26.12.2019	Law on Protection and Use of Objects of Historical and Cultural Heritage (No. 288-VI)	Amended periodically	Current framework for identification, registration, protection, and use of historical and cultural heritage. Defines categories of heritage objects (including "emergency monuments"), permitting procedures for archaeological surveys, chance-find obligations, and offences. Relevant for the cultural heritage receptors identified along the alignment.
11.04.2014	Law on Civil Protection (No. 188-V)	Amended periodically	Sets requirements for civil protection, emergency preparedness and response, fire safety, and management of hazardous production facilities. Relevant for emergency response arrangements at construction sites, worker camps, and during transportation of hazardous materials.
02.04.2010	Law on Roads	Amended periodically	Regulates the design, construction, operation, and protection of public roads, including approval of crossings, traffic management, and transport of oversized loads relevant to construction logistics.
19.05.2015	Law on Civil Code	Various	Civil Code of the Republic of Kazakhstan (general and special parts) sets out property rights, contractual obligations, valuation, and compensation principles applicable to land acquisition and resettlement.

Table 24: Key Social, Labour and Gender Legislation Relevant to the Project

Year	Law / Regulation	Status	Summary / Relevance
04.12.2009	Law on Prevention of Domestic Violence	Amended 2020 and subsequently	Defines legal protections against domestic and gender-based violence, victim support, and obligations of state authorities and employers. Relevant in the context of worker accommodation, community interfaces, and labour management.
08.12.2009	Law on State Guarantees of Equal Rights and Equal Opportunities of Men and Women	Amended periodically	Establishes principles of gender equality and non-discrimination in employment, education, and access to services. Of particular relevance for labour and working conditions, recruitment practices, and stakeholder engagement.

Year	Law / Regulation	Status	Summary / Relevance
23.04.2014	Law on Internal Affairs Bodies	Amended periodically	Sets out the role of internal affairs bodies in maintaining public order and safety, including in relation to large infrastructure projects and worker accommodation.
13.06.2005	Law on Migration of Population	Amended periodically	Regulates internal and external migration, including registration requirements for non-resident workers, relevant where construction workers are mobilised from outside the project area.
02.07.1998	Law on Combating Corruption (replaced by 2015 Law)	See 2015 Law	Historical reference.
18.11.2015	Law on Combating Corruption (No. 410-V)	Amended periodically	Establishes anti-corruption framework applicable to public officials, contractors, and procurement processes. Relevant for project implementation, contractor management, and governance arrangements.

Subordinate regulation of particular relevance falls into three groups:

1. Government Resolutions and orders of the Minister of Ecology and Natural Resources implementing the Environmental Code — covering OVOS, State Ecological Expertise, public hearings, and the Production Environmental Control programme;
2. Hygiene Norms (SanPiN) issued by the Minister of Health, setting ambient and workplace standards; and
3. orders of other relevant ministries on waste classification, hazardous-waste management, and emergency preparedness.

Where this Supplementary ESIA references a specific subordinate act, the relevant act and version are cited at the point of use.

3.3 Administrative Framework

Environmental and social management in the Republic of Kazakhstan is administered through a coordinated system of national, oblast (regional), and rayon (district) authorities. The institutional architecture has been modernized in successive reforms, most recently consolidating environmental and natural-resource functions under the Ministry of Ecology and Natural Resources (MENR). The institutions of most direct relevance to the Project are described below, with their specific role in the Project's authorization, oversight, and operational compliance identified for each.

Government of the Republic of Kazakhstan. The Government, through the Cabinet of Ministers, exercises executive authority in line with the Constitution. Its functions include the issuance of resolutions implementing the Environmental Code, the Land Code, and the Water Code; coordination of inter-ministerial policy on infrastructure development; and adoption of national programmes such as the Strategy for Achieving Carbon Neutrality 2060 and the Concept on the Transition to a Green Economy. *Relevance to the Project:* The Government's resolutions implementing the Environmental Code (notably on OVOS procedure, public hearings, SEE, and emissions standards) provide the subordinate-legislation framework against which the Project's permitting is assessed.

Ministry of Ecology and Natural Resources (MENR). MENR is the principal authority responsible for the formulation and implementation of national environmental policy, environmental protection, regulation of the use and protection of natural resources, climate policy, and supervision of the State Ecological Expertise (SEE) process. Core mandates include policy and regulation under the Environmental Code (2021); administration of the OVOS / EIA system, including categorization, public hearings, and SEE approval; issuance of Comprehensive Environmental Impact Permits for Category I and II activities; coordination of climate policy, GHG inventories, the national emissions trading scheme, and adaptation planning; management of specially protected natural areas and the Red Book of Kazakhstan; and oversight of subordinate territorial departments and inspectorates.

Relevance to the Project: MENR is the lead national authority for the Project. The applicable national environmental assessment and approval requirements, including the requirement for State Ecological Expertise, are described in Section 3.4. The status and adequacy of environmental approvals for construction undertaken to date are assessed separately through the ESCA. MENR (and its territorial inspectorate in Turkistan Oblast) is the principal regulator for ambient-air, surface-water, and waste-related permits and for emissions limit-setting (NDV) at operational facilities, including the Yerdaut locomotive depot. MENR's Forestry and Wildlife Committee (administered jointly with the Ministry of Agriculture) is the permitting authority for any clearance affecting the State Forest Fund or Red Book species, of particular relevance to the Shardara Reservoir KBA and the Syr Darya bridge approach.

State Ecological Expertise (SEE). The applicable SEE and environmental permitting requirements for the Project are determined by the national categorization and the completed working-design OVOS. The current status of the Project's national environmental approvals and any outstanding permitting requirements are addressed in Section 3.8 and verified through the parallel ESCA.

Akimats (Local Executive Authorities). The Akimats of Turkistan Oblast and the affected districts are the principal authorities for land allocation, withdrawal of land for state needs, valuation of affected assets through licensed valuators, payment of compensation, issuance of construction permits, and authorization of tree and shrub cutting outside the State Forest Fund.

Relevance to the Project: The Akimats of the five affected districts — Saryagash, Keles, Zhetysay, and Maktaaral — are the issuing authorities for the Akimat decrees that effect the involuntary land acquisition for the Project (Decrees 127, 209, 147 of Turkistan Oblast; with district-level decrees including Saryagash 134/323/324/214/349; Keles 79/215/226/92; Shardara 229; Zhetysay 625; Maktaaral 597/593 — per Section 2.9). The Akimats are accordingly the principal counterparties for the LARP workstream, the entry point for project-affected persons to the public administration, and the issuing authorities for construction permits and tree-felling authorizations along the alignment. They are also key stakeholders for the Stakeholder Engagement Plan and the public consultation process required under both the OVOS process and the Lenders' frameworks.

Ministry of Health and the State Sanitary-Epidemiological Service (SES). The SES, operating under the Ministry of Health, is responsible for sanitary and epidemiological well-being. SES approval is required for drinking-water supply systems for construction camps; wastewater handling and disposal; sanitary and hygiene conditions of worker accommodation and food services; control of communicable diseases and occupational hygiene; and confirmation of compliance with sanitary protection zone requirements for industrial and transport facilities, including railways.

Relevance to the Project: The SES is the permitting authority for the Project's Sanitary Protection Zone determination (see Section 2.5.2) and for sanitary clearance of construction camps, worker accommodation, on-site food preparation, and potable-water supply. SES will also be involved in the public-health response to any Project-related communicable-disease incident across the multi-subcontractor workforce. SES territorial offices in Turkistan Oblast are the day-to-day regulator at site level.

Ministry of Industry and Construction. Responsible for construction policy, technical regulation, and approvals of design documentation through State Expertise (Gosexpertiza), which examines engineering, environmental, and other sections of project design before construction may proceed.

Relevance to the Project: State Expertise approval is a parallel pre-condition to construction alongside SEE. The Project's Stage II and Stage III design documentation passes through Gosexpertiza review; the design and design changes implemented during construction (e.g., the ongoing Maktaaral Station design refinements noted in Section 2.5.5) must be cleared through this body.

Ministry of Emergency Situations. Responsible for civil protection, emergency preparedness and response, fire safety, and oversight of hazardous production facilities, including transportation of hazardous materials.

Relevance to the Project: The Project's Emergency Response Plan must be consistent with national civil-protection and fire-safety requirements administered by this Ministry. The Ministry is the principal counterparty for incident response involving the Syr Darya bridge and the Yerdaut fuel-storage installation (1,000 m^3 diesel storage per section 2.5.5), and for any transportation incident involving hazardous cargo on the operational line. Fire-safety design at stations, depots, and construction camps is reviewed by this Ministry through its regional offices.

Ministry of Labour and Social Protection of the Population. Responsible for labour relations, employment, occupational health and safety regulation, and the State Labour Inspectorate.

Relevance to the Project: The State Labour Inspectorate is the principal regulator for OHS compliance across the construction workforce — direct, contracted, and subcontracted — and the operational workforce at full operation (approximately 166 staff per section 2.8). The Inspectorate has powers of inspection and enforcement and is a key counterparty for the Project's labour and working conditions arrangements under IFC PS2 / ADB SR1 / AIIB ESS 1. The Ministry is also the implementing authority for any social protection programmes accessed by affected workers (e.g., Targeted Social Assistance, mandatory health insurance contributions).

Ministry of Agriculture (Forestry and Wildlife Committee). Responsible for agricultural policy, agricultural land use, irrigation policy, and — through the Forestry and Wildlife Committee — protection and use of forests, fauna, and the State Forest Fund.

Relevance to the Project: Of direct relevance given the alignment crosses extensive irrigated agricultural land in the southern districts (Zhetysay and Maktaaral cotton-producing zone) and traverses areas of value to wildlife including the Shardara Reservoir KBA. The Committee is the permitting authority for any clearance affecting the State Forest Fund and for activities affecting protected species; it is a co-regulator with MENR on biodiversity matters. Agricultural-land-use considerations are addressed through the Ministry's regional offices in Turkistan Oblast.

Ministry of Water Resources and Irrigation. Responsible for water-resources policy, regulation of water abstraction and discharges, and water-use permitting under the Water Code.

Relevance to the Project: The Ministry is the permitting authority for water abstraction (for construction camps, batching plants, dust suppression — see section2.7.9), surface-water discharges, and works affecting watercourses. The Syr Darya bridge crossing and in-river works at KM 83.5 require Ministry approval; the Project's interface with the Shardara Reservoir and Syr Darya hydrological regime is governed by this Ministry. The basin water organization (BWO) for the Syr Darya is the territorial body of most direct relevance.

Authorized Cultural Heritage Body. The authorized body for cultural heritage protection (currently the Ministry of Culture and Information through the relevant Committee) is responsible for registration of heritage objects, authorization of archaeological surveys, and oversight of chance-find procedures during earthworks.

Relevance to the Project: The alignment crosses the historically significant Syr Darya valley and Mirzachoel irrigated zone, where buried archaeological and ethnographic heritage are reasonably likely. The Committee is the permitting authority for any archaeological investigation along the alignment and the authority overseeing the chance-find procedures embedded in the construction-phase ESMP. Sites along the alignment classified as "emergency monuments" under national heritage legislation are subject to specific Committee oversight.

Kazhydromet. The National Hydrometeorological Service (RSE Kazhydromet) provides meteorological, climatological, and ambient-air-quality monitoring data.

Relevance to the Project: Kazhydromet station data and modelled outputs underpin the climate baseline, air-quality baseline, and natural-hazards assessment for the Project (Chapter 7). Kazhydromet operates the regional monitoring network in Turkistan Oblast, including the stations referenced in Section 7.3 of this Supplementary ESIA.

Cadastral Authorities. The State Corporation "Government for Citizens" (NAO) and the Land Cadastre Service maintain the Unified State Real Estate Cadastre, including land plot identifiers, ownership and use records, and cadastral maps.

Relevance to the Project: The cadastral records are the source of plot-level data for the 374 plots affected by the Project across four districts. Cadastral mapping and ownership records underpin the LARP workstream, the affected-household identification, and the legal effecting of land acquisition under the Akimat decree process.

Project Proponent — KTZ JSC and KTZ Finance B.V. As the Project Proponent, KTZ JSC is responsible for compliance with all applicable national requirements, including securing approvals through SEE and State Expertise, obtaining environmental, water, sanitary, and construction permits, and overseeing implementation by its EPC contractor (Integra Construction KZ LLP) and subcontractors. KTZ Finance B.V. acts as the contracting and financing entity for the Lenders' due diligence.

Relevance to the Project: KTZ holds operational accountability for the Project to MENR, the SES, the Akimats, and all other relevant authorities, and is the Lenders' counterparty for E&S performance. The Project's E&S Management System (ESMS), construction-phase ESMP, operational-phase ESMP, and Corrective Action Plan are issued and implemented under KTZ's authority.

3.4 National Environmental Impact Assessment (OVOS) Legislation

Kazakhstan’s environmental impact assessment system is implemented through the Environmental Code (2021) and is referred to as the OVOS procedure. OVOS is a mandatory pre-condition for project implementation; no project subject to OVOS may proceed to construction without a positive State Ecological Expertise (SEE) conclusion and an Environmental Impact Permit, where applicable.

The Environmental Code categorises projects according to the significance of their potential environmental impacts:

- **Category I** (high environmental impact) – large-scale infrastructure and industrial activities subject to a full OVOS, public hearings, and a Comprehensive Environmental Impact Permit. Category I projects must apply best available techniques (BAT).
- **Category II** (medium environmental impact) – simplified OVOS and a Comprehensive Environmental Impact Permit.
- **Category III** (low environmental impact) – declarative environmental impact reporting.
- **Category IV** (negligible impact) – no OVOS or permit requirement.

The completed national Report on Possible Impacts (OVOS), prepared for the Project working design in accordance with the Environmental Code of the Republic of Kazakhstan, classifies the Project during operation as a Category II facility under paragraph 5.4, Section 2 of Annex 2 to the Environmental

Code, applicable to railway transport infrastructure. The national environmental categorization is separate from the environmental and social risk categorizations applied by ADB, IFC and AIIB for financing purposes.

The OVOS process is implemented in staged form, comprising the following key steps:

- **Stage I – Screening and categorisation.** Determines whether an activity is subject to OVOS, assigns the project to a category (e.g. Category I), and confirms the requirement to prepare subsequent OVOS documentation. This stage is procedural and does not involve impact assessment or permitting decisions.
- **Stage II – Report on Possible (Potential) Impacts.** Prepared at the feasibility stage, providing a high-level identification of potential environmental and social impacts and sensitive receptors, preliminary mitigation assumptions, and the scope and content of the subsequent design-stage assessment.
- **Stage III – Design-stage environmental assessment and permit-enabling documentation.** Prepared once project design has been sufficiently developed, including detailed baseline studies, refined impact assessment, emissions limit-setting (NDV), waste management planning, a Production Environmental Control (ПЭК) programme, and a technical measures plan, and forming the basis for SEE review and issuance of the Environmental Impact Permit.

A detailed Report on Possible Impacts (OVOS) was prepared in 2025 for the working design under the Environmental Code. The OVOS uses the developed Project design as the basis for assessment and includes detailed calculation and assessment of emissions, water use and wastewater, waste generation, physical impacts and environmental protection measures. Relevant findings and design information from the completed OVOS have therefore been incorporated into this Supplementary ESIA where they supersede or supplement the earlier feasibility-stage information. The status of the corresponding national environmental approvals and permits is addressed in Section 3.8 and verified in detail through the parallel ESCA.

The national OVOS procedure includes statutory public disclosure and consultation requirements, including disclosure of the assessment documentation through the applicable environmental information platforms and consultation with affected communities and authorities in accordance with the Environmental Code and implementing procedures. Project-specific consultation undertaken through the national process is described in the stakeholder-engagement chapter.

3.5 Environmental Regulations and Standards

Kazakhstan applies a comprehensive set of environmental and sanitary standards for emissions, ambient quality, effluent discharge, noise, vibration, waste, and hazardous materials. These are issued primarily as Hygiene Norms (SanPiN) under the Code on Public Health, and as orders of MENR and the Government implementing the Environmental Code. The principal standards relevant to the Project are summarized in this section, alongside the corresponding World Bank Group (WBG) EHS Guidelines, which are applied where they are more stringent or more comprehensive than national requirements.

3.5.1 Quality and Emissions

National Standards. Ambient air-quality standards in Kazakhstan are expressed as Maximum Permissible Concentrations (MPCs) for atmospheric air in populated areas, established by Hygiene Norms approved by Order of the Minister of Health and corresponding orders of MENR. MPCs are set as maximum single (20–30 minute), 24-hour, and — for selected substances — longer-term values. Emissions from individual sources are regulated through Maximum Permissible Emissions (NDV) approved as part of the Environmental Impact Permit. The MPCs most relevant to the Project (railway construction and operation) are summarised in Table 25.

Table 25: Selected National Maximum Permissible Concentrations (MPC) for Atmospheric Air in Populated Areas

Parameter	Maximum Single (20–30 min) (mg/m³)	24-hour Average (mg/m³)	Notes
Nitrogen Dioxide (NO_2)	0.20	0.04	
Nitric Oxide (NO)	0.40	0.06	
Sulphur Dioxide (SO_2)	0.50	0.05	
Carbon Monoxide (CO)	5.0	3.0	
Suspended Particulates (TSP / dust)	0.50	0.15	
PM_{10}	0.30	0.06	
$PM_{2.5}$	0.16	0.035	
Hydrogen Sulphide (H_2S)	0.008	–	No 24-hr MPC set

Source: Order of the Minister of Health of the Republic of Kazakhstan No. ҚР ДСМ-70 dated 2 August 2022, "On Approval of Hygienic Standards for Atmospheric Air in Urban and Rural Settlements," Appendix 1.

WBG Standards. The WBG EHS Guidelines adopt the WHO Air Quality Guidelines as ambient values, summarized in Table 26. WBG guideline values will be applied as the project benchmark for any pollutant or averaging period for which the national MPC is silent or less stringent.

Table 26: WBG / WHO Ambient Air Quality Guidelines

Parameter	Averaging Period	Guideline Value (µg/m³)
Sulphur Dioxide (SO_2)	10 minute	500
	24-hour	20
Nitrogen Dioxide (NO_2)	1-hour	200
	1-year	40
PM_{10}	24-hour	50
	1-year	20
$PM_{2.5}$	24-hour	25
	1-year	10

Project Air Quality Standards. Construction- and operation-phase air-quality monitoring will be assessed against the more stringent of the national MPC and the WBG / WHO guideline value, in line with the WBG EHS Guidelines principle of applying national legislated standards or, in their absence,

the WHO Air Quality Guidelines. Detailed monitoring requirements are set out in the Construction-phase ESMP.

3.5.2 Water Quality

National Standards. Ambient surface-water quality is regulated through Maximum Permissible Concentrations (MPCs) set out in subordinate regulation under the Water Code and the Code on Public Health. MPCs distinguish between (i) waters used for centralised or non-centralised drinking-water supply and domestic / hygienic purposes; and (ii) waters used for fisheries and recreational purposes, with the more stringent fisheries MPCs typically governing protection of the Syr Darya River and other surface waters along the alignment. Wastewater discharges are regulated through Maximum Permissible Discharge (NDS) limits set as part of the Environmental Impact Permit.

WBG Standards. WBG indicative values for treated sanitary sewage discharges are summarised in Table 27. These values will be applied as the project benchmark for treated sanitary effluents from worker camps and construction sites, where they are more stringent than national NDS values to be set in the project permit.

Table 27: WBG Indicative Values for Treated Sanitary Sewage Discharges

Pollutant	Unit	Guideline Value
pH	pH unit	6–9
Biological Oxygen Demand (BOD)	mg/l	30
Chemical Oxygen Demand (COD)	mg/l	125
Total Nitrogen	mg/l	10
Total Phosphorus	mg/l	2
Oil and Grease	mg/l	10
Total Suspended Solids	mg/l	50
Total Coliform Bacteria	MPN/100 ml	400

Project Water Standards. Baseline surface- and ground-water quality will be assessed against national MPCs. Wastewater discharges from construction sites, camps, and operational facilities will be controlled to the more stringent of project-specific NDS limits and the WBG values in Table 27. Sediment, hydrocarbon, and turbidity controls are addressed in the Construction-phase ESMP, with specific provisions for the Syr Darya bridge works.

3.5.3 Noise

National Standards. Ambient noise in Kazakhstan is regulated through Hygiene Norms (SanPiN) for permissible noise levels in residential areas and on territories of public buildings. Permissible levels are differentiated by daytime (07:00–23:00) and night-time (23:00–07:00) and by receptor type. Indicative limits relevant to the Project are summarized in Table 28.

Table 28: Indicative National Ambient Noise Limits

Receptor / Area	Time	Equivalent Level L_{aer} (dBA)
Territories adjacent to residential dwellings, hospitals, sanatoria, kindergartens, schools, libraries	07:00–23:00	55
	23:00–07:00	45
Territories of public and recreational areas (parks, plazas)	07:00–23:00	60
Industrial / commercial territories	Day and night	70

WBG Standards. WBG noise-level guidelines are summarised in Table 29. The WBG EHS Guidelines additionally require that noise impacts should not result in a maximum increase in background levels of more than 3 dB at the nearest receptor location off-site. Where the WBG night-time period (22:00–07:00) is more conservative than the national period (23:00–07:00), the WBG period applies.

Table 29: WBG Ambient Noise Guidelines

Receptor	Daytime 07:00–22:00 (dBA)	Night-time 22:00–07:00 (dBA)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Workplace Noise. Workplace noise is regulated through SanPiN issued under the Code on Public Health, supplemented by employer obligations under the Labour Code. The WBG General EHS Guidelines provide an 8-hour time-weighted average exposure limit of 85 dBA (heavy industry) and 50–65 dBA for light industry / office work. Indicative national and WBG limits are compared in Table 30.

Table 30: Workplace Noise Limits

Workplace category	National SanPiN limit (dBA)	WBG / IFC EHS Guideline (L_{aer}, 8h)
Permanent workplaces in industrial premises (general)	80	85 (heavy industry)
Light industrial / office work	65–70	50–65
Construction worksites (mobile)	Per task-specific assessment; PPE required where >85 dBA	85 (TWA, 8h)

Project Noise Standards. For ambient noise, the WBG guideline limits in Table 30 will be applied as the project benchmark, with the WBG night-time period (22:00–07:00) governing. For workplace noise, the more stringent of the national SanPiN limit and the WBG 85 dBA L_{aer},8h limit will be applied.

3.5.4 Vibration

National Standards. National regulation of construction-induced vibration on buildings and structures is established through SanPiN and GOST norms, primarily for occupational exposure rather than structural protection thresholds. For protection of buildings and structures from short- and long-

term construction vibration, the German Standard DIN 4150-3 – Vibration in Buildings – Part 3: Effects on Structures is widely accepted as international good practice.

Table 31: Guideline Values for Vibration Velocity (DIN 4150-3, mm/s)

Group	Type of structure	Short-term – Foundation, <10 Hz	Short-term – Foundation, 10–50 Hz	Short-term – Foundation, 50–100 Hz	Short-term – Top floor (all freq.)	Long-term – Top floor
1	Commercial / industrial buildings	20	20–40	40–50	40	10
2	Residential dwellings and similar	5	5–15	15–20	15	5
3	Sensitive structures (e.g. heritage buildings)	3	3–8	8–10	8	2.5

The DIN 4150-3 thresholds in Table 31 govern structural-damage protection for buildings and structures; they do not address the human perception of vibration (annoyance, sleep disturbance, comfort). For human-receptor vibration assessment associated with operational rail traffic, the Project applies the United States Federal Railroad Administration High-Speed Ground Transportation Noise and Vibration Impact Assessment Manual (FRA TNVIM, 2018 edition) as the technical benchmark, consistent with current rail-industry good international practice. The principal FRA TNVIM criteria applied are:

- Land Use Category 2 (Residential or buildings where people sleep) — 72 VdB for Occasional Events (fewer than 30 events per day) and 65 VdB for Frequent Events (more than 70 events per day); intermediate values apply between these event frequencies.
- Land Use Category 3 (Institutional buildings used primarily during the day — schools, offices) — 75 VdB for Occasional Events; 70 VdB for Frequent Events.

Construction-phase vibration is assessed against the DIN 4150-3 structural-damage thresholds in Table 31 as the primary criterion, supplemented by the BS 5228-2:2009+A1:2014 human-receptor framework for nuisance and sleep disturbance at the nearest residential receptors. Pre-construction condition surveys, real-time vibration monitoring with PPV trigger and action levels at 50% and 75% of the applicable guideline value, and specific commitments at Ushagash (two receptors within 10 m of the working face) are detailed in Section 8 and the construction-phase Vibration Management Plan.

3.5.5 Waste

The Environmental Code (2021) provides the framework for waste management, including waste classification, segregation, storage, transport, recycling, and disposal. Hazardous waste is regulated more strictly, including requirements for waste passports, transfer documentation, and disposal through licensed operators. Construction wastes are subject to project-specific waste management plans approved as part of the Stage III environmental assessment package and the Environmental Impact Permit. Inert and excavated soils may be reused on site or disposed of at licensed disposal facilities; recyclable materials must be segregated where reasonably practicable. The polluter-pays principle applies to all waste generated by the Project. Waste management also has regard to the WBG General EHS Guidelines, Section 1.6 (Waste Management).

3.5.6 Hazardous Material

The Environmental Code (2021), the Law on Civil Protection (No. 188-V, 2014), and subordinate regulations on classification, packaging, marking, transport and emergency response apply to hazardous substances at construction sites, storage facilities and during rail and road transport. SanPiN provisions establish workplace exposure limits and emergency-response medical requirements. Storage and use of fuels, oils, lubricants, solvents, paints and explosives at construction sites must comply with national rules on hazardous-substance handling, hazard classification (GHS-aligned), spill response and fire safety. Construction-phase hazardous-waste arrangements are subject to permits and to manifest-and-licensed-disposal requirements; the waste-handling agreement in Table 32 is the relevant authorization. Hazardous materials management also has regard to the WBG General EHS Guidelines, Section 1.5 (Hazardous Materials Management).

The Project is required to comply with the Regulations concerning the International Carriage of Dangerous goods by rail (RID), as the rail-transport annex to COTIF (the Convention concerning International Carriage by Rail), to which Kazakhstan is bound via the KTZ–Uzbek Railways operational interface at Maktaaral. RID 2025 (or the version in force at operation) governs cargo classification (UN classes 1–9), packaging, tank construction, marking and labelling, documentation, segregation, handling, exception cargoes, and security. The Basel Convention applies to any transboundary movement of hazardous waste arising from the Project (e.g. spent solvents, certain residues, end-of-life ballast contaminated by hydrocarbons). The Stockholm Convention applies to the avoidance of POP-containing materials and equipment, including PCBs in transformers.

3.6 Sanitary Protection Zones and Electromagnetic Field Standards

3.6.1 Sanitary Protection Zone for the Railway

Sanitary Protection Zones (SPZ) are established under the Code on Public Health and Healthcare System of the Republic of Kazakhstan and the associated SanPiN provisions issued by the Minister of Health to protect the population from adverse effects associated with industrial and transport facilities, including noise, vibration, dust, and emissions. The applicable instrument for the Project is the Sanitary Rules approved by Order of the Ministry of Health of the Republic of Kazakhstan No. DSM-72 of 3 August 2021. Within the SPZ, residential, recreational, social, and similar sensitive land uses are restricted, and specific construction and operational management measures apply.

The standard SPZ for railways under DSM-72/2021 is 100 meters on each side of the alignment, measured from the center axis of the outermost track. Section 9 of the Sanitary Rules permits a reduction of this distance where the railway is in cutting or where engineered acoustic shielding measures are implemented and demonstrated to maintain the hygienic norms at the SPZ boundary. For the Project, the SPZ is established as follows:

- **Along the open running line**: 100 meters on each side of the alignment, measured from the center axis of the outermost track.
- **Stations**: 50 meters on each side of the outermost track, on the basis of the engineered acoustic shielding designed for the section of the station adjacent to settlements (acoustic screens of the "GeoTechExpert" type). The reduced SPZ is permitted under Section 9 of DSM-72/2021.

The completed OVOS applies the relevant SPZ requirements to the individual Project facilities and assesses atmospheric dispersion at both the applicable SPZ boundaries and nearby residential areas. The Project-specific SPZ dimensions and associated design controls are described in Section 2 and assessed in Chapter 8.

EMF emissions from The Project's 10 kV auxiliary overhead lines (ABS and LPS) and associated transformer substations are assessed against the International Commission on Non-Ionising Radiation

Protection (ICNIRP) Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields, as referenced in the WBG EHS Guidelines for Electric Power Transmission and Distribution (2007). For 50 Hz power-frequency exposure, the ICNIRP reference levels are: general public — 5 kV/m electric field strength, 200 µT magnetic flux density; occupational — 10 kV/m electric field strength, 1,000 µT magnetic flux density. at typical 10 kV distribution conductor heights (≥6.5 m above ground for spans crossing populated areas) and standard substation clearances, predicted exposure is well below the general public reference levels at the boundary of the SPZ. pre-commissioning measurements at representative locations (residential receptors closest to the OHL and substations, the disinfection complex at Maktaaral, the Yerdaut depot perimeter) are committed in the Operational ESMP, with corrective action where any measurement approaches 50% of the general public reference level.

3.7 Tree Cutting

Trees and shrubs in Kazakhstan are protected under the Forest Code (2003), the Environmental Code (2021), and subordinate regulation issued by Akimats and territorial environmental authorities. Tree cutting on lands of the State Forest Fund is subject to the regime of the Forest Code, including obligations for compensatory planting and restoration. Outside the State Forest Fund — in agricultural lands, settlements, gardens, and rights-of-way — tree and shrub cutting requires authorization from the relevant District or City Akimat, generally on the basis of a tree inventory, valuation, and payment of compensation.

Permitting Requirements. An application for tree cutting outside the State Forest Fund is submitted to the relevant Akimat, supported by a survey of trees affected (species, quantity, diameter, condition), a justification of the need for cutting, and a proposed compensatory planting / payment package. The territorial environmental authority typically participates in field inspection and verification. Permits are not required for trees specifically cultivated for timber or commercial fruit production on land owned or leased by legal entities or individuals (e.g. orchards, plantations).

Project-Specific Approach. Analysis of the Project alignment and associated facilities indicates that vegetation requiring cutting is primarily located in:

- private garden plots and farmsteads in proximity to the alignment;
- agricultural lands, including shelterbelts and irrigation-canal margins;
- isolated trees and small clumps of vegetation along access roads, borrow pits, and laydown areas; and
- tree cover in the immediate vicinity of stations, depots, and worker accommodation sites.

Construction of the Project commenced in 2024 and, at the date of this Supplementary ESIA, approximately 100 km of the railway alignment have been levelled. A material proportion of the vegetation clearance associated with the alignment, access roads, borrow pits and construction compounds has therefore already taken place ahead of preparation of the Stage III OVOS tree inventory. Verified findings on the legacy vegetation clearance are presented in the parallel ESCA, including the basis on which clearance was authorized (Akimat decrees, construction permits, State Expertise approvals), any non-conformances against the Forest Code or Akimat conditions, and the corresponding ESCA Corrective Action Plan items. The Stage III OVOS tree inventory addresses the residual vegetation clearance required to complete construction; Compensatory planting commitments arising from both the legacy clearance (under the ESCA CAP) and the residual clearance (under the Stage III OVOS / Construction-phase ESMP) are reported under the Production Environmental Control program and are reflected in the construction-phase ESMP.

3.8 Permits and Licenses

Table 32 identifies the principal approvals, permits and licenses applicable to the Project. The status of each approval, including any outstanding requirements and associated conditions, is verified in the parallel ESCA.

Table 32: Principal Permits and Licences for the Project

Phase	Permit / Approval	Legal Basis	Issuing Authority / Responsibility
Pre-construction	Stage II OVOS Report on Possible (Potential) Impacts – positive State Ecological Expertise conclusion	Environmental Code (2021); subordinate regulations on OVOS and SEE	Authorised environmental authority (Ministry of Ecology and Natural Resources / SEE) – KTZ as proponent
Pre-construction	Stage III environmental assessment package and Environmental Impact Permit (Comprehensive Environmental Permit)	Environmental Code (2021), Articles on environmental permitting and emissions limit-setting (NDV)	MENR / authorised environmental authority – KTZ via design institute
Pre-construction	State Expertise approval of design documentation (engineering, environmental, construction)	Construction legislation; Law on Architectural, Urban Planning and Construction Activity	State Expertise (Gosexpertiza) – KTZ via design institute
Pre-construction	Land allocation / withdrawal decrees (permanent and temporary)	Land Code; subordinate Akimat regulations on land for state needs	Oblast and District Akimats; Cadastral Authorities – KTZ
Pre-construction	Construction Permit	Law on Architectural, Urban Planning and Construction Activity	Local executive authority (Akimat) – KTZ / EPC
Pre-construction	Cultural heritage clearance / archaeological survey approvals	Law on Protection and Use of Objects of Historical and Cultural Heritage (2019)	Authorised cultural heritage body – KTZ via licensed archaeological organisation
Pre-construction / Construction	Tree and shrub cutting permit (outside State Forest Fund)	Forest Code; Akimat regulations	District / City Akimats; territorial environmental authorities – EPC with KTZ support
Construction	Water-use permit (abstraction / discharge); permit for in-river / hydraulic works	Water Code; Environmental Code	Authorised water and environmental authorities – EPC / KTZ
Construction	Borrow-pit / quarry permit (common minerals)	Code on Subsoil and Subsoil Use	Authorised subsoil authority / Akimat – EPC

Phase	Permit / Approval	Legal Basis	Issuing Authority / Responsibility
Construction	Hazardous waste handling agreement (transfer to licensed operator)	Environmental Code; subordinate waste regulations	Licensed waste operators; environmental authorities – EPC
Construction	Worker accommodation sanitary-epidemiological conclusion	Code on Public Health and Healthcare System; SanPiN	State Sanitary-Epidemiological Service – EPC
Construction	OHS plan approvals; high-risk works permits (working at height, lifting, hot work, in-river, confined space)	Labour Code; OHS regulations	Labour Inspectorate / employer system – EPC
Construction	Traffic management and road-crossing approvals; oversized load permits	Law on Roads; road traffic regulations	Road authorities / traffic police / Akimat – EPC
Construction	Emergency preparedness arrangements / fire safety approvals	Law on Civil Protection	Civil protection / fire safety authorities – EPC / KTZ
Operation	Operational Environmental Impact Permit (Comprehensive)	Environmental Code (2021)	MENR / authorised environmental authority – KTZ
Operation	Operational compliance with railway sanitary protection zone and EMF requirements	Code on Public Health; SanPiN	State Sanitary-Epidemiological Service; environmental authorities – KTZ

3.9 International Agreements and Conventions

Kazakhstan is a Party to the principal multilateral environmental, social, and labour agreements relevant to the Project. The most directly relevant instruments, and their relevance to the Project, are summarized in Table 33. As a member of the Commonwealth of Independent States (CIS), Kazakhstan also participates in regional environmental cooperation arrangements, including the Interstate Environmental Council and associated coordination on transboundary environmental matters.

Table 33: Principal International Agreements and Conventions Relevant to the Project

Convention / Agreement	Kazakhstan Status	Relevance to the Project
UN Framework Convention on Climate Change (UNFCCC)	Party (1995)	Climate-change considerations and GHG accounting for the operational rail service.

Convention / Agreement	Kazakhstan Status	Relevance to the Project
Kyoto Protocol	Party (acceded 1999, ratified 2009)	Historical climate commitments; superseded operationally by Paris Agreement.
Paris Agreement (2015)	Party (ratified 2016)	Establishes Kazakhstan's nationally determined contributions; relevant for project-level GHG assessment and climate-resilience considerations.
UN Convention on Biological Diversity (CBD)	Party (1994)	Biodiversity assessment and mitigation along the alignment, including in relation to the Shardara Reservoir KBA.
Convention on International Trade in Endangered Species (CITES)	Party (2000)	Relevant where species potentially affected by the Project are listed under CITES appendices.
Bonn Convention on the Conservation of Migratory Species (CMS)	Party (2006)	Migratory bird considerations associated with the Syr Darya valley and Shardara Reservoir KBA.
Ramsar Convention on Wetlands of International Importance	Party (2007)	Relevant where the alignment or associated facilities affect, or are near, wetlands of international importance.
UN Convention to Combat Desertification (UNCCD)	Party (1997)	Land degradation and rehabilitation considerations relevant to borrow pits, access roads, and reinstatement.
Basel Convention on Transboundary Movements of Hazardous Wastes	Party (2003)	Hazardous waste management and disposal arrangements during construction and operation.
Stockholm Convention on Persistent Organic Pollutants (POPs)	Party (2007)	Avoidance of POP-containing materials and equipment, including PCBs in transformers and capacitors.
Aarhus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters	Party (2001)	Public consultation, disclosure of environmental information, and access to justice in relation to the Project.
Espoo Convention on Environmental Impact Assessment in a Transboundary Context	Party (2001)	Although transboundary impacts are not anticipated, screening confirms applicability of Espoo principles.
UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage	Party (1994)	Cultural heritage protection along the alignment, particularly in relation to identified heritage receptors.

Convention / Agreement	Kazakhstan Status	Relevance to the Project
ILO Core Conventions (incl. Forced Labour, Freedom of Association, Discrimination, Child Labour)	Party to all eight ILO core conventions	Labour and working conditions for direct, contracted, and supply-chain workers.

3.10 Asian Development Bank Safeguard Policies (SPS, 2009)

The ADB Safeguard Policy Statement (SPS, 2009) sets out three Safeguard Requirements that seek to avoid, minimize, or mitigate adverse environmental impacts and social costs to third parties and vulnerable groups associated with ADB-financed projects. The Project has been treated as subject to the SPS (2009) and accordingly applies environmental safeguards and social safeguards as set out below.

3.10.1 Safeguard Requirement 1: Environment

The objective of SR1 is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into project decision-making. SR1 sets out eleven Policy Principles that have been adopted as part of the SPS. Their application to the Project is summarised below.

- **Principle 1 – Screening and categorisation.** Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment. *(The Project has been screened by ADB and is treated as Category A; a full ESIA process applies, of which this Supplementary ESIA forms a key element.)*
- **Principle 2 – Environmental assessment.** Conduct an environmental assessment to identify potential direct, indirect, cumulative, and induced impacts on physical, biological, socio-economic, and physical cultural resources, including impacts on health and safety, vulnerable groups, gender, and climate change. *(This Supplementary ESIA, together with the parallel ESCA and the LARP, addresses the SR1 environmental assessment requirements; transboundary impacts are screened in Chapter 8 and have not been identified as significant.)*
- **Principle 3 – Alternatives.** Examine alternatives to the project's location, design, technology, and components, including the no-project alternative. *(Alternatives are addressed in Chapter 4 of this Supplementary ESIA.)*
- **Principle 4 – Avoid, minimise, mitigate.** Apply the mitigation hierarchy and prepare an environmental management plan (EMP). *(Standalone construction- and operation-phase ESMPs are presented in Chapter 8, supported by a Biodiversity Management Plan, Preliminary Biodiversity Action Plan and a Stakeholder Engagement Plan.)*
- **Principle 5 – Meaningful consultation.** Carry out meaningful consultation with affected people, ensure women's participation, and establish a grievance redress mechanism. *(The SEP and project-level GRM are set out in the Stakeholder Engagement Plan; consultation outcomes are documented in Chapter 9 and the supporting consultation records.)*
- **Principle 6 – Disclosure.** Disclose draft and final environmental assessment in a timely manner. *(This Supplementary ESIA, the LARP, and the Non-Technical Summary are disclosed on the ADB website and through KTZ disclosure channels prior to ADB Board approval.)*
- **Principle 7 – Implementation and monitoring.** Implement the EMP, monitor effectiveness, and disclose monitoring reports. *(Monitoring requirements, institutional*

responsibilities, and reporting are set out in the Construction-phase ESMP and the operational-phase ESMP.)

- **Principle 8 – Biodiversity and natural resources.** Avoid impacts on critical habitats; do not undertake activities that result in significant conversion or degradation of natural habitats; apply the precautionary approach. *(Critical Habitat Assessment and seasonal bird surveys are undertaken by a separate consultant and integrated into the biodiversity baseline (Chapter 7), impact assessment (Chapter 8), Biodiversity Management Plan, and Preliminary Biodiversity Action Plan.)*
- **Principle 9 – Pollution prevention.** Apply WBG EHS Guidelines and good international practice; control GHG emissions, waste, hazardous materials. *(WBG EHS Guidelines (general and Railways) are applied in the impact assessment and ESMPs.)*
- **Principle 10 – Health and safety.** Provide workers with safe and healthy working conditions and protect community health and safety. *(Construction-phase OHS, worker accommodation, and community health and safety are addressed in Chapter 8 and the Construction-phase ESMP, drawing on verified findings from the parallel ESCA.)*
- **Principle 11 – Cultural heritage.** Use field-based surveys with qualified expertise and chance-find procedures during environmental assessment. *(Cultural heritage assessment, including the receptors identified along the alignment, and chance-find procedures are addressed in Chapter 8 and the Construction-phase ESMP.)*

3.10.2 Safeguard Requirement 2: Involuntary Resettlement

The objectives of SR2 are to avoid involuntary resettlement wherever possible; to minimise involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of displaced poor and other vulnerable groups. SR2 applies to full or partial, permanent or temporary physical displacement (relocation, loss of residential land or shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) resulting from involuntary acquisition of land or restrictions on land use.

For the Project, land acquisition affects 371 privately owned and/or leased plots across four districts (Saryagash, Keles, Zhetysay and Maktaaral); state-owned plots are excluded (to be transferred for the Project), and the fifth alignment district, Shardara, holds none of these plots, being subject only to a temporary land-use grant to KTZ. SR2 is addressed through a LARP, covering replacement-cost valuation, eligibility and entitlement, compensation, livelihood restoration, vulnerable groups, consultation, and the project-level grievance redress mechanism.

The principal land-use impacts associated with land acquisition are the permanent loss of agricultural and grazing land, severance of landholdings by the alignment, and displacement of a small number of residential structures and businesses (physical displacement is limited to 16 households and businesses; the large majority of impacts are economic displacement from loss of agricultural land - see Section 8.4.2 for the full impact discussion). The mitigation approach comprises compensation at replacement cost, relocation and transition allowances, additional assistance for severely affected and vulnerable households, and a livelihood restoration program, implemented through the LARP's grievance redress mechanism and internal and external monitoring, detailed in the LARP itself.

3.10.3 Safeguard Requirement 3: Indigenous Peoples

The objective of SR3 is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness, so that they receive culturally appropriate social and economic benefits, do not suffer adverse impacts, and can participate actively in projects that affect them.

Screening of the Project against the SR3 definition of Indigenous Peoples (a distinct, vulnerable social and cultural group with self-identification, collective attachment to ancestral territories, customary cultural and economic institutions, and a distinct language) confirms that no such groups are present in the Project Area of Influence. Accordingly, SR3 is not triggered and no further actions are required under this safeguard. Screening evidence is presented in Chapter 6.

3.11 IFC Performance Standards (2012)

The International Finance Corporation's Performance Standards on Environmental and Social Sustainability (Performance Standards, 2012, PS) provide a comprehensive, risk-based framework for identifying, assessing, and managing environmental and social risks and impacts at the project level. The Performance Standards are referenced together with the World Bank Group / IFC Environmental, Health and Safety (EHS) Guidelines, which are applied as good international industry practice (GIIP).

The framework comprises eight Performance Standards, of which the first — PS1: Assessment and Management of Environmental and Social Risks and Impacts — establishes the overarching requirements for environmental and social assessment and management, and the remaining seven address specific topic areas. Their application to the Project is summarised below.

- **PS1 – Assessment and Management of Environmental and Social Risks and Impacts.** Establishes the requirement for an Environmental and Social Management System (ESMS), including policy, identification of risks and impacts, management programs, organisational capacity and competency, emergency preparedness and response, stakeholder engagement, external communications and grievance mechanisms, and ongoing reporting to affected communities. *(Application: this Supplementary ESIA, the standalone construction- and operation-phase ESMPs, the Stakeholder Engagement Plan, and the project-level Grievance Redress Mechanism collectively meet the PS1 requirements; KTZ's corporate ESMS provides the institutional framework, with project-specific arrangements.)*
- **PS2 – Labor and Working Conditions.** Sets requirements relating to working conditions and management of worker relationships, protection of the workforce (including non-discrimination, freedom of association, child and forced labour), occupational health and safety, workers engaged by third parties (contractors and subcontractors), and supply-chain workers. *(Application: PS2 is highly relevant given the multi-contract delivery structure with Integra and subcontractors; labor management procedures, OHS, and worker accommodation arrangements and the Construction-phase ESMP, drawing on verified findings from the parallel ESCA.)*
- **PS3 – Resource Efficiency and Pollution Prevention.** Addresses resource efficiency (including water, energy, and greenhouse gases) and pollution prevention and abatement (air emissions, wastewater, waste, hazardous materials, and pesticides). Requires application of the WBG EHS Guidelines and good international industry practice. *(Application: PS3 is addressed through the impact assessment in Chapter 8, the GHG assessment, and pollution prevention measures in the Construction-phase ESMP. Hazardous materials handling, fuel storage, and waste management at borrow pits, batching plants, and worker camps are covered.)*
- **PS4 – Community Health, Safety, and Security.** Addresses risks and impacts to the health, safety, and security of affected communities arising from project activities, including infrastructure and equipment design and safety, hazardous materials and substances, ecosystem services, exposure to disease, emergency preparedness and response, and security personnel arrangements. *(Application: PS4 is addressed through the community health and safety assessment in Chapter 8, including traffic management, road and rail crossings, drainage and waterlogging, dust, noise, and emergency arrangements at the Syr Darya bridge crossing and other major works.)*

- **PS5 – Land Acquisition and Involuntary Resettlement.** Sets requirements to avoid involuntary resettlement, minimise it where avoidance is not possible, and restore or improve the livelihoods of displaced persons through replacement-cost compensation, livelihood restoration, and dedicated arrangements for vulnerable groups. *(Application: PS5 is addressed through the LARP the LARP applies replacement-cost valuation, livelihood restoration measures, vulnerable PAP identification, and a project-level GRM.)*
- **PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources.** Sets requirements to protect and conserve biodiversity, maintain the benefits from ecosystem services, and promote sustainable management of living natural resources. Establishes specific requirements for natural habitats, critical habitats, legally protected and internationally recognised areas, invasive alien species, and supply chains. *(Application: PS6 is highly relevant given the proximity of the alignment to the Shardara Reservoir KBA and the Syr Darya River. A Critical Habitat Assessment and seasonal bird surveys are being undertaken by a separate consultant; findings inform the biodiversity baseline (Chapter 6), impact assessment (Chapter 8), Biodiversity Management Plan, and Preliminary Biodiversity Action Plan.)*
- **PS7 – Indigenous Peoples.** Sets requirements to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural-resource-based livelihoods of Indigenous Peoples, including provisions for Free, Prior, and Informed Consent (FPIC) in defined circumstances. *(Application: screening confirms that Indigenous Peoples as defined under PS7 are not present in the Project Area of Influence; PS7 is therefore not triggered. Screening evidence is presented in Chapter 6.)*
- **PS8 – Cultural Heritage.** Sets requirements to protect cultural heritage from adverse impacts, including chance-find procedures, consultation with affected communities, and — for critical cultural heritage — specific avoidance and consent requirements. *(Application: PS8 is highly relevant given the cultural heritage receptors identified along the alignment, including a number classified as "emergency monuments" under national heritage legislation; assessment, mitigation, and chance-find procedures are addressed in Chapter 6 and the Construction-phase ESMP.)*

In addition to the Performance Standards, the IFC has issued a series of Good Practice Notes (GPNs) and guidance notes that provide further direction on specific topics. Of particular relevance to the Project are the IFC Good Practice Note on Managing Contractors' Environmental and Social Performance (2017), applied to KTZ's and Integra's contractor-management arrangements; the IFC / EBRD Guidance Note on Worker Accommodation: Processes and Standards (2009), applied to construction worker camps;, applied in Chapter 8; and the IFC Good Practice Note on Addressing Gender Based Violence and Harassment (GBVH) in Investments Involving Major Civil Works (2020), applied to the labor management and stakeholder engagement workstreams; and the IFC Good Practice Handbook on Cumulative Impact Assessment and Management (2013), applied to the cumulative impact assessment in Section 8.4.6.

3.12 AIIB Environmental and Social Framework (ESF, 2024)

The Asian Infrastructure Investment Bank's Environmental and Social Framework (ESF, June 2024) supports AIIB and its Clients in the management of environmental and social risks and impacts associated with AIIB-financed projects. The ESF was originally adopted in 2016 and has been amended in 2019, 2021, 2022, and 2024. The version applicable to a given AIIB-financed project depends on when the project entered AIIB's investment pipeline; the references in this Supplementary ESIA are to the ESF (June 2024) as the most recent version applicable at the time of preparation.

The ESF comprises an aspirational Vision Statement, a mandatory Environmental and Social Policy (ESP), three mandatory Environmental and Social Standards (ESSs), an Environmental and Social

Exclusion List (ESEL), a Glossary, a Directive on the Environmental and Social Policy, and a body of Environmental and Social Guidance. The three ESSs are:

- **ESS 1 – Environmental and Social Assessment and Management.** Sets the overarching requirements for environmental and social risk and impact assessment, the application of the mitigation hierarchy, ESMS arrangements, stakeholder engagement, project-level grievance redress, monitoring, and reporting. ESS 1 also includes provisions on greenhouse gas reporting for projects with significant emissions and on dam safety where applicable. *(Application: ESS 1 is addressed at the project level through this Supplementary ESIA, the construction- and operation-phase ESMPs, the Stakeholder Engagement Plan, and the project-level Grievance Redress Mechanism, supported by KTZ's corporate ESMS.)*
- **ESS 2 – Land Acquisition and Involuntary Resettlement.** Establishes requirements to avoid involuntary resettlement, minimise it where avoidance is not possible, and restore or improve the livelihoods of displaced persons through compensation at full replacement cost, livelihood restoration, and dedicated measures for vulnerable groups. ESS 2 may apply to land acquisition and involuntary resettlement that occurred earlier than the project's entry into the AIIB pipeline, where the activities are linked to the project. *(Application: ESS 2 is addressed through the LARP.)*
- **ESS 3 – Indigenous Peoples.** Establishes requirements to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness, including provisions for Free, Prior, and Informed Consent in specified circumstances. *(Application: screening confirms that Indigenous Peoples as defined under ESS 3 are not present in the Project Area of Influence; ESS 3 is therefore not triggered.)*

AIIB has classified the Project as Category A under the ESF. Category A projects have significant adverse environmental and social impacts that may be irreversible, cumulative, diverse or unprecedented. Disclosure of the draft Supplementary ESIA in advance of AIIB Board consideration is required at least 60 calendar days prior to consideration; this Supplementary ESIA is prepared to support that disclosure timeline. The Project is Category A under the AIIB ESF and ADB Environment Category A under the ADB SPS. The Project is also considered Category A under the IFC Sustainability Policy (2012). The basis for these categorizations is set out in Section 2 Table 3 and elsewhere in this Section.

Topics covered by the IFC Performance Standards but not addressed by a dedicated AIIB ESS — including labor and working conditions (PS2), resource efficiency and pollution prevention (PS3), community health, safety, and security (PS4), biodiversity (PS6), and cultural heritage (PS8) — are addressed by AIIB through ESS 1's overarching environmental and social assessment and management requirements, with reference to the IFC Performance Standards and the WBG / IFC EHS Guidelines as good international industry practice. The Project's alignment with PS2, PS3, PS4, PS6, and PS8 in Section 3.11 therefore also supports compliance with the corresponding requirements under AIIB ESS 1.

AIIB applies an Environmental and Social Exclusion List (ESEL) setting forth activities and items that are excluded from AIIB financing and that the Client is required to exclude from the project. Screening of the Project against the ESEL has been undertaken and confirms that no excluded activities are involved. The ESF requires disclosure of draft environmental and social documentation in advance of AIIB Board consideration of financing — 60 calendar days for Category A projects and 0 calendar days for Category B projects; this Supplementary ESIA is being prepared to support that disclosure timeline.

3.13 World Bank Group / IFC Environmental, Health and Safety Guidelines

The World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) are technical reference documents containing examples of good international industry practice (GIIP) for the

prevention and control of environmental, occupational, and community health and safety risks. The EHS Guidelines comprise a General document containing cross-cutting guidance applicable to all industry sectors, supplemented by Industry-Sector Guidelines applicable to specific activities. Where one or more members of the World Bank Group are involved in a project, the EHS Guidelines are applied as required by the relevant institutional policies and standards. Where host-country regulations differ from the EHS Guidelines, projects are required to achieve whichever standard is more stringent.

For the Project, the EHS Guidelines are applied directly through the IFC Performance Standards (PS3) and through the references in the AIIB ESF and the inception-stage scope of the Supplementary ESIA. They form an integral part of the technical benchmark used in the impact assessment, the design of mitigation measures, and the standalone ESMPs.

3.13.1 General EHS Guidelines (2007)

The General EHS Guidelines provide cross-cutting guidance organised under four headings, each comprising a set of substantive sub-topics. The headings and sub-topics most directly relevant to the Project are:

- **Environmental:** Air Emissions and Ambient Air Quality; Energy Conservation; Wastewater and Ambient Water Quality; Water Conservation; Hazardous Materials Management; Waste Management; Noise; and Contaminated Land.
- **Occupational Health and Safety:** General Facility Design and Operation; Communication and Training; Physical Hazards; Chemical Hazards; Biological Hazards; Radiological Hazards; Personal Protective Equipment (PPE); Special Hazard Environments; and Monitoring.
- **Community Health and Safety:** Water Quality and Availability; Structural Safety of Project Infrastructure; Life and Fire Safety; Traffic Safety; Transport of Hazardous Materials; Disease Prevention; and Emergency Preparedness and Response.
- **Construction and Decommissioning:** additional environmental, OHS, and community-safety considerations specific to construction and decommissioning activities, of particular relevance to the active construction phase of the Project.

Numerical performance levels from the General EHS Guidelines have been incorporated into the project standards in Section 3.5 (air quality, water, noise, vibration). For other topics — hazardous materials, fire safety, traffic safety, disease prevention, and emergency preparedness — the General EHS Guidelines provide the benchmark against which project-specific arrangements are designed and assessed. Implementation requirements are reflected in the Construction-phase ESMP and operational-phase framework ESMP.

3.13.2 Sector-Specific EHS Guidelines for Railways (2007)

The IFC EHS Guidelines for Railways (April 2007) are applicable to activities typically conducted by rail-infrastructure operators dedicated to passenger and freight transport, and are designed to be used together with the General EHS Guidelines. The document is organised into two principal areas:

- **Rail operations:** construction and maintenance of rail infrastructure (including track, structures, signalling, and traction power) and operation of rolling stock (locomotives and rail cars); and
- **Locomotive maintenance activities:** engine services and other mechanical repair and maintenance of locomotives and railcars at depots and workshops.

The EHS Guidelines for Railways address industry-specific environmental, occupational, and community health and safety impacts, with corresponding management measures and performance

indicators. The aspects most directly relevant to the construction and operation of the Darbaza–Maktaaral railway are:

- **Environmental aspects:** habitat alteration and ecological connectivity (linear barrier effects, fauna crossings, vegetation clearance); soil erosion and water quality (earthworks, embankments, in-river works at bridges, drainage); hazardous materials and accidental releases (transport of dangerous goods, fuelling and maintenance facilities, herbicide use along the track); air emissions (locomotive and ancillary equipment emissions, dust from earthworks and ballast); noise and vibration (construction activities, train pass-by noise, vibration at bridges and structures); and waste (ballast, sleepers, scrap metal, used oils).
- **Occupational health and safety aspects:** track-side and right-of-way hazards (struck-by, slips, trips, falls); operation of heavy lifting and rail-laying equipment; work at height (bridges, overhead contact lines, signalling masts); confined space and excavation hazards; exposure to electrical hazards from traction power systems and electromagnetic fields; chemical exposures during locomotive and rolling-stock maintenance; ergonomic and psychosocial hazards for train crew (work / rest cycles); and emergency preparedness for derailments, fires, and hazardous-material releases.
- **Community health and safety aspects:** level crossings and trespass on the right-of-way; pedestrian and livestock interaction with the alignment; noise and vibration at sensitive receptors; transport of dangerous goods through populated areas; emergency response coordination with civil-protection authorities; and security of the right-of-way and stations.

The Project applies the EHS Guidelines for Railways as a primary technical benchmark, alongside national regulation, for the design of mitigation and management measures during the remainder of construction and the operational phase. Specific commitments are reflected in the Construction-phase ESMP and the operational-phase framework ESMP.

3.13.3 Other Applicable Sector-Specific EHS Guidelines

In addition to the EHS Guidelines for Railways, the following Industry-Sector EHS Guidelines are applied to specific Project components and associated facilities, in line with the WBG approach for complex projects in which multiple industry-sector guidelines may be necessary:

- **EHS Guidelines for Electric Power Transmission and Distribution (2007),** applied to the Project's 10 kV auxiliary power supply lines (ABS and LPS), associated transformer substations and electrical infrastructure, including EMF management and avian collision and electrocution risks.
- **EHS Guidelines for Construction Materials Extraction (2007),** applied to borrow pits and quarries used to source ballast, sand, and other construction materials, including dust control, slope stability, water management, and rehabilitation requirements.
- **EHS Guidelines for Toll Roads (2007),** drawn upon by analogy for permanent and temporary access roads constructed for the Project, where relevant for traffic safety, community interfaces, and pavement design.
- **EHS Guidelines for Waste Management Facilities (2007),** drawn upon for management of construction and operational waste streams, including segregation, storage, and transfer to licensed facilities.
- **IAQM Construction Dust Assessment Guidance** (Institute of Air Quality Management, 2024 edition) — applied to assess construction-phase dust impacts at sensitive receptors and to specify the dust-control measures in the Air Quality Management Plan. The Project is classified

as High Risk under IAQM, triggering the full set of IAQM "highly recommended" mitigation measures.

- **FRA TNVIM (2018)** — applied to operational vibration human-receptor assessment (see Section 3.5 vibration subsection).
- **BS 5228-2:2009+A1:2014** — applied to construction-phase vibration human-receptor assessment alongside DIN 4150-3 structural protection (see Section 3.5 vibration subsection).
- **IUCN Red List of Threatened Species criteria (current version)** — applied to species-level conservation status determination in the Critical Habitat Assessment.
- **IFC Guidance Note 6** (Biodiversity Conservation and Sustainable Management of Living Natural Resources, 2019 update) — applied to operationalise PS6, including the Critical Habitat trigger criteria (Criterion 1 — Critically Endangered / Endangered species at species-specific trigger thresholds; Criterion 2 — endemic / restricted-range; Criterion 3 — migratory / congregatory; Criterion 4 — key evolutionary processes; Criterion 5 — highly threatened or unique ecosystems).
- **Guidance Notes for the other triggered Performance Standards (GN1, GN2, GN3, GN4, GN5 and GN8)** are applied throughout this Supplementary ESIA where relevant to the corresponding topic area, in addition to Guidance Note 6 for PS6 referenced above.
- **Key Biodiversity Area (KBA) Standard 1.0 (IUCN, 2016)** — applied to the determination that the Shardara Reservoir qualifies as a KBA under criterion A4(iii) (waterbird assemblages exceeding 20,000 individuals).
- **International Bird Census Committee survey methods** — applied to the February 2025 winter waterbird transects and the 2025 biodiversity studies that underpin the biodiversity baseline.
- **BirdLife International Avian Powerline Interaction Working Group guidance** — applied to the bird flight diverter and bird-safe pole-top design commitments for the 10 kV ABS and LPS overhead lines.

Cross-references to the relevant EHS Guidelines are provided at the point of use in Chapter 8 (Identification and Evaluation of Impacts and Mitigation Measures) and in the standalone ESMPs.

3.14 Gap Analysis

The Project is required to satisfy the national requirements of the Republic of Kazakhstan and the requirements of the three Lender frameworks applied to the assignment — ADB SPS (2009), the IFC Performance Standards (2012), and the AIIB ESF (2024) — together with the WBG / IFC EHS Guidelines applied as good international industry practice. The three Lender frameworks are largely consistent in scope and intent but differ in structure (the SPS is organized into three Safeguard Requirements, the IFC PS into eight Performance Standards, and the AIIB ESF into three Environmental and Social Standards). Where the regimes differ, the more stringent or more comprehensive requirement applies.

A harmonized compliance framework, comparing the principal aspects of the national and Lender requirements and identifying the corresponding approach for the Project, is summarized in Table 34.

.

Vista Environment

Table 34: Comparison of National Requirements and Lender Frameworks (ADB SPS 2009, IFC PS 2012, AIIB ESF 2024)

Aspect	Lender Requirement (ADB SPS / IFC PS / AIIB ESS)	Kazakhstan Requirement (Environmental Code 2021 and related legislation)	Harmonized Approach for the Project
Environmental and Social Policy and Framework	ADB SPS (2009): SR1 with 11 Policy Principles, plus SR2 and SR3. IFC PS (2012): PS1 sets the ESMS framework, supported by PS2–PS8. AIIB ESF (2024): ESS 1 sets the overarching framework, supported by ESS 2 and ESS 3, with cross-reference to IFC PS and the WBG EHS Guidelines for topics not covered by a dedicated ESS.	Environmental Code (2021) establishes the OVOS/EIA system with project Categories I–IV, State Ecological Expertise, the Comprehensive Environmental Impact Permit, and the production environmental control (ПЭК) programme.	The Supplementary ESIA, ESMPs, BMP, SEP, and project-level GRM collectively meet the overarching requirements of all three Lender frameworks and complement the national OVOS process. Where requirements differ, the more stringent or more comprehensive provision applies.
Screening / Categorization	ADB SPS: Categories A, B, or C; this Project is treated as Category A. IFC PS: applied risk-based; the Project is high-risk consistent with PS1 risk rating. AIIB ESF: high-risk projects are subject to the 60-day pre-Board disclosure requirement under ESS 1.	The completed working-design OVOS classifies the Project during operation as a Category II facility under the Environmental Code.	The Project is treated as ADB Environment Category A and AIIB Category A for lender purposes. IFC applies the Performance Standards on a risk-based basis rather than through an A/B/C categorization system. The national Category II classification is separate from these lender risk classifications.
Alternatives Analysis	Required: location, design, technology, and “no project” alternatives, with documented rationale (ADB SPS Principle 3; IFC PS1 paragraph 7; AIIB ESS 1).	Alternatives are required as part of the Stage II Report on Possible Impacts and the Stage III environmental assessment.	Alternatives are addressed in Chapter 4 of this Supplementary ESIA, satisfying both Lender and national requirements.
Reporting Requirements	Full ESIA in English with ESMP comprising mitigation, monitoring, institutional arrangements, capacity building, costs, and indicators.	Stage II Report on Possible Impacts and Stage III package, in Russian / Kazakh, including baseline, alternatives, mitigation, monitoring, NDV emissions limits, waste plan, and ПЭК programme.	Documentation prepared in two parallel streams: Lender-aligned Supplementary ESIA in English; national OVOS package in Russian / Kazakh. Content is harmonized so that each system’s requirements are met.
Public Consultation and Disclosure	Meaningful consultation with affected people; women’s participation; ongoing engagement; project-level grievance redress mechanism.	Public hearings required for Category I under Environmental Code; disclosure of OVOS materials in accordance with	Consultations are designed and recorded so as to satisfy all three Lender frameworks and the Environmental Code; the ESIA is

Aspect	Lender Requirement (ADB SPS / IFC PS / AIIB ESS)	Kazakhstan Requirement (Environmental Code 2021 and related legislation)	Harmonized Approach for the Project
	Disclosure of draft and final ESIA on ADB / AIIB / KTZ websites; AIIB requires 60 days for Category A projects.	national procedures and the Aarhus Convention.	disclosed in line with AIIB's 60-day requirement and ADB's pre-Board disclosure timing; the SEP includes the project-level GRM.
Public Consultation and Disclosure — Timing	ADB SPS Public Communications Policy — 120 calendar days before Board consideration for Category A projects; IFC PS1 — 60 calendar days for IFC Category A projects (current IFC practice); AIIB ESF — 60 calendar days for Category A projects. ILO C190 / IFC GPN GBVH for harassment-related consultation.	Environmental Code — draft OVOS report accessible online for at least 30 days; advance notice in newspapers / TV / radio in Kazakh and Russian at least 20 working days before hearings (per Article 73 and subordinate regulation).	The most demanding rule applies — 120 calendar days before ADB Board consideration. Disclosure of the draft Supplementary ESIA in English, Kazakh and Russian satisfies all three Lender frameworks and the Environmental Code. The SEP and project-level GRM operationalize ongoing consultation.
Land Acquisition and Resettlement	ADB SPS SR2; IFC PS5; AIIB ESS 2 — avoid, minimize, replacement-cost valuation, livelihood restoration, vulnerable groups, GRM, monitoring; ESS 2 may apply to LAR that occurred earlier where linked to the project.	Land Code procedures led by Akimats, valuation under national methodologies, no specific livelihood-restoration framework.	Addressed through a separate LARP applying the more stringent of SR2, PS5, and ESS 2 requirements; reviewed at policy level in Chapter 6 of this Supplementary ESIA.
Indigenous Peoples	ADB SPS SR3; IFC PS7; AIIB ESS 3 — free, prior, and informed consultation / consent leading to broad community support where Indigenous Peoples (as defined under each framework) are affected.	No equivalent national legal definition; population profile screened through socio-economic baseline.	Screening confirms that Indigenous Peoples as defined under SR3, PS7, and ESS 3 are not present in the Area of Influence; these standards are therefore not triggered. Screening evidence is presented in Chapter 6.
Labour and Working Conditions	IFC PS2 — working conditions, OHS, child / forced labour, freedom of association, contracted and supply-chain workers. Addressed under ADB SPS SR1 and AIIB ESS 1 with cross-reference to PS2 and the WBG EHS Guidelines.	Labour Code (2015), Code on Public Health, and subordinate OHS regulation; State Labour Inspectorate.	PS2 applied as the primary benchmark, with reference to ILO core conventions and the WBG EHS Guidelines; KTZ and Integra labour management procedures and contractual chain reviewed and strengthened where necessary.
Worker Accommodation	IFC PS2 ¶15–17 (Workers Provided by Third Parties; Worker Accommodation); IFC / EBRD Guidance on Worker Accommodation: Processes and Standards (2009) — room occupancy, floor area per worker, sanitation, food, ventilation, fire safety, welfare.	Code on Public Health and Healthcare System; SanPiN provisions on worker accommodation sanitary requirements; SES sanitary-epidemiological conclusion required.	IFC / EBRD 2009 applied as the primary benchmark, with national SanPiN applied where more stringent. Camp Management Plan submitted by each subcontractor and approved by Integra; routine internal inspections; periodic third-party audits. (See Section 2.7.2 of this Supplementary ESIA.)

Aspect	Lender Requirement (ADB SPS / IFC PS / AIIB ESS)	Kazakhstan Requirement (Environmental Code 2021 and related legislation)	Harmonized Approach for the Project
	Addressed under ADB SPS SR1 ¶3 and AIIB ESS 1 with cross-reference.		
Gender-Based Violence and Harassment	IFC Good Practice Note on Addressing GBVH in Investments Involving Major Civil Works (2020); IFC PS2 ¶22 (anti-harassment); ILO C190 (Violence and Harassment in the World of Work, 2019).	Law on Prevention of Domestic Violence (2009, amended 2020); Law on State Guarantees of Equal Rights and Equal Opportunities of Men and Women (2009); Labour Code anti-discrimination provisions.	IFC GPN (2020) applied as the primary benchmark, with the project workforce influx context (800 specialists across the corridor, multi-subcontractor labour, predominantly male workforce, rural communities) triggering enhanced GBVH measures. The Gender Action Plan committed in the ESCA Corrective Action Plan and the Labour Management Procedures of the construction-phase ESMP address training, codes of conduct, complaint channels (including the workers' GRM), referral pathways and disciplinary measures.
Resource Efficiency and Pollution Prevention	IFC PS3 — resource efficiency, GHGs, air, water, waste, hazardous materials. Addressed under ADB SPS SR1 Principle 9 and AIIB ESS 1 with cross-reference to PS3 and the WBG EHS Guidelines.	Environmental Code emissions limits (NDV); SanPiN ambient and workplace standards; sector-specific norms.	WBG EHS Guidelines (general and Railways) applied as minimum benchmark; the more stringent of national and WBG values applies, as set out in Section 3.5.
Greenhouse Gas Emissions	ADB SPS SR1 Principle 9 — control GHG emissions in line with WBG EHS Guidelines and GIIP. IFC PS3 ¶7–8 — annual quantification of direct (Scope 1) and indirect (Scope 2) emissions where combined emissions are expected to exceed 25,000 tCO_2e/year, with consideration of options for technically and financially feasible reductions. AIIB ESS 1 — greenhouse gas reporting for projects with significant emissions.	National emissions trading scheme (administered by MENR) applies to large emitters; railway transport operators not currently within scheme thresholds. Strategy for Achieving Carbon Neutrality 2060 sets long-term direction; no project-level quantification threshold.	Operational-phase GHG emissions (diesel locomotive Scope 1; auxiliary electricity Scope 2; supporting Scope 3 where material) are quantified and reported. Where annual emissions are projected to exceed 25,000 tCO_2e/year, PS3 ¶8 mitigation options analysis applies. The methodology is set out in Section 8 (GHG Assessment) of this Supplementary ESIA.
Climate Resilience	IFC PS3 ¶7 — climate change considerations integrated where material; AIIB ESS 1 — climate-resilient design.	Strategy for Achieving Carbon Neutrality 2060 (mitigation focus); limited project-level climate adaptation requirement.	Preliminary Climate Risk Assessment over the 120-year design life of the railway, applying SSP-based climate projections (SSP5-8.5 P90 upper bound; SSP2-4.5 P50 mid-range). Hazard-by-hazard assessment of river flood, rainfall-induced landslide, mean temperature, heat stress, drought, water scarcity, and wildfire. Adaptation framework integrated into the construction-

Aspect	Lender Requirement (ADB SPS / IFC PS / AIIB ESS)	Kazakhstan Requirement (Environmental Code 2021 and related legislation)	Harmonized Approach for the Project
			and operational-phase ESMPs and the Climate Resilience Annex of this Supplementary ESIA.
Community Health, Safety and Security	IFC PS4 — community health and safety, infrastructure safety, hazardous materials, ecosystem services, security personnel. Addressed under ADB SPS SR1 Principle 10 and AIIB ESS 1 with cross-reference to PS4 and the WBG EHS Guidelines.	Code on Public Health; Law on Civil Protection; SanPiN; Law on Roads; sector-specific norms.	PS4 and WBG EHS Guidelines (general and Railways) applied as the technical benchmark; specific provisions for the Syr Darya bridge works, level crossings, and traffic management included in the Construction-phase ESMP.
Security Personnel	IFC PS4 ¶12–14 — proportionality, use-of-force training, no excessive force, due-diligence screening, complaint mechanism; Voluntary Principles on Security and Human Rights (VPSHR) where applicable.	Law on Internal Affairs Bodies (2014); KTZ corporate paramilitary security regime at stations; National Security Committee (KNB) presence at Maktaaral border-crossing.	PS4 ¶12–14 applied to KTZ-employed and KTZ-contracted security at stations, including the paramilitary security buildings at Yerdaut and Maktaaral. The KNB and customs personnel at Maktaaral are state actors operating under their own statutory regimes; the Project's interface with state security actors is addressed through coordination protocols, not direct PS4 application. Security arrangements and the boundary between KTZ and state-actor responsibilities are described in Section 8 (Community Health, Safety and Security).
Biodiversity and Critical Habitat	IFC PS6 — critical habitat, natural habitat, legally protected and internationally recognized areas, invasive alien species, supply chains. Addressed under ADB SPS SR1 Principle 8 and AIIB ESS 1.	Law on Specially Protected Natural Areas; Law on Animal World; Law on Flora; Red Book of Kazakhstan species lists.	Biodiversity baseline, Critical Habitat Assessment, and impact assessment aligned with PS6; mitigation hierarchy and, if required, offsets developed through F-BAP and BMP.
Cultural Heritage	IFC PS8 — chance-find procedures, qualified expertise, conservation of physical cultural resources; specific avoidance and consent requirements for critical cultural heritage. Addressed under ADB SPS SR1 Principle 11 and AIIB ESS 1.	Law on Protection and Use of Objects of Historical and Cultural Heritage (2019); chance-find obligations; permitting for archaeological works.	PS8 and national requirements applied; assessment of the cultural heritage receptors identified along the alignment, and chance-find procedures, included in Section 7.6 and the Construction-phase ESMP.
Cumulative Impacts	IFC PS1 ¶8 — cumulative impact assessment required for Category A / high-risk projects; AIIB ESS 1 ¶27 — cumulative impacts to be considered.	National OVOS provisions reference cumulative effects but provide limited methodological detail.	Cumulative impact assessment is undertaken in Section 8 (Cumulative Impact Assessment) of this Supplementary ESIA, applying the IFC Good Practice Handbook on Cumulative Impact Assessment and Management (2013) framework to the alignment, the parallel infrastructure development in the

Aspect	Lender Requirement (ADB SPS / IFC PS / AIIB ESS)	Kazakhstan Requirement (Environmental Code 2021 and related legislation)	Harmonized Approach for the Project
	ADB SPS SR1 Principle 2 — direct, indirect, cumulative and induced impacts on physical, biological, socio-economic and physical cultural resources.		Turkistan corridor, and the existing Arys–Saryagash–Tashkent rail corridor.

The harmonized framework ensures that the Project complies with the Environmental Code and applicable subordinate national regulation, while concurrently meeting the Lender requirements applied to the assignment. The Supplementary ESIA, ESMPs, and supporting management instruments are structured so that the documentation prepared in English (for the Lenders) and in Russian / Kazakh (for the national OVOS process) is content-aligned and mutually reinforcing.

4. Analysis of Alternatives

4.1 Consideration of Alternatives

The Project is subject to the environmental and social requirements of the ADBADB, IFC and AIIB. Each of these frameworks requires the impact assessment process to include an examination of alternatives, in order to demonstrate that environmental and social risks have been considered in the design of the Project and that opportunities to avoid or minimize adverse impacts have been incorporated into the selected option. The specific requirements applicable to this assessment are as follows:

- ADB Safeguard Policy Statement (2009), Safeguard Requirement 1 (Environment) sets out the most explicit alternatives requirement of the three frameworks. The borrower is required to examine alternatives to the Project's location, design, technology, and components, to assess the potential environmental and social impacts of each, and to document the rationale for the selection of the alternative proposed. The no-project alternative is required to be considered as part of this examination.
- IFC Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts) requires that, for projects with potentially significant adverse environmental or social impacts, the environmental and social impact assessment include an examination of technically and financially feasible alternatives to the source of such risks and impacts, and documentation of the rationale for selecting the particular course of action proposed.
- AIIB Environmental and Social Framework (2024), Environmental and Social Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts) requires that the environmental and social assessment, where appropriate, include an examination of technically and financially feasible alternatives, including the no-project alternative, together with documentation of the rationale for selecting the particular course of action proposed.

The completed National EIA (OVOS) also considers the requirement under the national environmental assessment process to identify a “possible rational alternative” to the proposed activity. The OVOS applies feasibility criteria relating to the proposed location and implementation conditions and considers the consequences of the Project not proceeding. The OVOS does not, however, provide the same comparative environmental and social evaluation of location, design, technology and component alternatives required by the Lender frameworks; accordingly, the Supplementary ESIA continues to rely principally on the TEO variant-selection record and the supplementary E&S evaluation presented below.

Across the three frameworks the expectation is consistent: alternatives should be considered at the level of project location, design, technology, and components; the no-project alternative should be examined; and the rationale for the selected option should be documented in a manner that demonstrates how environmental and social considerations have informed the decision. The ADB SPS is the most prescriptive of the three with respect to the dimensions of alternatives to be examined (location, design, technology, and components); the IFC PS and AIIB ESF formulations are more open in scope but consistent in intent.

The Supplementary ESIA has been prepared at a stage where the Project's principal design decisions — route alignment, station locations, structural design, traction approach, staging structure, and operational concept — were taken in advance of the Consultant's engagement, and where construction is already advanced (approximately 100 km of alignment levelled at the date of this report). The alternatives examined in this chapter accordingly fall into three categories:

(a) Ex ante alternatives examined and recorded in the TEO. The Consultant has reviewed The variant-selection record set out in TEO Volume 1 (Transproekt-K, Almaty, 2023, Document 747605/2022/1-ТЭО-ОПЗ). This record covers the route direction variants, the traction variants, the staging structure,

and the community-feedback-driven alignment adjustment in Keles district. The Consultant has assessed the variant-selection record against the SPS, IFC PS and AIIB ESF requirements for alternatives analysis, and has identified where the record meets, partially meets, or does not address those requirements. Where the record does not address an E&S consideration that the lender frameworks require, a supplementary Consultant evaluation has been prepared (see Section 4.3 supplementary E&S evaluation).

(b) Alternatives still open at the Consultant's engagement and examined independently. The configuration and routing of the 10 kV auxiliary power line through the Shardara Reservoir IBA/KBA was still under design at the date of the Consultant's engagement and is examined as an independent alternatives analysis in Section 4.7.

(c) Design refinements remaining feasible within the construction window. A number of design adjustments remain practicable within the residual construction program and are addressed as forward-looking commitments in Section 8 (Impact Assessment) and the construction-phase ESMP. These include: the specification of bird flight diverters and bird-safe pole-top design on the 10 kV overhead lines and the design of noise barriers at Maktaaral and Erdaulet stations. These refinements are not framed as alternatives in the SPS Principle 3 sense — they are mitigation measures designed against the finalized Project — but they reflect the proportionate exercise of the mitigation hierarchy at the current Project stage.

1. Lender review during preparation of this Supplementary ESIA has accepted this framing, on the basis that the ex ante variant-selection record is documented and reviewable, the consultant has identified the supplementary considerations where the record is incomplete, and the late-stage design refinements within the construction window are documented as commitments rather than represented as alternatives that influenced the original selection.

4.2 Project vs No Project Scenario

Under the No Project scenario, the Darbaza–Maktaaral railway expansion would not be constructed. Kazakhstan would continue to rely on transit through Uzbekistan for north–south freight movements on this corridor, the existing rail network would remain unchanged, and the alignment corridor would remain in its current condition (predominantly irrigated agriculture, grazing land, and the Shardara Reservoir wetland system). Table 35 summarizes the comparison of environmental and social impacts between the two scenarios.

Table 35: **Comparison of E&S Impacts between the Project and the No Project Scenario**

#	E&S Topic	Project — Positive	Project — Adverse	No Project — Positive	No Project — Adverse
1	Air quality	Strategic shift of freight from cross-border road and longer rail routings reduces transit-related emissions at the national level.	Construction-phase PM, NOx, CO and SO2 from earthworks, plant, and haul traffic; operational diesel emissions from locomotives.	No new construction or operational emissions along the alignment corridor.	Continued reliance on longer freight routings (including transit through Uzbekistan) results in higher overall transport-sector emissions.
2	Noise and vibration	None expected.	Construction noise from earthworks, piling, bridge works and haul traffic; operational noise from train pass-by	Absence of new noise sources along the alignment.	Continuation of existing ambient noise conditions in the rural receiving environment, with any change over

#	E&S Topic	Project — Positive	Project — Adverse	No Project — Positive	No Project — Adverse
			and horn use, introducing a new noise source to a rural receiving environment.		time driven by background trends in agricultural mechanization and road traffic growth rather than by the Project.
3	Surface water	Improved drainage and culvert provision at crossings is designed to maintain, and in places improve, conveyance of local surface-water flows relative to existing informal crossing conditions.	Risk of sedimentation, turbidity and accidental pollution during bridge and culvert construction at the Syr Darya and Keles crossings; embankment effects on seasonal flows and drainage patterns; potential effects on the Shardara Reservoir hydrological regime.	No new in-river or near-water works.	None additional.
4	Soil quality	Reinstatement of borrow pits and temporary works areas, where properly managed, is expected to restore these areas to a condition comparable to pre-disturbance land use; no net improvement over baseline land quality is assumed.	Disturbance of predominantly saline soils along the alignment; erosion risk on embankments and slopes; potential contamination from fuel, oil, and concrete handling at work fronts.	Existing land condition maintained.	Continuation of existing soil conditions, including ongoing salinization and degradation pressures associated with current agricultural practices, unrelated to the Project.
5	Groundwater	None expected.	Localized dewatering during deep excavations; potential alteration of shallow groundwater flow regimes by embankments; contamination risk from fuel and chemical storage during construction.	No new excavation or embankment effects.	

#	E&S Topic	Project — Positive	Project — Adverse	No Project — Positive	No Project — Adverse
6	Biodiversity	Reinstatement and management of corridors adjacent to the embankment Implemented though the , with appropriate measures (Biodiversity Management Plan, Preliminary BAP), deliver localized habitat enhancements outside the IBA/KBA. This is treated as a mitigation and enhancement commitment rather than an assured outcome, subject to post-construction monitoring.	Permanent habitat loss within the Shardara Reservoir IBA/KBA (Critical Habitat for Dalmatian Pelican, 2–6% of global population); risk of bird collision with the embankment and overhead infrastructure; disturbance of wetland-dependent species; risk of invasive alien species spread along the corridor.	Avoidance of permanent habitat loss within the IBA/KBA; no new collision risk infrastructure.	Ongoing anthropogenic pressures on the reservoir margin, including grazing, agricultural activities and associated disturbance, unrelated to the Project.
7	Land use and ownership	Improved national connectivity may enhance the strategic value of land in the corridor over time.	Permanent land acquisition affecting approximately 371 plots totaling around 417 ha; physical displacement involving 14 households and one legal entity; economic displacement affecting households and legal entities through loss of residential, agricultural and commercial land, structures, crops, trees and other productive assets	No land acquisition; no physical or economic displacement.	None additional.
8	Labour and working conditions	Direct employment for construction and operations workforce; capacity-building opportunities for local workers,	Occupational health and safety risks for workers, including working at height, lifting, excavation, work near water, and electrical works; risks	Absence of new occupational risks.	Fewer employment opportunities for local workers and nearby communities.

#	E&S Topic	Project — Positive	Project — Adverse	No Project — Positive	No Project — Adverse
		subcontractors, and suppliers.	associated with subcontractor management and dispersed work fronts.		
9	Community health and safety	Improved level-crossing infrastructure may enhance road safety relative to informal crossings.	Construction traffic risk on access roads and at crossings; dust and noise nuisance for settlements within ~500 m of works; risks of sexual exploitation, abuse, and gender-based violence and harassment (SEA/GBVH) associated with non-local workforce presence; strain on local social and public infrastructure. Vulnerable groups and persons with disabilities (for example, hearing-impaired individuals who may not reliably perceive audible warnings such as train horns or reversing alarms) may face elevated safety risks from construction traffic and rail operations;	No new community exposure to construction traffic or workforce influx.	None additional.
10	Cultural heritage	Heritage monuments identified during pre-construction surveys may benefit from formal recording and improved awareness.	Direct loss of and impacts on the setting of identified cultural heritage monuments along the alignment, including burial sites classified as emergency monuments; risk of encountering previously unknown artefacts during earthworks.	Heritage setting preserved.	Continued risk of low-level damage from uncontrolled grazing and agriculture.

#	E&S Topic	Project — Positive	Project — Adverse	No Project — Positive	No Project — Adverse
11	Socio-economic conditions	Direct and indirect employment during construction and operations; local procurement opportunities; regional and national economic benefits from improved freight connectivity and reduced reliance on cross-border transit.	Loss of agricultural livelihoods where compensation is not delivered at full replacement cost; loss of income for businesses dependent on existing transport patterns; uneven distribution of benefits between workforce-receiving and project-affected communities.	No livelihood disruption from land acquisition.	Continued absence of new employment opportunities in the corridor; continued exposure of national freight movements to cross-border transit costs and risks.
12	Transport systems	Removal of dependency on transit through Uzbekistan for north–south freight; increased national rail capacity; improved freight reliability and reduced delivery times; reduced pressure on road freight and associated road accident risk.	Temporary disruption to existing road and rail movements at crossings during construction; competition for technical and operational resources during commissioning.	Absence of construction-phase transport disruption.	Continued reliance on cross-border transit; continued exposure to delays, transit charges, and geopolitical risk; persistent inefficiencies in national freight capacity.

On balance, the No Project scenario avoids the construction- and operation-phase adverse impacts of the Project but forgoes the strategic transport, economic, and connectivity benefits that motivated the Project. The principal residual concerns under the Project scenario relate to biodiversity within the Shardara Reservoir IBA/KBA, land acquisition and resettlement, and construction-phase occupational and community health and safety — all of which are addressed through the Supplementary ESIA, the Land Acquisition and Resettlement Plan, the construction and operation ESMPs, and the Biodiversity Management Plan and Preliminary Biodiversity Action Plan.

This is consistent with the completed OVOS, which identifies increased railway capacity, improved transport safety and reliability, improved logistics and regional socio-economic development as principal benefits of implementing the Project.

4.3 Route Direction Variants

The new line was conceptually divided by the designer into two sections for the purposes of variant selection:

- the southern section through Maktaaral and Zhetysay districts, which essentially follows the existing Maktaaral–Zhetysay and Zhetysay–state border railway formation (with reconstruction of the existing track) and crosses the Syr Darya at a structurally pre-determined location (the existing road bridge crossing, where the new railway bridge openings align with

the existing road bridge openings). No real route alternatives existed within the southern section other than the existing formation;

- the northern section through Saryagash and Keles districts, where genuine route alternatives existed for the connection of the new line to the existing Arys–Saryagash line. This is the section in which variant selection was conducted.

Pre-screening.

Three connection points to the existing Arys–Saryagash line were initially considered: Zhilga station (existing); Darbaza station (existing); and Passing Loop 52 (a disused passing loop located 4 km from Darbaza). Joint site review with the Shymkent Branch of KTZ JSC concluded that Darbaza station could not be expanded due to dense urban development around the station. A decision was accordingly taken to use Passing Loop 52, upgrading it to station status — this station was subsequently named Yerdaut.

A third route variant

Proposed as Annex 13 of TEO Volume 1, would have routed the line via Shardara town and Shardara district centre, with exit at Maktaaral.

Variant C (the variant proposed at Annex 13 of TEO Volume 1, routed via Shardara town and Shardara district centre with exit at Maktaaral) was screened out at TEO stage as non-competitive on three grounds: (i) substantial extension of the alignment; Variant B); (ii) crossing of the Shardara Reservoir over a substantially longer span and closer to the central reservoir than the Variant B crossing at the eastern margin of the reservoir, with correspondingly greater hydrological footprint, deeper water at the bridge piers, larger total area within the IBA/KBA exposed to embankment, and higher anticipated bird-collision and disturbance footprint; and (iii) loss of the shortened transit route advantage to Jizzakh and Khavast in Uzbekistan (a key element of the strategic case for the Project). The selected Variant B crosses the Shardara Reservoir at KM 80–90 on raised embankment plus the 500 m Syr Darya bridge at the eastern margin of the IBA, with the alignment configured to constrain the permanent IBA/KBA footprint to approximately 150 ha (c. 0.15% of the total IBA area). Variant C was therefore the more E&S-impactful Shardara crossing in absolute terms, despite the surface description ('crossing of the Shardara Reservoir') being applicable to both

A future spur connection from the main alignment at Intermediate station (KM 70.2) to Shardara town has been recommended in the TEO as a separate future project (not in the current TEO scope), to serve the social, productive, and demographic potential of Shardara town and district.

Two route variants taken forward for detailed comparison:

- **Variant A** — Connection at Zhilga station: Zhilga– passing loop 1 – passing loop 2 – KM 76.0 (start of the Syr Darya bridge).
- **Variant B** — Connection at Yerdaut station (upgraded Passing Loop 52): Yerdault Station – passing loop 1 – PK76.0.

Both variants converge at KM 76.0 (the start of the railway bridge over the Syr Darya River). The two variants were compared against 13 technical, economic, operational, social, and environmental criteria summarized in the table below.

Table 36: Route variant comparison

#	Criterion	Unit	Variant A (Zhilga–PK760+50)	Variant B (Yerdaut–PK760+50)	Preferred variant
1	Total operational length of railway	km	122	118	B
2	Additional operational length	km	31	0	B
3	Length of new construction	km	122	91	B
4	Indicative construction cost	KZT billion	110	82	B
5	Separation points — new / reconstructed	count	6 / 1	4 / 1	B (new); tie (reconstructed)
6	Length of service communications (access roads, power supply, etc.) required	km	30	0	B
7	Distance from settlements (affecting access for railway workers, passengers, and goods)	km	30	–	A
8	Construction complexity	qualitative	Less populated and less agriculturally developed land, with no irrigated agriculture	Built-up populated areas, with sections of irrigated agriculture	A
9	Terrain conditions in the construction area	qualitative	Plain relief over most of the route	Elevation differences on part of the route	A
10	Throughput capacity	train pairs / day	Lower (longer block sections)	–	B
11	Bypass of Saryagash and Tashkent rail node	qualitative	Worse prospect for transferring traffic flows due to greater length	–	B

#	Criterion	Unit	Variant A (Zhilga–PK760+50)	Variant B (Yerdaut–PK760+50)	Preferred variant
12	Total operational length of main route within Kazakhstan	km	120	130	A
13	Environmental impact (atmosphere and land)	qualitative	Emissions from diesel locomotives and occupation of agricultural land along an additional 31 km	–	B

Source: Adapted from TEO Volume 1 section4.1, Table 4.1-1.

Treatment of community-proximity and agricultural-land-take trade-offs. Criterion #7 (Distance from settlements) and criterion #8 (Construction complexity — populated and agriculturally developed land) of Table 36 jointly capture the principal environmental and social trade-off between the two variants. Variant B passes closer to populated areas in Saryagash, Keles and the southern districts than Variant A, and crosses more intensively cultivated irrigated agricultural land (notably the cotton-producing zones of Zhetysay and Maktaaral). The implications include: shorter distances from sensitive noise and dust receptors during construction and operation; a higher number of plot acquisitions and a higher proportion of irrigated agricultural land take (with corresponding livelihood-restoration weight in the LARP); a greater number of cross-corridor passages required to maintain agricultural and livestock connectivity; and a greater number of community engagements required during construction and operation.

KTZ and the designer accepted these trade-offs on the basis that (i) the 31 km of additional alignment under Variant A would have introduced its own land-take, biodiversity, agricultural and community-proximity impacts over a longer corridor, partially offsetting the apparent E&S advantage; (ii) the additional KZT 28 billion of construction cost under Variant A (approximately 25% higher) and the additional 30 km of service communications would have increased the Project's overall resource footprint; (iii) the longer Variant A alignment would have increased operational diesel emissions over the design life; and (iv) the residual community-proximity and agricultural impacts of Variant B were judged to be addressable through the LARP, the construction-phase ESMP, the cross-corridor passage design, and ongoing stakeholder engagement. The community-proximity implications of Variant B are addressed in the impact assessment for noise, dust, traffic, community health and safety (Section 8), and the agricultural-land-take and severance implications are addressed in the LARP and in the cross-corridor passage commitments. The Keles District alignment adjustment described in Section 4.4 demonstrates the operation of community-feedback-driven design refinement within the Variant B corridor.

The variant-selection table in TEO Volume 1 reflects an integrated engineering, economic, operational and (partial) E&S appraisal. For the purposes of confirming alignment with the SPS, IFC PS and AIIB ESF alternatives requirements, the Consultant has prepared the supplementary E&S evaluation set out in . The supplementary evaluation re-presents the E&S dimensions of the two variants alongside the qualitative direction of effect and the Consultant's overall preference.

Table 37: Supplementary E&S Evaluation of Variants A and B

E&S dimension	Variant A (Zhilga connection)	Variant B (Yerdaut connection — selected)	E&S preference
Biodiversity — Shardara IBA/KBA	Both variants converge at KM 76.0 (Syr Darya bridge approach) and cross the same IBA/KBA section. Net direct biodiversity footprint within the IBA/KBA is comparable between variants; differs principally in the alignment northbound of KM 76.0.	Same as Variant A within the IBA/KBA. Outside the IBA/KBA, 31 km shorter alignment reduces overall habitat footprint and corridor effect.	B — narrowly preferred on overall habitat footprint; equal on Critical Habitat exposure.
Community proximity	Further from populated areas; less direct interface with residential receptors during construction and operation. Lower construction-phase noise and dust exposure.	Closer to populated areas; greater number of residential receptors within noise and dust influence zones during construction and operation. Higher number of community engagements and grievance interactions over the life of the Project.	A — preferred on community proximity.
Agricultural displacement	Crosses less irrigated agricultural land. Lower land-take from active cropping; lower agricultural-livelihood impact.	Crosses more irrigated agricultural land, particularly in the southern districts (cotton-producing zone). Higher land-take from active cropping; more polytunnel and soft-fruit production affected.	A — preferred on agricultural displacement footprint.
Cultural heritage proximity	Alignment-specific heritage receptor screening required; based on the Project's geographic context, both alignments cross the historically significant Syr Darya valley and likely encounter similar buried archaeological resources.	Same archaeological context. Specific cultural heritage receptors identified along the Variant B alignment are addressed in the cultural heritage assessment.	Approximately equal; subject to alignment-specific archaeological survey.
Water resources — Syr Darya crossing	Converges at KM 76.0; same Syr Darya crossing as Variant B. No difference in surface-water crossing impact.	Same Syr Darya crossing.	Equal.
GHG — construction phase	Higher embodied emissions from 31 km of additional formation, ballast, rail and structures; higher construction-phase plant emissions over a longer linear footprint.	Lower embodied emissions and construction-phase plant emissions over the shorter alignment.	B — preferred on construction GHG.
GHG — operational phase	Higher per-train operational emissions over the longer alignment (assuming same throughput). Lifecycle Scope 1 emissions higher.	Lower per-train operational emissions over the shorter alignment.	B — preferred on operational GHG.
Air quality — operational	Higher diesel NOx, PM and CO emissions over the longer alignment for the same train throughput.	Lower diesel emissions over the shorter alignment.	B — preferred.

E&S dimension	Variant A (Zhilga connection)	Variant B (Yerdaut connection — selected)	E&S preference
Worker safety / OHS	Longer alignment = larger overall construction exposure (more person-hours at risk); plain relief throughout reduces some specific risks.	Shorter alignment = lower aggregate exposure; some elevation differences may introduce specific localised risks.	B — narrowly preferred on aggregate exposure; manageable on localised risks.
Community health and safety	Lower interaction with residential and agricultural community along the alignment; lower aggregate community-health exposure.	Higher interaction with residential and agricultural community; addressable through ESMP, LARP, cross-corridor passage commitments and GRM.	A — preferred on aggregate community exposure.
Cumulative impact	Longer alignment increases total cumulative footprint when combined with other Turkistan corridor developments.	Shorter alignment reduces total cumulative footprint.	B — preferred on cumulative footprint.
Overall E&S preference	Preferred on three dimensions (community proximity, agricultural displacement, community H&S aggregate exposure).	Preferred on six dimensions (biodiversity overall footprint, construction GHG, operational GHG, operational air quality, worker safety aggregate, cumulative).	B — preferred overall on E&S grounds, with the trade-offs identified.

Conclusion of the supplementary E&S evaluation. The Consultant's supplementary E&S evaluation supports the Variant B selection on overall E&S grounds, while explicitly recognizing that Variant A would have been preferred on community proximity, agricultural displacement and aggregate community H&S exposure. These three dimensions therefore frame the priority focus of the construction and operational mitigation framework set out in Section 8, the LARP, the cross-corridor passage commitments, and the project-level GRM. The selection of Variant B is accordingly consistent with the SPS Principle 3, IFC PS1 section7 and AIIB ESS1 alternatives requirements, with the E&S basis transparently documented and the residual E&S trade-offs explicitly identified.

4.4 Community Feedback-driven Alignment Adjustment (Keles District)

The variant selection in Section 4.3 above resolved the strategic route direction. The detailed alignment within the selected Variant B corridor was further refined following public consultation. Under the Environmental Code of the Republic of Kazakhstan 2 January 2021 № 400-VI ZRK, public hearings on the OVOS documentation are required prior to issuance of the State Ecological Expertise conclusion. Public hearings were convened in each administrative center of the districts crossed by the alignment.

14 April 2023 — Public hearings at Abay village, Keles District, Turkistan Region.

Residents of Abay and adjacent settlements expressed categorical objection to the proposed alignment, which passed through the Keles River valley close to settlement areas. The Akimat of Keles District prepared and presented an alternative route, located approximately north-west of the proposed alignment and approximately 15 km longer overall than the Project-recommended route.

Escalation to national government.

Given the strategic status of the Project (TEO had been confirmed by Government Resolution and First Deputy Prime Minister direction), the public-hearing outcome was reported by KTZ to the Government of the Republic of Kazakhstan. At a working meeting chaired by First Deputy Prime Minister R.V. Sklyar,

a protocol decision was taken to dispatch officials from the Apparatus of the Government of the Republic of Kazakhstan to Keles District to investigate the situation in the field.

22 April 2023 — Working Group at site.

A Working Group on the determination of the alignment of the Darbaza–Maktaaral railway project was convened on site under the chairmanship of Mr E.K. Uskenbayev (Head of the Infrastructure Development Sector, Real Sector and Regions Development Department, Apparatus of the Government of the Republic of Kazakhstan), with Mr Zh.B. Akhmetov (Regional Inspector, Real Sector and Regions Development Department, Apparatus of the Government). In attendance: representatives of KTZ JSC, the Maslikhat (representative legislative body) and Executive Body of the Oblast (MIO), and the designer (Transproekt-K). The Working Group, recognizing the high risk of further community protest, instructed:

- Transproekt-K — to take the protest risks into account and, in agreement with the Akimat of Keles District (Turkistan Region), to develop a new alignment for the affected section of the Project;
- KTZ JSC — to amend the technical assignment for the Project, specifying the precise alignment.

Final alignment. Per the Working Group's instructions, Transproekt-K revised the alignment in the Keles District section. The revised alignment was agreed with the Akim of Turkistan Region, the Akimats of Keles and Saryagash districts, and KTZ. The final alignment bypasses the Keles River valley between Abay and Kyzylasker villages, with the main route running westwards along the Kuryukkeles River valley. The corrected alignment retains the staging structure of the Project but increases the total alignment length within Kazakhstan.

Confirmatory public hearings — 20 and 21 July 2023. Public hearings on the final alignment were held in four districts of Turkistan Region (Saryagash, Keles, Shardara/Zhetysay, and Maktaaral). The four districts' hearings confirmed the corrected final alignment. a summary of attendance, issues raised and responses given is provided in Section 9 (Stakeholder Engagement and Grievance Mechanism) and the consultation record annexed to that chapter. Consultations on livestock movement through pasture areas were also a material input to the design process. Subsequent consultation with affected communities and local authorities identified locally important livestock routes and informed the location and dimensions of crossing structures, including the 4.0 × 2.5 m livestock passages at KM 22.9, KM 42.8 and KM 55.1. These consultations and their relationship to the Project crossing design are described further in Section 8.4.1 (AF001) and Section 9.

4.5 Traction Variants

Industry baseline.

International railway practice recognizes that electrification provides comprehensive multi-functional strengthening of railway infrastructure, with significant benefits including: lower freight transport unit costs; lower energy consumption; higher section speeds and heavier train loads; elimination of harmful emissions to the environment; improved working conditions for operational staff; lower operational, maintenance and equipping costs compared with diesel traction; higher reliability; and better performance on heavy gradient profiles. The principal disadvantage of electrification is the high capital cost of contact-line infrastructure, traction substations, external electricity supply, and additional maintenance staff.

Rationality test.

In the specific case of this Project, electric traction would be technically rational because the connecting lines on both sides of the Project — the Arys–Saryagash line in Kazakhstan and the connecting Uzbek line — are already electrified.

Decision criterion.

KTZ applied the standard variant-selection criterion for traction: the lower of total reduced construction-plus-operational costs over a 20-year comparison period.

External electricity supply scheme.

A scheme for external electricity supply for an electrified railway was developed by the designer (Annex 14 of TEO Volume 1). The scheme was submitted for technical approval to the regional electricity distribution operator, ТОО "Оңтүстік Жарық Транзит" (Southern Light Transit). The regional operator did not approve the electrification proposal, citing lack of technical capacity to connect the additional power demand to the regional grid (Annex 15 of TEO Volume 1, letter № 06-692 of 24 February 2023).

Strategic context.

The TEO further notes that the southern Turkistan Region is energy-deficient, that connection of additional industrial loads is constrained, and that this constraint is unlikely to be resolved on a TEO design horizon (less than 10 years).

Decision

Diesel traction. Based on (i) the regional operator's refusal of additional electricity capacity, (ii) the energy-deficiency of southern Turkistan Region, and (iii) the resulting infeasibility of electrification on a TEO-stage timescale, KTZ and the designer concluded that the Project should be developed and built on diesel traction. This decision was confirmed at the First Deputy Prime Minister R.V. Sklyar working meeting.

Future electrification option preserved.

The TEO recognizes global trends towards green-economy transitions, the projected continued rise in diesel fuel costs relative to electricity costs, and the desirability of electrification once the regional electricity supply position improves. Accordingly, the TEO has retained the electrification design as a separate supplementary deliverable, brochure 747605/2022/1-Э ("Electrification and locomotive economy for the electric-traction variant"), not included in the TEO scope but available as reference material for a future modernization stage when regional electricity supply allows. The decision is recorded as an expert assessment of a future perspective electrification stage, dependent on objective indicators and conditions emerging over a period of 10 years or more.

Implications for the ESIA.

The diesel-traction decision has the following consequences for the ESIA assessment:

- Construction-phase and operational-phase air quality emissions are higher than would have been the case under electric traction.
- Construction-phase and operational-phase GHG emissions are higher than would have been the case under electric traction.
- The strategic emission case for the Project (set out above — Project vs No Project) relies on modal-shift benefits (freight from longer rail routings and from cross-border road) rather than on lower per-ton-km emissions from electrification. The modal-shift benefits are documented in the Project's transport demand modelling.
- The future electrification option remains a residual mitigation pathway for the Project's operational GHG and air-quality emissions.

4.6 Staging Alternatives

The TEO Volume 1 Section 4.2 documents the staging structure of the Project. Two staging-sequence variants were considered:

- Staging variant 1: Stage 1 = Yerdaut – PL1 – PL2 – Intermediate – PL3 – Maktaaral (109.8 km); Stage 2 = Zhetysay – state border via Irjarskaya (12.9 km), with 5 km of slip connection between the new alignment and the existing Maktaaral–Zhetysay line without entry into Maktaaral station; Stage 3 = PL1 – state border via Uzbekistan (37 km), classified as perspective.
- Staging variant 2: Stage 1 = Yerdaut – PL1 – state border via Uzbekistan (37 km), classified as perspective; Stage 2 = PL1 – Maktaaral (86.8 km); Stage 3 = Zhetysay – state border via Irjarskaya (12.9 km), with 5 km slip without entry into Maktaaral station.

The decision on staging was taken with reference to the higher-level Government Protocol of 24 January 2023 № 17-04/07-1220, paragraph 1.3.1, chaired by the Prime Minister of the Republic of Kazakhstan (Annex 10 of TEO Volume 1).

Selected staging structure (incorporating the corrected alignment from section4.4):

- Stage 1 — Yerdaut – Maktaaral – state border (Syrdarya), with modernisation of the existing Maktaaral – state border – Syrdarya section and the border crossing point;
- Stage 2 — Maktaaral – Zhetysay – state border (Irjarskaya);
- Stage 3 — PL1 – state border (Uzbekistan) — perspective only, not included in the TEO.

The current Supplementary ESIA addresses Stage 1 only. Stages 2 and 3 are not within the ESIA scope and are subject to separate ESIA preparation if and when KTZ proceeds with them.

4.7 Alternative 10kV Auxiliary Power Line

The Project includes a 10 kV power distribution system running along the railway alignment to supply feeder station posts (FSPs) that provide auxiliary power for signaling, communications, station services, and ancillary railway infrastructure. Two distinct design decisions are relevant to the alternatives analysis: (i) the circuit configuration of the 10 kV system as a whole, and (ii) the routing of the section that passes through and adjacent to the Shardara Reservoir Important Bird Area / Key Biodiversity Area (IBA/KBA).

Circuit configuration

Three configurations were considered for the system as a whole:

- FSP01 — Single-end fed (daisy chain). A single source supplies all FSPs sequentially along one cable. A fault at the source or in any cable section disables every FSP downstream of the fault. No redundancy is provided.
- FSP02 — Dual-end fed with normally-open mid-point. A single cable runs between two substations with a normally-open point near the middle. Each substation feeds one half of the line under normal conditions. Following a fault, the open point is relocated by switching, allowing any FSP to be re-fed from either substation. This arrangement provides N-1 resilience but requires fault isolation and switching before supply is restored, resulting in a short-duration outage. This is the configuration most commonly adopted on UK and European distribution networks.
- Two parallel, continuously energized circuits. Two full-length cables run continuously in parallel between the two substations, with each FSP connected to both. Either cable can supply every FSP independently and, in the event of a fault on one circuit, supply continues from the other without interruption. This arrangement provides higher redundancy than FSP02 but with materially greater capital cost and operational complexity.

KTZ have selected the two-parallel-circuits configuration to avoid the reliability limitations of the daisy-chain arrangement and to ensure continuous supply in the event of a cable fault, in response to

the remoteness of much of the alignment, the long lead times associated with locating and repairing faults in extended rural corridors, and the operational consequences of any interruption to signalling and communications.

Biodiversity context within the Shardara Reservoir IBA/KBA

The Shardara Reservoir IBA/KBA is the section of the alignment with the greatest sensitivity to overhead infrastructure. The reservoir is internationally designated by BirdLife International on the basis of three IBA criteria — globally threatened species (A1), congregatory waterbird species (A4i), and a waterbird assemblage of more than 20,000 individuals (A4iii) — and is co-listed as a Key Biodiversity Area. Nine IBA/KBA-qualifying species are documented at the site, ranging from the Dalmatian Pelican (Pelecanus crispus, IUCN Near Threatened, Kazakhstan Red Data Book, 2–6% of global population) to a suite of congregatory waterbirds including Greylag Goose, Mallard, Common Teal, Tufted Duck, Smew, Goosander, and Pygmy Cormorant. Project-specific surveys (winter 2025 and 2026) recorded additional species of conservation concern within the alignment's area of influence, including Steppe Eagle (IUCN Endangered), Common Pochard (Vulnerable), Ferruginous Duck (Near Threatened), Northern Lapwing (Near Threatened), White-tailed Eagle, Peregrine Falcon, and Whooper Swan. The reservoir lies on the Central Asian Flyway and supports a winter assemblage that has historically exceeded 100,000 individuals.

The Project's Critical Habitat Assessment confirms the Shardara Reservoir IBA/KBA as Critical Habitat. Under IFC PS 6 and ADB SPS Safeguard Requirement 1, the Project's biodiversity mitigation framework (set out in Chapter 8 and the Biodiversity Management Plan, with offsetting addressed through the Preliminary Biodiversity Action Plan) requires that impacts on Critical Habitat features demonstrably achieve Net Gain in the affected biodiversity values relative to the baseline, and that impacts on Natural Habitat features achieve at least No Net Loss, and preferably Net Gain. Overhead linear infrastructure within waterbird-significant areas is a recognized source of bird mortality through collision, with risk highest for large-bodied, less-maneuverable species (pelicans, swans, large ducks, and geese) and for nocturnal and crepuscular migrants. Raptors, which generally have better eyesight and collision-avoidance ability, are instead disproportionately at risk of electrocution on lower-voltage lines through perching and wing/body contact across live conductors; this risk is addressed through bird-safe pole-top design and insulation of exposed live parts (see mitigation commitments below), consistent with published guidance on raptors and overhead electrical systems.

Routing options considered

Three options for the routing of the 10 kV system through the IBA/KBA were considered:

- Option A — Overhead, two parallel circuits. Both circuits are constructed as overhead lines throughout, including across the IBA/KBA. This is the lowest-capital-cost option for the line itself. Residual bird collision risk affecting both Critical Habitat-triggering species and species assessed as Natural Habitat features cannot be eliminated through standard mitigation measures and will require offsetting calibrated to deliver Net Gain and No Net Loss respectively.
- Option B — Buried, two parallel circuits. The parallel-circuit arrangement is retained but with both cables buried through the IBA/KBA. This eliminates collision risk at source and removes the requirement for offsetting in respect of overhead line collision. Capital cost is highest of the three options for the line itself.
- Option C — Buried, dual-end fed (FSP02) single circuit. A single cable is buried through the IBA/KBA, operated in the FSP02 configuration. This eliminates collision risk at source in the same way as Option B but at substantially lower cost than burying two parallel circuits, accepting a short-duration outage in the event of a cable fault on the buried section (mitigated by the materially lower fault rates of buried cables relative to overhead lines).

Options B and C represent application of the avoidance step of the mitigation hierarchy at source and would, accordingly, present the lowest residual risk to qualifying biodiversity values. The Consultant identified Option C as the preferred alternative on environmental and social grounds, balancing biodiversity outcomes against capital cost and operational redundancy.

Selected option

This Supplementary ESIA assumes that Option A (overhead, two parallel circuits) will be taken forward for the IBA/KBA section, based on KTZ's current indication, on the grounds of capital cost and consistency with the configuration adopted for the remainder of the alignment. KTZ have advised verbally that burying the line through the IBA/KBA section would be materially more expensive than the overhead configuration. No quantitative cost comparison between the three options has been made available to the Consultant.

Under the mitigation hierarchy applicable to Critical Habitat and Natural Habitat features, the consequence of selecting Option A is that residual collision impacts on qualifying species cannot be avoided at source and must instead be managed through minimization and offsetting in order to demonstrate Net Gain for Critical Habitat features and No Net Loss (preferably Net Gain) for Natural Habitat features.

Consequential mitigation and offset requirements

The selection of Option A places additional weight on the project's biodiversity minimization and offsetting program. The following measures are accordingly required and are addressed in detail in Chapter 8, the Biodiversity Management Plan, and the Preliminary Biodiversity Action Plan:

- **Minimization through enhanced collision mitigation.** The overhead line through the IBA/KBA section is to be designed and constructed with collision mitigation measures appropriate to the affected species assemblage, including but not limited to bird flight diverters at appropriate spacing along all conductors, increased conductor visibility, removal of earth wires where compatible with system design, and species-specific marking where supported by current evidence (notably for Dalmatian Pelican and large raptors).
- **Pre- and post-construction monitoring.** Systematic carcass searches, vantage-point surveys, and species-specific monitoring (including for Critical Habitat-triggering species and the wider qualifying assemblage) are required from pre-construction through commissioning and into operation, with a minimum monitoring period of three years post-energization, to verify mitigation performance and quantify residual mortality for offset calibration.
- **Biodiversity offsets.** A funded and binding offset program is required, designed to deliver Net Gain for each Critical Habitat-triggering species affected by residual collision mortality, and No Net Loss (preferably Net Gain) for affected species and habitats assessed as Natural Habitat features. The offset program is to be developed through the Preliminary Biodiversity Action Plan, in consultation with the relevant national conservation authorities, BirdLife International, the Association for the Conservation of Biodiversity of Kazakhstan (ACBK), and other relevant stakeholders. Offset design and delivery are subject to the technical and operational uncertainties characteristic of bird-population offsets and should accordingly be sized with conservative loss-multiplier assumptions and supported by a contingency mechanism to address underperformance.
- **Adaptive management.** Where monitoring confirms that residual mortality exceeds the levels assumed in the offset design, the Project will be required to deploy additional minimization measures and to scale up the offset program accordingly, until Net Gain and No Net Loss can be demonstrated to lender satisfaction.
- The remaining overhead sections of the 10 kV line outside the IBA/KBA are to incorporate standard bird collision mitigation measures (bird flight diverters at key crossings, appropriate

conductor spacing, and earth-wire management) as set out in the Biodiversity Management Plan, on the basis that wetland-dependent and migratory bird use of the corridor outside the designated IBA/KBA is lower but not negligible.

5. Methodology

5.1 Impact Assessment (IA) as a Process

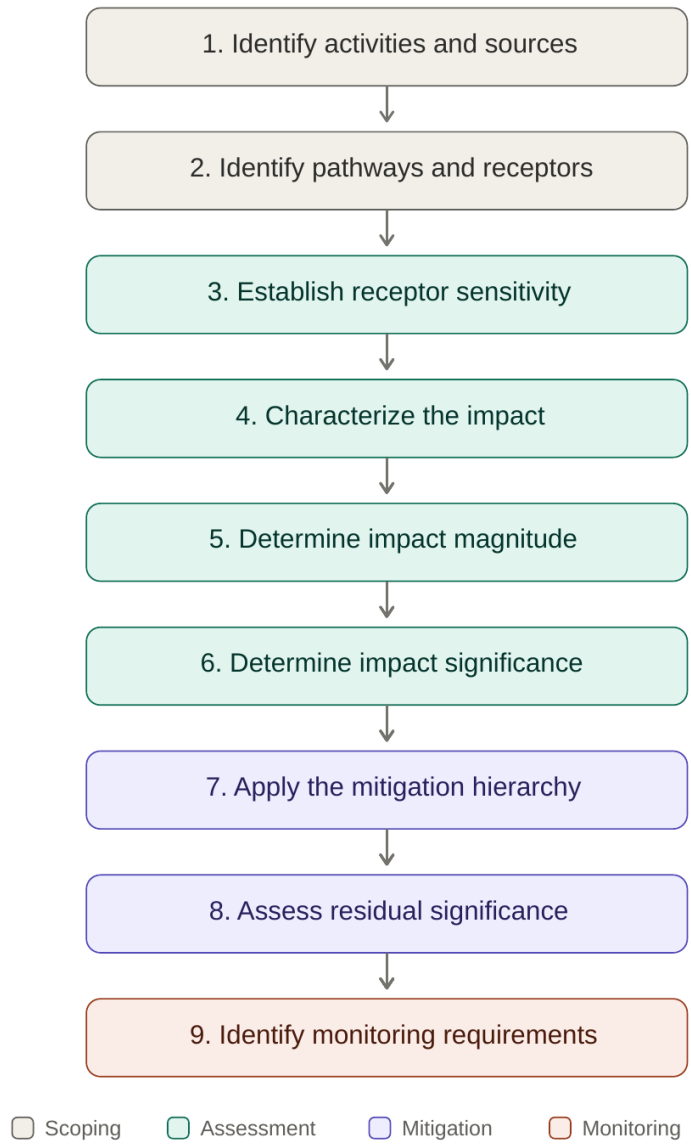
The impact assessment undertaken for this Supplementary ESIA follows a source–pathway–receptor approach. Project activities and sources of potential impact are identified for each relevant stage of the Project and the pathways through which these may affect environmental and social receptors are established. The sensitivity or vulnerability of the receptor and the magnitude of the predicted change are then evaluated to determine impact significance.

The assessment process comprises the following principal steps:

1. **Identify Project activities and sources of impact** associated with design, land acquisition, construction, operation and maintenance.
2. **Identify impact pathways and receptors** through which Project activities may result in environmental or social change.
3. **Establish receptor sensitivity or vulnerability**, taking account of the value, importance, legal or conservation status, resilience, adaptive capacity and dependence of the receptor, as applicable.
4. **Characterize the impact**, including its nature, spatial extent, duration, frequency, intensity or scale, reversibility and, where relevant, likelihood of occurrence.
5. **Determine impact magnitude** based on the characteristics of the predicted change relative to baseline conditions and applicable standards or thresholds.
6. **Determine impact significance** by considering impact magnitude together with receptor sensitivity or vulnerability.
7. **Apply the mitigation hierarchy**, prioritizing avoidance, followed by minimization and mitigation, and where significant residual impacts remain, compensation or offsetting where applicable.
8. **Assess residual significance** following implementation of the committed mitigation and management measures.
9. **Identify monitoring and adaptive-management requirements** where these are necessary to verify predictions, demonstrate mitigation effectiveness or respond to uncertainty.

The general assessment process is illustrated in Figure 15.

Figure 15: Impact Assessment Process



The methodology provides a consistent framework across environmental and social topics while recognizing that certain impacts and risks require specialist assessment approaches. These include biodiversity and Critical Habitat, noise and vibration, air quality, greenhouse-gas emissions, climate and natural hazards, occupational and community health and safety, and accidental or emergency events. Where a recognized quantitative standard, model, guideline or topic-specific methodology is available, this takes precedence over generic qualitative criteria and is identified in the relevant assessment section.

The assessment distinguishes between embedded measures, which are already incorporated into the Project design or committed Project arrangements, and additional mitigation measures identified through the Supplementary ESIA. Embedded measures form part of the Project being assessed. Pre-mitigation significance therefore represents the significance of an impact associated with the defined Project before application of additional ESIA mitigation. Residual significance represents the significance remaining following implementation of all additional committed mitigation measures.

As this Supplementary ESIA has been undertaken after construction commenced, the assessment also distinguishes between impacts that have already occurred or are occurring, impacts associated with remaining construction activities, and future operational impacts and risks. Where activities have already occurred, the assessment draws on available monitoring information, site observations, the Environmental and Social Compliance Audit (ESCA), stakeholder consultation, Project records and the national environmental assessment documentation to identify actual effects and any corrective or remedial measures required. Predictive assessment is applied to remaining construction activities and future operation and maintenance.

This approach allows the Supplementary ESIA to assess both the environmental and social consequences of the Project as currently implemented, and the risks and impacts associated with its completion and future operation.

5.2 Applicable Lender Requirements and Good International Industry Practice

The methodology applied in this Supplementary ESIA has been developed to meet the environmental and social assessment requirements of the Project Lenders and applicable Good International Industry Practice (GIIP). The applicable policy and legal frameworks are described in detail in Chapter 3 and are not repeated here.

The principal lender frameworks informing the assessment methodology are:

- the **Asian Development Bank Safeguard Policy Statement (2009)**, including Safeguard Requirement 1 on Environment and Safeguard Requirement 2 on Involuntary Resettlement;
- the **IFC Performance Standards on Environmental and Social Sustainability (2012)**, in particular PS1 on Assessment and Management of Environmental and Social Risks and Impacts and the topic-specific requirements of PS2–PS8; and
- the **AIIB Environmental and Social Framework (2024)**, principally ESS1 on Environmental and Social Assessment and Management and ESS2 on Land Acquisition and Involuntary Resettlement.

The assessment also applies the World Bank Group General Environmental, Health and Safety Guidelines and the applicable sector-specific EHS Guidelines, including the EHS Guidelines for Railways, as technical benchmarks for pollution prevention, resource efficiency, occupational and community health and safety, and other relevant technical matters.

Across these frameworks, the central methodological principles applied in this Supplementary ESIA are consistent:

1. **Proportionality to risk and impact.** The level of assessment effort is proportionate to the nature, scale, sensitivity and significance of the potential environmental and social risks and impacts. Topics capable of giving rise to significant impacts are therefore assessed in greater depth than those for which impacts are demonstrably limited or readily controlled.
2. **Assessment across the Project lifecycle.** Risks and impacts are considered, as relevant, during design, land take, construction, operation and maintenance. Because construction commenced before preparation of this Supplementary ESIA, the assessment additionally distinguishes between impacts that have already occurred and those that remain prospective.
3. **Consideration of direct, indirect and cumulative effects.** The assessment considers reasonably foreseeable direct and indirect impacts arising from the Project and, where relevant, cumulative effects arising from interaction with other existing, planned or reasonably foreseeable developments.

4. **Consideration of environmental and social receptors together.** The methodology recognizes that Project activities may affect physical, biological, cultural and human receptors and that receptor sensitivity includes both environmental value and social vulnerability or dependence.
5. **Application of the mitigation hierarchy.** Avoidance is prioritized wherever practicable, followed by minimization and mitigation of adverse effects. Restoration, compensation or offsetting are applied where relevant to residual impacts that cannot otherwise be adequately addressed.
6. **Use of recognized standards and quantitative methods.** Where applicable regulatory limits, lender standards, recognized modelling methods or specialist assessment criteria exist, these are used in preference to generic qualitative judgement. Examples include air-quality standards, noise and vibration criteria, biodiversity Critical Habitat requirements, occupational and community health and safety standards and greenhouse-gas accounting methods.
7. **Precaution under uncertainty.** Where important environmental or social risks cannot be reliably excluded because of limitations in available baseline information, uncertainty is explicitly identified and a precautionary approach is applied where warranted by receptor sensitivity or potential consequence.
8. **Stakeholder-informed assessment.** Issues raised through stakeholder engagement, grievance records and consultation with affected communities are treated as an important source of information for identifying receptors, impact pathways, vulnerability and locally significant effects.
9. **Management, monitoring and adaptive response.** Where impact predictions depend on assumptions that cannot be fully verified at the assessment stage, monitoring requirements and defined management responses are established through the ESMP and associated topic-specific management plans.

GIIP has additionally informed the selection of assessment methods, mitigation measures and management controls. This includes relevant IFC and World Bank Group guidance, internationally recognized technical standards, and accepted professional practice for railway infrastructure, construction management, biodiversity, pollution prevention, occupational and community health and safety and stakeholder engagement.

The methodology therefore provides a common assessment framework across the Project while allowing recognized topic-specific methodologies to be applied where these provide a more appropriate basis for evaluating a particular impact or risk.

5.3 Scoping Methodology

The ESIA scoping methodology determines which environmental and social topics are scoped in for detailed assessment in this Supplementary ESIA, and which are scoped out with rationale. Scoping criteria comprise: (a) lender safeguards trigger — topics for which applicable Lender requirements establish specific assessment requirements (e.g. Critical Habitat under IFC PS6); (b) baseline sensitivity — topics where baseline conditions indicate particular sensitivity or vulnerability to Project-induced change; (c) Project mechanism — topics where a credible source–pathway–receptor relationship exists between the Project and an environmental or social receptor; (d) stakeholder concern — topics identified as material through stakeholder engagement or grievances; (e) potential consequence — topics involving reasonably foreseeable events or circumstances that could result in serious environmental, worker or community consequences, even where the likelihood of occurrence is low; and (f) precautionary application — topics where available evidence is incomplete or uncertainty remains, but receptor sensitivity, potential consequence or Lender requirements warrant further assessment.

Scoping is iterative and has been reviewed as the Project design and evidence base have developed. In particular, scoping has taken account of information from the TEO and national environmental assessment documentation, including the completed OVOS; findings from the ESCA and site investigations; specialist studies and modelling; stakeholder engagement; and the status and effects of construction activities already undertaken. A topic initially considered unlikely to result in a material effect may therefore be brought into detailed assessment where subsequent information identifies a credible impact pathway, increased receptor sensitivity, material stakeholder concern or greater uncertainty than previously understood.

Scoping outcome. Section 6 documents the outcome of the scoping process, identifying the topics scoped IN for detailed assessment and those scoped OUT with supporting rationale. Topics scoped IN are assessed in Section 8 using the methodology set out in the following sections. Topics scoped OUT are retained in the scoping record with sufficient justification to demonstrate why detailed assessment is not required. The scoping outcome can therefore be reviewed against the criteria established above and revisited where new information materially changes the basis for the original scoping decision.

5.4 Identification of Project Activities, Sources and Impact Pathways

The assessment identifies environmental and social impacts through consideration of the relationship between Project activities, sources of change, impact pathways and receptors. An impact can occur only where a Project activity or source has a credible pathway through which it can affect an environmental or social receptor.

Project activities have been considered across the relevant stages of the Project lifecycle, including:

- land acquisition and site preparation;
- construction of the railway formation, bridges, culverts, stations, passing loops and ancillary infrastructure;
- operation of construction camps, batching plants, borrow areas, material-storage areas and other temporary facilities;
- construction traffic and movement of workers, equipment and materials;
- testing and commissioning;
- railway operation, including train movements, stations, locomotive servicing and fuelling, dangerous-goods movements and maintenance activities; and
- routine and periodic maintenance of the railway, structures, drainage systems and associated infrastructure.

For each activity, the assessment identifies the source or mechanism of environmental or social change. These may include, for example, physical land take, vegetation clearance, excavation, emissions to air, noise and vibration, wastewater discharge, changes in surface-water flow or drainage, generation of waste, use of natural resources, traffic movements, workforce presence, restrictions on access, hazardous-material storage or transport, and the presence and operation of permanent infrastructure.

An impact pathway describes the mechanism through which the source may result in a change to a receptor. Pathways may be direct or indirect and may operate through physical, biological or social processes. Examples are shown in the following figure.

Figure 16: Source–Pathway–Receptor Model as Applied to the Impact Assessment



Where no credible pathway exists between a Project activity and a receptor, no Project-related impact is predicted and the issue may be scoped out from detailed assessment, subject to the scoping process described in Chapter 6.

The assessment considers direct, indirect and induced impacts**,** where relevant. Direct impacts arise from a direct interaction between a Project activity and a receptor, such as permanent habitat loss within the railway footprint. Indirect impacts occur through an intermediate environmental or social pathway, such as changes in drainage affecting agricultural land beyond the immediate Project footprint. Induced impacts are secondary changes facilitated or stimulated by the Project, where these are reasonably foreseeable and attributable to the Project.

The assessment also distinguishes between planned activities and unplanned events**.** Planned activities are assessed principally through the magnitude–sensitivity methodology described in Sections 5.5–5.7.

Where several Project activities affect the same receptor, their combined Project-level effect is considered within the relevant topic assessment rather than assessing each activity in isolation. Interaction with impacts from other existing, planned or reasonably foreseeable developments is addressed through the cumulative impact assessment methodology described in Section 5.11.

The source–pathway–receptor approach is applied proportionately. Detailed quantitative assessment or modelling is undertaken where required by applicable standards, where receptor sensitivity is high, where significant effects are reasonably foreseeable, or where qualitative assessment alone would not provide sufficient confidence in the predicted outcome. For other impacts, assessment is based on available baseline information, Project design information, site observations, stakeholder information and professional judgement.

5.5 Identification and Sensitivity of Valued Environmental and Social Receptors

The impact assessment is structured around a defined set of Valued Environmental and Social Receptors (VERs). For the purposes of this Supplementary ESIA, a VER is a physical, biological, social, socio-economic or cultural feature, resource, individual, group or system that may experience change as a result of the Project and for which a value or sensitivity can be established.

VERs provide the formal link between the environmental and social baseline and the impact assessment. They are identified principally from the baseline conditions described in Section 7, supplemented by information obtained through stakeholder engagement, the ESCA, specialist studies and modelling, the national environmental assessment documentation, including the OVOS, and observations made during preparation of the Supplementary ESIA. The VERs identified for this Project are presented in Section 8.2 and are assigned unique reference numbers which are carried through the impact assessment tables, allowing individual impacts and significance ratings to be traced back to the receptors on which the assessment is based. This reflects the existing structure of Chapter 8, in which VER numbers are intended to provide traceability between the receptor register, impact tables and residual-effects assessment.

The identification of a VER does not in itself indicate that a significant impact will occur. Rather, the VER identifies what may be affected by a Project activity. The significance of the resulting effect is determined through consideration of the sensitivity of that VER together with the magnitude of the predicted Project-induced change, as described in Sections 5.6 and 5.7.

5.5.1 Identification of VERs

VERs are identified where the source–pathway–receptor analysis described in Section 5.4 demonstrates that a Project activity has a credible pathway through which it could affect an environmental or social receptor. The definition of VERs is proportionate to the nature of the Project and the level of assessment required. VERs may include, as applicable:

- **physical environment receptors**, including surface-water and groundwater resources, soils, air-quality-sensitive receptors and the acoustic environment;
- **biological receptors**, including habitats, species and species assemblages, protected areas, internationally recognized biodiversity areas and ecosystem services;
- **human receptors**, including residents, land users, farmers, livestock owners, road and railway users and Project workers;
- **social and socio-economic receptors**, including livelihoods, agricultural production, community infrastructure, access routes, public services and community cohesion;
- **cultural heritage receptors**, including known archaeological resources, built heritage, cemeteries, sacred sites and other tangible or intangible cultural heritage; and
- **vulnerable or disadvantaged individuals or groups** who may experience Project impacts disproportionately or have reduced capacity to avoid, withstand, adapt to or recover from adverse effects.

The VER framework is intended to identify actual receptors or resources capable of experiencing Project-induced change. Standards, guideline values and regulatory thresholds are not themselves VERs; rather, they provide criteria against which changes affecting the relevant receptor may be evaluated. Similarly, an impact mechanism, such as noise, dust or severance, is not a VER; the VER is the environmental or social receptor affected by that mechanism.

Where several baseline features have similar characteristics and would respond similarly to a Project impact, they may be grouped into a single VER for assessment purposes. Conversely, where receptors

within the same broad category have materially different sensitivities or exposure to the Project, they are assessed separately.

5.5.2 Determination of VER Sensitivity

Each VER is assigned a sensitivity rating appropriate to the particular impact being assessed. Sensitivity represents the importance or value of the receptor together with its susceptibility to the type of Project-induced change under consideration.

Sensitivity is therefore impact-specific rather than an immutable characteristic of a receptor. The same receptor may have different sensitivity to different forms of change. For example, a community may have relatively high sensitivity to permanent loss of access to agricultural land but lower sensitivity to a short-duration and readily reversible construction disturbance.

Determination of sensitivity is based on professional judgement supported by the available baseline evidence and, as relevant, consideration of:

- statutory or policy protection;
- local, regional, national or international importance;
- ecological, social, cultural or economic value;
- rarity, uniqueness or irreplaceability;
- vulnerability or susceptibility to the particular change;
- existing condition and resilience;
- capacity and timescale for recovery;
- dependence upon the affected resource, service, livelihood or access arrangement;
- availability of realistic alternatives or substitutes;
- stakeholder values and concerns;
- vulnerability or disadvantage of affected individuals or groups; and
- the consequences of loss or deterioration of the receptor.

The sensitivity assigned to each VER is classified as **Low, Moderate, High or Extreme**, using the general framework presented in Table 38.

Table 38: General Criteria for VER Sensitivity

Sensitivity	General criteria
Low	A receptor of predominantly local importance or relatively low environmental, ecological, social, cultural or economic value. The receptor is common or readily replaceable, has relatively low susceptibility to the predicted change and/or has a high capacity to accommodate, adapt to or recover from the change. For human receptors, reasonable alternatives or coping mechanisms are readily available and the predicted change would not materially affect wellbeing or livelihood security.
Moderate	A receptor of local or regional importance with recognized environmental, ecological, social, cultural or economic value and/or moderate susceptibility to the predicted change. The receptor has some capacity to accommodate, adapt to or recover from the change, although this may require time, intervention or expenditure. For human receptors, there may be meaningful dependence upon the affected resource, livelihood, access arrangement or service, but reasonable alternatives or adaptive capacity remain available.

Sensitivity	General criteria
High	A receptor of national importance, or a receptor of substantial environmental, ecological, social, cultural or economic value, which is highly susceptible to the predicted change and/or has limited capacity to adapt or recover. This may include legally protected or nationally important biodiversity or cultural heritage features, important water resources, communities with high dependence upon affected land or resources, or vulnerable groups with limited adaptive capacity.
Extreme	A receptor of international or exceptional importance and/or one for which loss or substantial deterioration could result in irreversible or effectively irreplaceable consequences. This may include internationally recognized biodiversity features where relevant to the impact pathway, qualifying Critical Habitat features, cultural heritage of exceptional significance, or human receptors where the predicted change could have exceptionally severe consequences and there is very limited capacity for avoidance, adaptation or recovery.

The criteria in the table above provide a common framework across the Supplementary ESIA and are not intended to replace recognized topic-specific approaches. Where legislation, Lender requirements, international guidance or established specialist methodologies provide more appropriate criteria for determining receptor sensitivity, these are applied in the relevant topic assessment and the basis for the rating is explained.

For biodiversity, for example, sensitivity takes account of conservation status, habitat importance, ecological function, distribution, irreplaceability and the relevance of protected-area, Key Biodiversity Area (KBA), Important Bird and Biodiversity Area (IBA), Natural Habitat and Critical Habitat designations. The existence of a designation does not automatically determine the significance of a Project impact; the ecological feature affected, its relationship with the designation and the nature and magnitude of the predicted change are considered.

For social receptors, sensitivity takes account of factors including livelihood dependence, land and natural-resource dependence, vulnerability or disadvantage, access to alternative resources or services, ability to adapt to change and the distribution of effects between different groups. Vulnerable or disadvantaged status therefore informs sensitivity but does not automatically result in a predetermined impact-significance rating.

For physical environment receptors such as water resources, soils and the acoustic environment, sensitivity is determined with reference to existing condition, use, environmental function, applicable protection or quality objectives, the presence and sensitivity of human or ecological users, and the receptor's capacity to accommodate the predicted change.

5.5.3 Value and Sensitivity

The importance or value of a receptor and its sensitivity to change are related but distinct considerations. Local, regional, national or international importance may inform the sensitivity rating but does not automatically determine it. A receptor of national or international importance may have relatively low susceptibility to a particular Project-induced change, while a receptor of primarily local importance may be highly sensitive where affected people or ecological functions have limited alternatives or capacity to recover.

Accordingly, the sensitivity ratings applied in the impact assessment reflect the specific receptor–impact relationship, supported by the baseline evidence and professional judgement. The rationale for the assigned sensitivity is provided in the VER register in Section 8.2 and, where necessary, further explained in the relevant topic assessment.

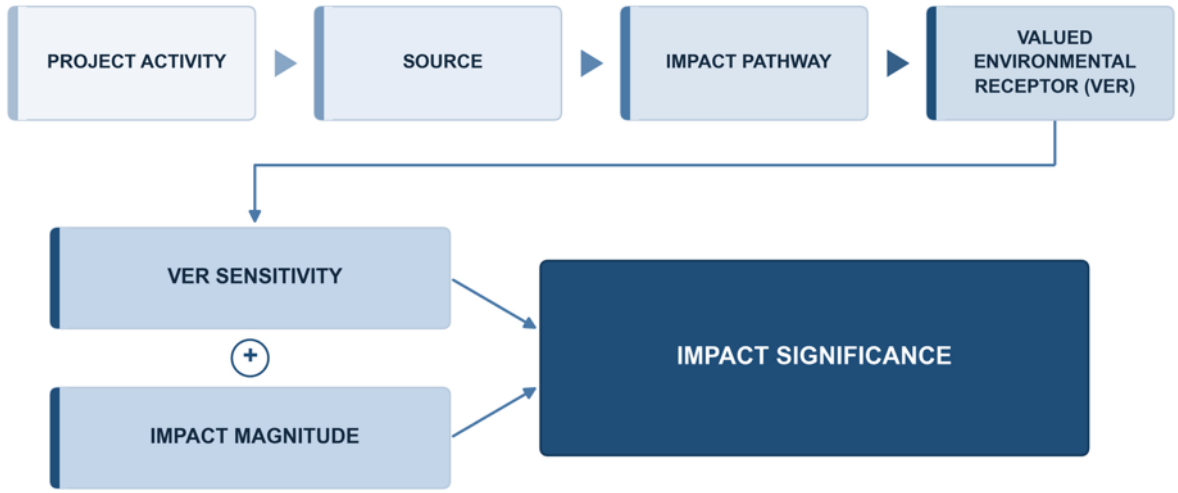
Where information is insufficient to establish receptor sensitivity confidently, uncertainty is identified explicitly. A precautionary sensitivity rating may be adopted where justified by the potential

importance of the receptor or consequences of underestimating the impact. Such precautionary ratings are not intended to substitute indefinitely for information that can reasonably be obtained; where additional survey, investigation or design information is necessary, this is identified as a further assessment or management requirement.

5.5.4 Use of VERs in the Impact Assessment

For each identified impact, the relevant VER and its sensitivity are combined with the magnitude of the predicted change determined in accordance with Section 5.6. The resulting impact significance is then established using the significance framework described in Section 5.7. The relationship can be summarized as follows:

Figure 17: VER Assessment Relationship



Where mitigation is required, the mitigation hierarchy is applied as described in Section 5.8 and the residual impact is reassessed following implementation of the committed mitigation measures.

The VER reference number is retained throughout the assessment so that the relationship between the baseline receptor, predicted impact, significance assessment, mitigation measures and residual effect can be readily traced. This is consistent with the existing Chapter 8 approach, where the VER number is repeated in the impact and mitigation tables and the residual-effects table.

5.6 Characterisation of Impacts and Determination of Magnitude

Following identification of the relevant Project activity, impact pathway and VER, each potential impact is characterized to determine its magnitude. Magnitude describes the scale and characteristics of the Project-induced change before consideration of the value or sensitivity of the affected receptor. Receptor sensitivity is considered separately when determining significance in accordance with Section 5.7.

The Supplementary ESIA applies a systematic scoring framework to promote consistency and transparency across the environmental and social topics assessed. The framework does not replace professional judgement or recognized topic-specific assessment methods. Rather, it provides a common means of translating the characteristics of an impact into a magnitude category that can subsequently be combined with VER sensitivity.

Wherever practicable, impact characterization is informed first by quantitative evidence. This may include, for example, predicted changes in noise or vibration levels, pollutant concentrations, areas of habitat or agricultural land affected, quantities of water used or discharged, numbers of people or households affected, traffic movements, or other measurable changes. Applicable national standards,

Lender requirements and recognised technical criteria are used where relevant to interpret the importance of the predicted change.

The magnitude of each impact is determined through consideration of six characteristics:

- Size of impact;
- Extent of impact;
- Duration of impact;
- Frequency of impact;
- Probability of the impact occurring; and
- Reversibility of the impact.

Each characteristic is assigned a score using the criteria set out below. The scores are then summed to provide an overall magnitude score. The scoring framework provides consistency across the assessment, while the rationale for individual scores is informed by the available baseline data, Project design information, quantitative modelling or specialist assessment where available, and professional judgement.

5.6.1 Size of Impact

Size describes the degree of change from the baseline condition resulting from the Project activity. Wherever possible, the size of the change is quantified or otherwise defined using recognized technical criteria.

Examples may include a predicted change in sound level, an increase in the concentration of an air pollutant, the area of habitat or agricultural land affected, the number of people experiencing a change in access or livelihood conditions, or the quantity of a resource used or discharged.

The significance of the change is not considered at this stage because significance also depends upon the sensitivity of the affected receptor. Size therefore describes the Project-induced change itself rather than the importance of the receptor experiencing that change.

The following classifications and scores are applied:

- High: 8
- Medium: 5
- Low: 3
- Negligible: 1

A High size of change represents a substantial change from baseline conditions or a major alteration in the relevant environmental or social parameter. A Medium change represents a material and clearly measurable alteration. A Low change represents a limited but measurable or perceptible alteration, while a Negligible change represents no material or readily perceptible alteration to the relevant environmental or social parameter.

Where the size of change is demonstrably negligible, the resulting effect will normally be considered non-significant unless a topic-specific methodology, applicable threshold or Lender requirement indicates otherwise.

5.6.2 Extent of Impact

Extent describes the geographic area over which the impact occurs. In general, impacts occurring over a wider area have greater potential to give rise to significant effects than highly localized impacts,

although extent is only one component of the overall magnitude assessment. The classifications and scores used are presented in Table 39.

Table 39: Classification of Extent of Impact and Assigned Scores

Classification	Description	Illustrative example	Score
Very Local	Impact is confined to the immediate point of impact, individual work area or receptor and does not materially extend into the surrounding environment.	Minor construction noise confined to the immediate worksite.	1
Local	Impact extends beyond the immediate point of impact but remains within the Project site, nearby settlement, local catchment or immediate surrounding area.	Loss of common habitat or localized disturbance immediately adjacent to a work area.	2
Regional	Impact extends beyond the immediate Project area and affects a wider part of the Project corridor or regional environmental or social system.	Air emissions affecting a wider area, or socio-economic effects occurring across several affected districts.	3
National	Impact occurs or has implications at national scale.	Generation of a specialist waste stream that cannot be managed using available national capacity.	5
International	Impact extends across an international boundary or affects a genuinely transboundary or global environmental or social system.	Greenhouse-gas emissions contributing to global climate change, or a transboundary effect on a shared water system.	7

Extent relates to the geographic area over which the impact occurs, rather than the value or importance of the receptor. A locally occurring impact on an internationally important receptor therefore remains local in extent; the international importance of the receptor is reflected separately through the VER sensitivity rating.

5.6.3 Duration of Impact

Duration describes the period for which the resulting environmental or social change persists. It is not necessarily the same as the duration of the activity causing the impact.

For example, a loss-of-containment event may last only a few minutes, while contamination resulting from that event could persist for months or years. Duration is therefore determined by the persistence of the impact on the receptor rather than simply the length of the Project activity.

Table 40: Classification of Duration of Impact and Assigned Scores

Classification	Description	Illustrative example	Score
Transient	Less than 1 day	Temporary disruption associated with delivery of an oversized item.	1
Very Short Term	1–30 days	Temporary closure of a road or local access route.	2

Classification	Description	Illustrative example	Score
Short Term	1–12 months	Dust associated with a discrete construction work package.	3
Medium Term	1–5 years	Construction traffic effects persisting through the main construction period.	5
Long Term	More than 5 years	Operational changes in noise or air quality that persist for a substantial period.	7
Permanent	Permanent or effectively irreversible over the Project life	Permanent land take or loss of habitat that cannot practicably be recreated.	10

The duration category is interpreted in relation to the affected receptor. A relatively short interruption may nevertheless have a material effect where it coincides with a critical livelihood, agricultural, ecological or community period.

5.6.4 Frequency of Impact

Frequency describes how often the event or activity giving rise to the impact occurs. An individual event may be of short duration but, where repeated frequently, may result in a greater overall magnitude. Conversely, a one-off activity may have limited magnitude where its consequences are short-lived and reversible.

Table 41: Classification of Frequency of Impact and Assigned Scores

Classification	Description	Illustrative example	Score
One-off	Event occurs once during the relevant Project phase or Project life.	Initial clearance of land or habitat.	1 / 5*
Rare	Event occurs rarely during the relevant Project phase or Project life.	Unusual increase in emissions under abnormal operating conditions.	2
Infrequent	Event is expected to occur but not routinely under normal Project conditions.	Periodic maintenance activity.	3
Frequent	Event occurs regularly throughout the relevant Project phase or Project life.	Daily construction traffic or regular train movements.	5
Continuous	Effect or activity is effectively continuous.	Continuous operational noise from fixed equipment.	7

* For a one-off event, a score of 1 is applied where the resulting impact is reversible and non-permanent. Where the one-off event causes a permanent and irreversible change, a score of 5 is applied.

5.6.5 Probability of Occurrence

For some impacts, occurrence is uncertain or dependent upon particular circumstances. Probability is therefore included as one of the characteristics contributing to magnitude for planned Project activities where an impact may or may not occur. The following classifications are applied:

Probability	Description	Score
Certain	The impact is expected to occur as a consequence of the planned Project activity.	5

Probability	Description	Score
High	The impact is likely to occur, although occurrence may depend on particular conditions or circumstances.	3
Low	The impact is possible but is not expected to occur under normal conditions.	2

For predictable impacts arising directly from planned Project activities, such as permanent land take or routine operational noise, probability will normally be classified as Certain.

Probability within this scoring system is not intended to provide the primary assessment basis for accident or emergency scenarios where the principal issue is risk rather than a routinely predicted impact.

5.6.6 Reversibility

Reversibility describes the extent to which the affected receptor can reasonably be expected to return to its previous condition following cessation of the impact. For the purposes of the assessment, a simple two-point classification is applied.

Classification	Description	Score
Reversible	The receptor can reasonably be expected to return substantially to its previous condition naturally or through practicable restoration following cessation of the impact.	1
Irreversible	The previous condition cannot reasonably be restored within a relevant environmental or social timescale.	5

Reversibility is assessed separately from duration. A long-term effect may ultimately be reversible, while a short-duration activity may cause an irreversible effect, such as destruction of an archaeological feature or permanent loss of a particular habitat feature.

5.6.7 Overall Impact Magnitude Scoring

The scores assigned for Size + Extent + Duration + Frequency + Probability + Reversibility are summed to derive the overall impact magnitude score.

The scoring system produces a theoretical range of 7 to 42. The resulting score is converted to one of four magnitude categories as follows:

Total Score	Impact Magnitude
7–16	Negligible
17–25	Minor
26–34	Moderate
35–42	Major

The qualitative meaning of the four magnitude categories is set out in Table 42.

Table 42: Criteria for Magnitude of Impacts Used in the IA

Magnitude	Description of Adverse Consequence	Description of Beneficial Consequence
Major	Substantial loss of resource, quality or integrity, or severe damage to key characteristics, features or functions.	Major improvement in resource quality; extensive restoration or enhancement; substantial improvement in key characteristics or functions.
Moderate	Material adverse change to the resource without fundamentally compromising its overall integrity; partial loss of or damage to key characteristics, features or functions.	Material benefit to or improvement of key characteristics, features or functions.
Minor	Measurable but limited change in quality, vulnerability or function; minor loss of or alteration to one or more characteristics or features.	Limited beneficial change or addition to characteristics, features or functions, or measurable reduction in an existing adverse condition or risk.
Negligible	No material loss, or only very minor detrimental alteration to a characteristic, feature or function.	Very minor beneficial change or addition to a characteristic, feature or function.

The magnitude rating describes the Project-induced change and does not incorporate receptor sensitivity. The magnitude rating is combined with the sensitivity of the relevant VER in Section 5.7 to determine the significance of the resulting effect.

5.6.8 Application of Professional Judgement and Topic-Specific Methods

The numerical scoring framework provides a consistent and auditable basis for characterizing impacts across the Supplementary ESIA but is not intended to substitute for recognized specialist assessment methods or professional judgement.

Where applicable regulations, Lender requirements, quantitative modelling methods or specialist technical criteria provide a more robust basis for characterizing an impact, these are applied in the relevant assessment. This includes, as applicable, air-quality dispersion assessment, noise and vibration modelling, hydrological and flood-risk assessment, Critical Habitat and biodiversity assessment, greenhouse-gas accounting, land acquisition and livelihood assessment, and occupational and community health and safety assessment.

The outputs of these topic-specific assessments are used to inform the six scoring characteristics above. Where strict application of the numerical scoring system would produce a magnitude category that is inconsistent with robust technical evidence or an applicable standard or threshold, professional judgement may be used to adjust the magnitude classification. Any such adjustment is to be stated and justified transparently in the relevant impact assessment.

Where evidence is incomplete or uncertainty remains material to the magnitude determination, the uncertainty is identified and a conservative assumption may be applied where warranted by the potential consequence or sensitivity of the receptor. Additional survey, modelling, monitoring or adaptive-management requirements are identified where necessary to verify the assessment conclusion.

This retains the same six-factor scoring system, scores and magnitude bands already used in the existing impact tables.

5.7 Assessment of Significance

Impact significance represents the importance of an environmental or social effect and provides the basis for determining whether additional mitigation or management measures are required.

Significance is determined by combining:

- the magnitude of the Project-induced change, determined in accordance with Section 5.6; and
- the sensitivity of the affected VER, determined in accordance with Section 5.5.

The assessment therefore recognizes that the same magnitude of change may have different significance depending upon the receptor affected. A relatively small change affecting a highly sensitive receptor may be significant, while a larger change affecting a receptor of low sensitivity may result in a lower significance rating.

The significance framework provides a consistent basis for comparison across environmental and social topics. It does not imply that fundamentally different types of impact are directly equivalent; rather, it provides a common terminology for expressing the importance of the predicted effect and the level of management attention required.

5.7.1 Significance Matrix

The significance of an effect is determined using the matrix presented in Table 43. The matrix combines the four impact-magnitude categories defined in Section 5.6 with the four VER sensitivity categories defined in Section 5.5.

Table 43: Matrix for Determining Significance of Environmental and Social Effects

VER Sensitivity	Negligible	Minor	Moderate	Major
Extreme	Not Significant	Medium	High	High
High	Not Significant	Medium	High	High
Moderate	Not Significant	Low	Medium	High
Low	Not Significant	Low	Low	Medium

The significance matrix is applied to both adverse and beneficial effects. For beneficial effects, the significance category is reported as beneficial, for example Moderate Beneficial, rather than adverse.

5.7.2 Interpretation of Significance

The significance of an impact is determined by combining the assessed magnitude of change with the sensitivity of the affected VER, using the significance matrix presented in Table 43. Significance is expressed using four categories: **Not Significant, Low, Medium and High**.

- **Not Significant:** The predicted change is negligible and is not expected to result in a material adverse or beneficial effect on the VER. No impact-specific mitigation is normally required beyond embedded design measures, legal requirements and standard good international industry practice.
- **Low:** A limited effect on the VER that does not materially alter its key characteristics, function or value. The impact can normally be managed through standard good practice and routine environmental or social management measures.

- **Medium:** A material effect on the VER that warrants specific impact-management measures. Mitigation should be defined and implemented to reduce the magnitude and/or duration of the effect, with monitoring undertaken where appropriate to verify effectiveness.
- **High:** A significant effect on a sensitive or highly valued VER, or a substantial change affecting a VER of lower sensitivity. High impacts require priority application of the mitigation hierarchy and clearly defined mitigation, management and monitoring measures. Where a High residual adverse impact remains after application of feasible mitigation, this should be specifically identified and considered against applicable lender requirements.

For the purposes of this Supplementary ESIA, high adverse effects are considered significant and require specific mitigation or management action. Medium adverse effects are subject to professional judgement: they may be considered significant where they affect sensitive receptors, approach or exceed applicable standards, occur over prolonged periods, contribute to cumulative effects, or are otherwise material in the Project context.

Low and not significant are generally considered not significant, although applicable legal requirements, Lender standards and GIIP remain applicable irrespective of the significance rating.

5.7.3 Professional Judgement

The matrix provides a consistent framework but does not replace professional judgement. The significance assigned to an effect must remain consistent with the underlying technical evidence, applicable regulatory and Lender requirements, specialist assessment methods and the environmental or social context in which the effect occurs.

Where application of the matrix produces a significance rating that does not adequately reflect these considerations, professional judgement may be used to modify the rating. Any such modification is to be clearly identified and justified in the relevant assessment.

Professional judgement is particularly relevant where:

- applicable standards or thresholds are exceeded;
- the effect concerns a receptor subject to specific Lender protection requirements;
- uncertainty remains regarding the scale or consequence of an impact;
- impacts affect vulnerable or disadvantaged groups;
- multiple Project impacts interact on the same receptor; or
- specialist assessment methods provide a more appropriate indication of significance than the generic matrix.

The significance matrix does not override specific requirements established by applicable Lender standards. For example, the acceptability of impacts on Critical Habitat, requirements for biodiversity No Net Loss or Net Gain, involuntary resettlement requirements, or occupational and community health and safety obligations are determined by the applicable safeguard requirements and cannot be demonstrated solely through a generic significance score.

5.7.4 Pre-Mitigation Significance

The initial significance rating presented in the impact assessment represents the **pre-**mitigation significance of the effect.

For the purposes of this Supplementary ESIA, pre-mitigation significance is determined for the Project including established embedded design measures, but before application of additional mitigation measures identified through this Supplementary ESIA.

This distinction is important because a number of environmental and social controls have already been incorporated into the Project design or established Project arrangements. Such measures form part of the Project being assessed and are therefore not removed hypothetically when establishing pre-mitigation significance.

Where an existing design feature is relied upon as embedded mitigation, it should be sufficiently defined and committed to form part of the Project design. Measures that remain recommendations, future options or unconfirmed design proposals are not treated as embedded mitigation.

Additional mitigation identified through the Supplementary ESIA is applied subsequently through the mitigation hierarchy described in Section 5.8, following which the residual significance of the impact is determined in accordance with Section 5.9.

5.8 Mitigation Hierarchy and Embedded Mitigation

The mitigation hierarchy is applied throughout the assessment and management of Project environmental and social risks and impacts. The objective is to address adverse effects as early as practicable and to prioritize measures that prevent impacts from occurring rather than relying on subsequent remediation.

The hierarchy applied in this Supplementary ESIA is:

- Avoid adverse impacts wherever practicable, including through location, alignment, design, technology, construction methodology or operational decisions;
- Minimize the magnitude, extent, duration or probability of impacts that cannot reasonably be avoided;
- Mitigate remaining adverse effects through engineering, operational, management or other controls;
- Restore or rehabilitate affected environmental or social resources where practicable; and
- Compensate or offset significant residual impacts where required and appropriate under the applicable Lender standards.

The hierarchy is not intended to imply that each stage must necessarily be applied to every impact. Priority is given to avoidance and minimization, particularly where receptors are highly sensitive, impacts may be irreversible, or applicable Lender requirements establish specific conditions for the acceptability of residual impacts.

5.8.1 Environmental Design Approach

The environmental design approach is intended to be applied across all relevant aspects of the Project and seeks to identify potential environmental and social impacts and risks sufficiently early for these to be avoided or reduced through modification of the Project design.

This is an iterative process involving identification of potential impacts and risks, consideration of alternative design or implementation options, incorporation of environmental and social constraints into the design, and subsequent review of the modified design. **错误!未找到引用源。** illustrates this process.

Through this iterative process, some potential impacts and risks can be avoided or reduced before they arise. Measures incorporated into the Project through this process are referred to in this Supplementary ESIA as embedded mitigation.

Embedded mitigation may include, for example:

- alignment or layout changes to avoid sensitive receptors;

- changes to the location or configuration of Project facilities;
- incorporation of drainage, containment or pollution-control infrastructure;
- provision of livestock, agricultural or community access;
- engineering measures incorporated into bridges, culverts or railway infrastructure;
- selection of construction methods that reduce environmental or community disturbance; and
- other design measures incorporated specifically to avoid or reduce identified environmental or social risks.

The environmental design process should continue throughout detailed design, construction planning and development of construction methods. Where design elements remain open, relevant environmental and social constraints and opportunities for further avoidance or minimization should be considered before those elements are finalized.

5.8.2 Application to the Darbaza–Maktaaral Project

For this Project, many of the principal design decisions had already been taken and substantial construction had commenced before preparation of the Supplementary ESIA. The environmental design approach therefore cannot be applied retrospectively in the same manner as it would for a greenfield project assessed from the feasibility or concept-design stage.

The Supplementary ESIA consequently applies the mitigation hierarchy in three ways:

- retrospective review of established design decisions, to identify whether practicable opportunities remain to avoid or reduce identified environmental and social effects;
- prospective application to design elements that remain open, including detailed-design refinements and elements for which the final technical solution has not yet been confirmed; and
- application to construction and operational planning, where construction methods, sequencing, management controls and operational procedures can still avoid or reduce impacts and risks.

Where an impact has already occurred, avoidance may no longer be possible. In such cases, the assessment considers whether the effect can be reduced, remediated, restored or otherwise addressed through corrective action. The methodology for assessing works already undertaken is described further in Section 5.10.

5.8.3 Embedded and Additional Mitigation

For the purposes of the impact assessment, a distinction is made between embedded mitigation and additional mitigation.

Embedded mitigation comprises measures that are sufficiently defined and incorporated into the Project design or established Project arrangements to form part of the Project being assessed. These measures are taken into account when determining the magnitude and pre-mitigation significance of an impact.

Additional mitigation comprises measures identified through the Supplementary ESIA as necessary to further avoid, minimize, mitigate, restore or compensate for an identified adverse effect. These measures are applied after determination of pre-mitigation significance and are taken into account when determining residual significance.

A measure is not treated as embedded mitigation merely because it has been proposed or discussed. Where implementation remains subject to further assessment, detailed design, feasibility review,

agreement with third parties or another future decision, the measure is treated as an additional commitment or future action rather than as part of the existing Project design.

This distinction is particularly important for a Project at an advanced stage of development, as it prevents the assessment from assuming the effectiveness of measures that have not yet been confirmed or implemented.

5.8.4 Selection of Mitigation Measures

Mitigation measures identified through the Supplementary ESIA are developed with regard to:

- the significance and nature of the predicted impact;
- the sensitivity and vulnerability of the affected VER;
- applicable national requirements and Lender standards;
- the mitigation hierarchy;
- technical and operational feasibility;
- the stage of Project development;
- the effectiveness and reliability of the proposed control;
- responsibility for implementation;
- the ability to monitor or verify effectiveness; and
- the need for adaptive management where uncertainty remains.

Mitigation is intended to be **specific and implementable**. Where practicable, measures therefore identify the action required, the relevant Project phase or activity, the party responsible for implementation and the monitoring or verification necessary to demonstrate effectiveness.

Mitigation measures identified through the assessment are consolidated into the Project ESMP and, where appropriate, associated topic-specific management plans and procedures.

5.8.5 Mitigation and Uncertainty

Where the effectiveness of a mitigation measure cannot be predicted with sufficient confidence at the ESIA stage, the assessment adopts an adaptive-management approach. This may require additional investigation or modelling, implementation of defined initial controls, monitoring of actual effects and predetermined corrective or supplementary measures where monitoring demonstrates that the required outcome is not being achieved.

Reliance on future monitoring does not substitute for practicable avoidance or mitigation that can reasonably be identified at the assessment stage. Monitoring and adaptive management are used principally to verify predictions, manage residual uncertainty and confirm the effectiveness of committed controls.

Following identification of additional mitigation in accordance with the mitigation hierarchy described in Section 5.8, each adverse impact is reassessed to determine its residual significance.

Residual significance represents the environmental or social effect expected to remain following implementation of the committed mitigation and management measures. It therefore provides the principal basis for evaluating the significance of the Project's remaining impacts and identifying where further management, monitoring, compensation or other action may be required.

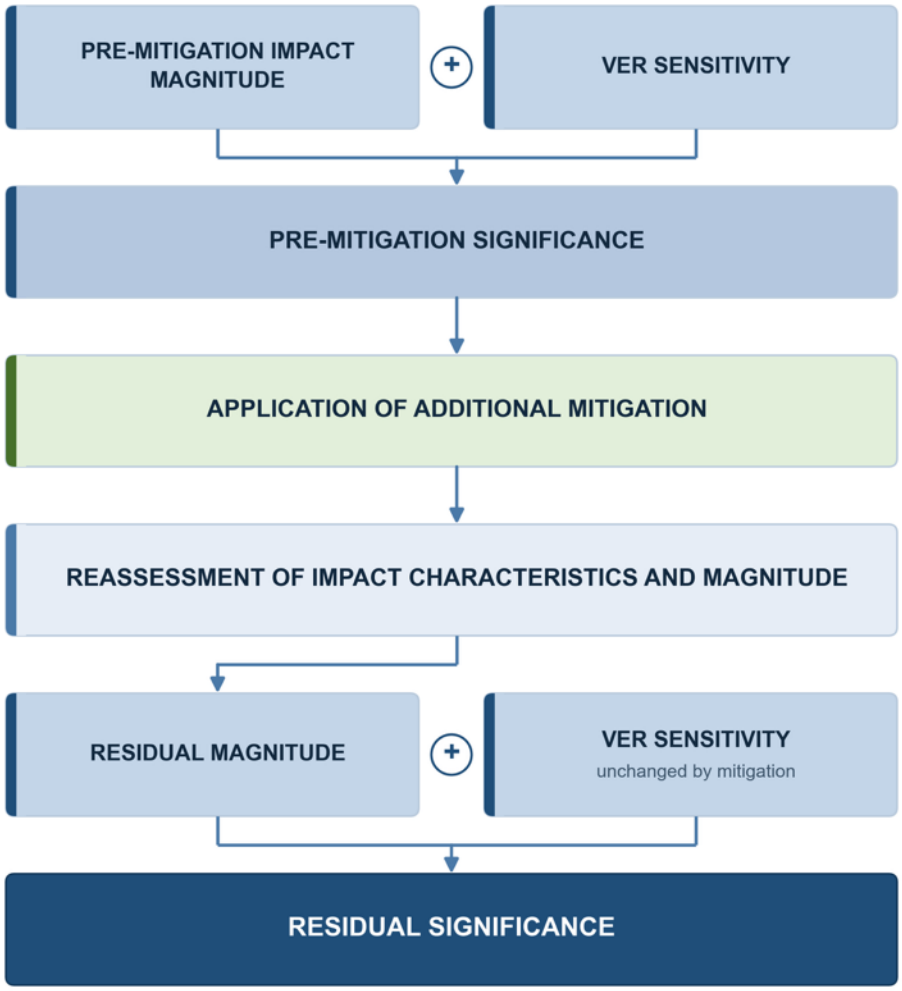
The residual assessment follows the same methodology used for the initial assessment. The effectiveness of the committed mitigation is considered in determining how the characteristics of the impact identified in Section 5.6 are expected to change. Where mitigation reduces the size, extent,

duration, frequency, probability or reversibility of an impact, the relevant characteristics are reassessed and a revised magnitude is determined.

The sensitivity of the affected VER will normally remain unchanged between the pre-mitigation and residual assessments because mitigation generally acts upon the Project-induced impact rather than the intrinsic sensitivity of the receptor. A different sensitivity rating may only be applied where the mitigation itself demonstrably changes the condition, vulnerability, resilience or dependence of the receptor in a manner relevant to the impact being assessed. Any such change is to be explicitly justified.

The revised residual magnitude is combined with VER sensitivity using the significance matrix presented in Section 5.7 to determine the residual significance of the effect.

The process can therefore be summarized as:



5.9 Residual Impacts

5.9.1 Evaluation of Residual Effects

Residual effects are reported using the same significance categories applied to the initial assessment: Not Significant, Low, Medium and High.

Residual High adverse effects are considered significant and require particular attention. Where such effects remain, the assessment considers whether:

- further avoidance or mitigation is technically and financially feasible;

- alternative design, construction or operational measures are available;
- compensation, restoration or offsetting is required or appropriate under the applicable Lender standards;
- additional monitoring or adaptive management is required;
- further assessment or specialist investigation is necessary; and
- the residual effect is compatible with the specific requirements of the applicable Lender standards.

A residual Medium adverse effect is evaluated in its specific context. Further mitigation should be considered where reasonably practicable, particularly where the effect involves sensitive receptors, vulnerable groups, regulatory or Lender thresholds, cumulative effects, or material uncertainty.

Residual Low and Not Significant effects are generally considered not significant, although applicable legal requirements, Lender standards, GIIP and committed management controls continue to apply irrespective of the residual significance rating.

5.9.2 Basis for Assuming Mitigation Effectiveness

Residual significance is determined only on the basis of mitigation measures that are sufficiently defined, practicable and committed to allow their likely effectiveness to be reasonably predicted.

The residual assessment does not assume that an impact has been reduced solely because a future study, assessment or management plan is proposed. Where the effectiveness of mitigation depends upon further investigation, modelling, detailed design, consultation, third-party agreement or confirmation of technical feasibility, the residual significance reflects that uncertainty unless a sufficiently conservative mitigation outcome can reasonably be demonstrated.

Where a final mitigation solution cannot be established at the time of the Supplementary ESIA, the assessment may identify a required performance outcome together with the process for achieving and verifying that outcome. In such cases, the ESMP or associated management plan specifies the further assessment, design or monitoring required, the responsible party, the applicable performance criterion and the action to be taken if the required outcome is not achieved.

5.9.3 Residual Effects and Lender Requirements

The residual significance rating does not override specific requirements established by the applicable Lender standards. Compliance with such requirements is assessed separately where necessary.

For example, a generic residual significance rating does not itself demonstrate compliance with requirements relating to Critical Habitat, Natural Habitat, No Net Loss or Net Gain, involuntary resettlement and livelihood restoration, worker health and safety, community health and safety, or cultural heritage. Where such requirements apply, the relevant topic-specific standards and performance outcomes must also be satisfied.

5.10 Retrospective Assessment of Works Already Undertaken

As construction of the Project commenced before preparation of this Supplementary ESIA, a proportion of the environmental and social effects associated with the Project have already occurred or are ongoing. The assessment therefore combines the conventional prospective assessment of remaining construction and future operation with a retrospective assessment of works already undertaken.

For activities that have already been completed or are substantially advanced, the assessment considers the actual effects observed or reasonably attributable to the Project, rather than attempting to reconstruct a purely hypothetical pre-construction impact assessment.

The retrospective assessment draws, as available, on:

- findings of the Environmental and Social Compliance Audit (ESCA);
- Supplementary ESIA site observations and field investigations;
- environmental and social monitoring data;
- construction and contractor records;
- stakeholder consultation and grievance information;
- the national environmental assessment documentation, including the OVOS;
- available land acquisition and compensation information; and
- relevant specialist surveys and studies.

Where the available evidence indicates that an adverse impact has already occurred, the assessment considers the nature and extent of that effect, the effectiveness of measures already implemented and whether further corrective, remedial or restoration measures are required.

The retrospective assessment also considers whether construction activities have resulted in impacts that may persist into future Project phases. Where such effects remain relevant, they are carried forward into the assessment of residual impacts and the associated mitigation, monitoring or corrective actions.

Where information on past activities or effects is incomplete, the limitation is identified and available evidence is used to establish the most reasonable assessment of the likely effect. Where necessary, further investigation or monitoring is identified to confirm the condition of the affected receptor or determine whether corrective action is required.

For construction activities that remain to be undertaken, the prospective impact assessment methodology described in Sections 5.4–5.9 is applied. The same methodology is applied to future operation and maintenance impacts.

This approach allows the Supplementary ESIA to distinguish between:

- impacts that have already occurred and may require corrective or remedial action;
- ongoing construction impacts requiring continued or strengthened management;
- impacts associated with remaining construction activities that can still be avoided or mitigated prospectively; and
- future operational and maintenance impacts.

The purpose of the retrospective assessment is therefore not to retrospectively assign mitigation to completed activities, but to identify their environmental and social consequences and determine whether any outstanding corrective, restoration, monitoring or management measures are required.

5.11 Cumulative Impact Assessment Approach

Cumulative impacts may arise where the environmental or social effects of the Project interact with existing pressures or with the effects of other developments or activities affecting the same Valued Environmental and Social Receptor (VER).

The cumulative impact assessment is proportionate to the nature and scale of the Project and the availability of reliable information. It focuses on receptors for which the Project could make a material contribution to an existing or reasonably foreseeable cumulative effect. It does not seek to assess the environmental and social impacts of other developments independently of the Project.

Potential cumulative effects are identified through consideration of:

- the spatial and temporal extent of the Project impact;
- the sensitivity and existing condition of the affected VER;
- existing environmental or social pressures affecting the receptor;
- other developments or activities for which sufficient information is available and which have a credible spatial and temporal interaction with the Project; and
- the potential for the combined effects to materially alter the significance of the Project's effect on the receptor.

Other developments or activities are considered where they are sufficiently defined to allow a meaningful assessment. Speculative, undefined or insufficiently documented future developments are not assessed.

Where a credible cumulative interaction is identified, the assessment considers whether the Project's effect could materially contribute to or exacerbate the cumulative pressure on the receptor and whether additional Project-specific mitigation or monitoring is warranted.

Where cumulative effects are influenced principally by activities outside the control of KTZ or the Project, this is recognized in the assessment. Where appropriate, coordination or engagement with relevant authorities, infrastructure operators or other parties may be identified, while distinguishing such measures from actions that are directly within the Project's control.

Cumulative effects are addressed within the relevant topic assessments in Section 8 where a credible cumulative interaction has been identified.

5.12 Topic-Specific Methodologies

The general impact assessment methodology described in Sections 5.1–5.11 is applied across the environmental and social topics assessed in this Supplementary ESIA. For certain topics, however, applicable Lender requirements or recognized specialist approaches establish additional assessment criteria or performance requirements that cannot be determined solely through the generic impact significance methodology.

Where such requirements apply, the topic-specific methodology supplements the general assessment framework. The VER and significance methodology remains applicable where appropriate, but compliance with a specific Lender requirement is determined against the relevant topic-specific criteria rather than solely by the generic significance rating.

Topic-specific methodologies applied in this Supplementary ESIA are described below.

5.12.1 Critical Habitat Assessment

The biodiversity assessment includes consideration of Critical Habitat in accordance with the applicable Lender biodiversity requirements. Critical Habitat assessment is undertaken separately from the generic VER significance methodology because Critical Habitat status is determined against defined biodiversity criteria and thresholds rather than through the magnitude–sensitivity matrix.

The assessment considers biodiversity features potentially capable of triggering Critical Habitat and evaluates available baseline information against the applicable criteria and thresholds. Where Critical Habitat is identified, the assessment considers the Project's potential effects on the biodiversity features for which the habitat qualifies and the specific requirements applicable to development within Critical Habitat.

The Critical Habitat assessment therefore informs, but is not replaced by, the general impact significance assessment. A generic Minor, Moderate or Major significance rating does not itself determine whether the requirements applicable to Critical Habitat have been satisfied.

The detailed Critical Habitat assessment, including the features assessed, applicable criteria, evidence base and conclusions, is presented in the biodiversity assessment and associated Project biodiversity documentation.

5.12.2 Biodiversity No Net Loss and Net Gain

Where applicable Lender requirements establish No Net Loss (NNL) or Net Gain (NG) objectives, these are assessed separately from the generic impact significance methodology.

The assessment follows the mitigation hierarchy, with priority given to avoidance of biodiversity impacts, followed by minimization, restoration or rehabilitation and, where required and appropriate, biodiversity compensation or offsetting.

The requirement for NNL or NG is determined by the applicable Lender biodiversity standard and the biodiversity features affected. Achievement of the required outcome is therefore not demonstrated solely through reduction of an impact to Minor or Negligible residual significance.

Where NNL or NG applies, the biodiversity assessment and Project Biodiversity Action Plan (BAP) identify the relevant biodiversity features, mitigation and management measures, monitoring requirements and, where necessary, the approach for demonstrating achievement of the required biodiversity outcome.

Where the evidence required to demonstrate the final biodiversity outcome will only become available through further survey, detailed design or implementation monitoring, the required process and performance objective are identified in the BAP rather than assuming that the outcome has already been achieved.

5.12.3 Gender, Vulnerability and Disproportionate Effects

The social assessment considers whether Project impacts may affect women, vulnerable or disadvantaged individuals or groups differently or disproportionately.

This assessment is integrated into the identification and sensitivity of social VERs and the assessment of individual social impacts. Relevant considerations include, as applicable, differences in access to land, livelihoods, employment, services, transport and community infrastructure; participation in consultation and decision-making; exposure to community health and safety risks; and risks associated with worker-community interaction, sexual exploitation and abuse and sexual harassment (SEA/SH) or gender-based violence and harassment (GBVH).

The assessment considers both the distribution of Project impacts and the capacity of affected individuals or groups to avoid, adapt to or recover from those impacts. Where particular vulnerability or disproportionate exposure is identified, this informs receptor sensitivity and the design of mitigation, engagement and monitoring measures.

The purpose of the assessment is not to assign a separate generic gender significance rating, but to ensure that potentially differentiated or disproportionate effects are recognized within the relevant social impact assessment and addressed through appropriate mitigation and management measures.

Other technical topics, including air quality, noise and vibration, hydrology, climate risk and greenhouse-gas emissions, apply recognized standards, modelling approaches or technical criteria where appropriate. These methods and the applicable assumptions, standards and thresholds are described within the relevant topic sections of the Supplementary ESIA rather than repeated in this general methodology chapter.

6. ESIA Scope

6.1 Scoping

The methodology used to determine which environmental and social topics require detailed assessment is described in Section 5.3. This Section defines the resulting physical, spatial, temporal and technical scope of the Supplementary ESIA and records the topics scoped into and out of detailed assessment. The scope has been reviewed iteratively as Project design information, the OVOS, ESCA findings, specialist studies and stakeholder information have become available.

6.2 Physical or Project Scope

The physical/project scope of the IA defines the project extent in terms of what is to be developed/constructed. In general terms, good practice for IA would expect all elements which are directly related to the project; and any other elements which are either a consequence of the project or which the project relies upon will be included in the IA process.

The physical scope includes all components and activities forming part of the Project, together with temporary and ancillary facilities required for its construction and operation. Borrow pits, aggregate sources, batching plants, construction camps, dedicated construction access routes and other facilities provided under the EPC contract are treated as Project facilities and are therefore included directly within the assessment scope. No Associated Facilities have been identified for the purposes of this Supplementary ESIA, consistent with the assessment presented in Section 2.6.

The Physical Scope will include all elements of the project to include, *inter alia*:

- The footprint of the formation and any additional land take requirements for fencing, drainage and services etc.;
- Fule storage;
- 10kV Electricity supply
- Station development and associated lines;
- All structures, including bridges, culverts and drains;
- The installation of permanent way;
- All temporary facilities and structures, such as offices, workers accommodation, work sites, laydown areas, batching plants and temporary access routes;
- Operation of the railway;
- Ongoing maintenance of the Permanent way, such as tamping and re-ballasting.

Some of the above works have already been carried out at the time of preparation of this Supplementary ESIA Report. Reference is made to the Temporal Scope which is set out below.

6.3 Spatial Scope

Spatial Scope. The spatial scope of the assessment is defined as the Area of Influence (AoI) within which the Project's environmental and social impacts and risks may reasonably be expected to manifest, consistent with the definitions in IFC PS1 section6, ADB SPS SR1 ¶4 and AIIB ESS1 ¶12. The AoI is topic-specific; some topics have a tightly bounded AoI (e.g., construction-phase noise — typically the alignment plus 100–500 m of either side), while others extend further (e.g., biodiversity — the Ecologically Appropriate Area of Analysis for the Shardara IBA/KBA; cumulative impacts — the Turkistan corridor scale). The following framework AoIs are adopted:

- Direct AoI — the permanent and temporary land take of the Project, including the formation Right of Way, station footprints, sidings, passing loops, the Shardara IBA/KBA crossing embankment, and the 10 kV overhead line corridor.
- Indirect AoI — the corridor of influence for each topic, typically extending up to 500 m from the alignment for construction noise, dust and traffic; up to 1 km from the alignment for vibration screening and operational noise modelling; up to the IBA/KBA boundary plus 1 km buffer for biodiversity; basin-scale for hydrology and ecosystem services associated with the Syr Darya.
- Affected Communities AoI — settlements, households, land users, businesses and other community receptors that may be directly or indirectly affected by Project land take, construction activities, access restrictions, traffic, noise/vibration, community health and safety or operational activities. This includes the principal affected settlements identified in the baseline and consultation process and the cross-border context around Maktaaral where relevant.
- IBA/KBA-specific AoI — the Shardara Reservoir IBA/KBA and the Ecologically Appropriate Area of Analysis defined in the Critical Habitat Assessment (Annex F).
- Cumulative AoI — defined on a receptor-specific basis where a credible cumulative interaction is identified, taking account of the spatial extent of the Project impact and other sufficiently defined activities affecting the same receptor.

The topic-specific AoI for each Scoped In topic is set out in the corresponding subsection of Section 8 (Impact Assessment).

6.4 Temporal Scope

The temporal scope relates to the time over which the assessment process considers potential impacts and effects may occur. In general, these are broken into project related phases, for example:

- Design;
- Site Clearance;
- Construction;
- Commissioning;
- Operations and Maintenance; and
- Decommissioning.

However, the current ESIA Report represents a Supplementary Report, building on the approved National EIA and associated permits. As previously noted, the construction stage of the project commenced in 2024 and as of September 2026, works have taken place to install long lead time items such as bridges, and approximately 75% of the formation has been completed. Work sites, offices, workers accommodation, laydown areas etc. have already been established and are in use.

The Supplementary ESIA does not propose alternatives to the alignment, structure design or station locations approved at the TEO stage in 2023 (see Section 4 — Analysis of Alternatives, which sets out the variant-selection record retrospectively reviewed against the SPS, IFC PS and AIIB ESF alternatives requirements). The Supplementary ESIA does present an independent alternatives analysis for the 10 kV auxiliary power line routing through the Shardara IBA/KBA (Section 4.7), and identifies late-stage design refinements that remain feasible within the construction window and that are addressed as forward-looking commitments in Section 8 and the construction-phase ESMP.

Within the terms of ADB and other lender safeguard requirements, the need for environmental and social risk assessments and production of an ESIA Report are predicated on them being conducted

prior to the project development and in fact being integrated into the project development process. Because construction commenced before preparation of this Supplementary ESIA, the temporal scope combines retrospective assessment of completed and ongoing works with prospective assessment of remaining construction, commissioning and operation, in accordance with the approach described in Section 5.10. Table 44 sets out the position regarding the physical scope of this current ESIA process.

Table 44: Elements within Temporal Scope of ESIA

Stage	ESIA Scope	Justification
Design and footprint	Late-stage design refinements that remain feasible within the construction window are addressed as forward-looking commitments (verification and, where required, practicable refinement of agricultural and livestock crossing provision, BFDs and bird-safe pole-top design, noise barriers, trackform mitigation). Strategic alternatives (route, traction, staging) are reviewed retrospectively against the TEO variant-selection record (see Section 4). The 10 kV configuration through the IBA/KBA is examined as an independent alternatives analysis.	The project alignment, structural design and station locations are approved and construction is well advanced. The ESIA cannot influence the approved design but documents the variant-selection record, the consultant-led independent alternatives where the design was still open at engagement, and the design refinements feasible in the residual construction window.
Pre-Construction / Land Take	Land acquisition addressed in the parallel LARP; severance, agricultural network disruption, irrigation network disruption and livelihood impacts of the land-take phase addressed in Section 8 as severance and ecosystem-services impacts.	Land acquisition is the gateway phase between Design and Construction. The LARP holds the authoritative treatment; the ESIA addresses the wider severance and livelihood implications of the land-take footprint.
Site Clearance	Partial — works completed before the date of this ESIA are addressed retrospectively through the parallel ESCA, with verified findings integrated into the construction-phase ESMP via dedicated ESCA-CAP-anchored entries. Residual site clearance is included in the forward-looking assessment. For biodiversity, estimates of habitat loss within the IBA/KBA and across the wider alignment include both completed and remaining clearance, with offsetting calibrated to the cumulative loss.	Approximately 100 km of alignment has been levelled at the date of this ESIA, with significant vegetation clearance already complete. Forward-looking assessment is supplemented by the ESCA's retrospective audit and corrective-action framework; biodiversity offsetting with the cumulative habitat loss considered in determining biodiversity mitigation and, where required, offset requirements under the BAP.
Construction	All works to be completed within the residual program to January 2027 are within scope, including: completion of the formation, structures, station works, signaling and communications installation, OHL installation, and commissioning preparation. Construction-phase impacts (noise, vibration, dust, traffic, water, hazardous materials, waste, OHS, community H&S) are assessed in Section 8 with mitigation in the construction-phase ESMP.	Substantial construction remains, including completion of structures, station works, permanent way, signaling/communications, utilities and commissioning activities.. Verified compliance issues from the works already undertaken are addressed through the ESCA CAP, with corrective actions integrated into the forward-looking construction-phase ESMP.

Stage	ESIA Scope	Justification
Commissioning	Included to the extent that commissioning activities are known and differ from operational steady-state activities — principally trial running, signaling system test and commissioning, locomotive crew familiarization, and pre-operational monitoring (baseline noise and vibration confirmation, EMF measurements, IBA/KBA pre-construction baseline finalization).	Commissioning is a distinct phase between Construction completion and operational steady state, with its own monitoring requirements (notably for residual mitigation verification).
Operations and Maintenance	Included with focus on: operational noise and vibration at the six sensitive locations; operational air quality at sensitive receptors (notably Akui); avian collision and electrocution at the 10 kV OHL through the IBA/KBA; hazardous-cargo carriage and associated emergency response; cumulative impacts; community H&S at level crossings; operational waste management at Yerdaut depot and Maktaaral disinfection complex; climate resilience adaptation; ongoing OHS for operations and maintenance workforce; project benefits (modal shift, employment, connectivity).	Operational impacts over the 120-year design life of the railway are the primary forward-looking ESIA focus following commissioning. The Operational ESMP elaborates topic-specific operational monitoring, reporting and adaptive management.
Decommissioning	Scoped Out. Detailed decommissioning assessment is scoped out because of the long design life of the railway and the uncertainty associated with eventual closure conditions. Closure and decommissioning requirements will be addressed through future operational planning in accordance with applicable legal and Lender requirements when relevant.	Long design life of the principal assets (track formation and embankments effectively permanent; bridges 100 years; ballast/sleepers/rail 25–40 years to renewal) means a detailed decommissioning assessment at this stage would be speculative. PS1 closure planning expectations met through the Operational ESMP forward commitment.

6.5 Technical Scope

A key part of the scoping process is ensuring that the IA process is focused on those issues which matter, that is impacts created by the project which when acting on a VER may have significant effects, either through the magnitude of impact or the sensitivity of the VER (or a combination of these and other factors). Table 45 provides a rationale for the inclusion or exclusion of topics within the current IA process. It has been based on the existing knowledge of the form of the project, alignment and the receiving environment.

Table 45: Summary of Scoping Outcome

Topic	Potential Receptors	Notes on Risk of Significant Impacts	Scoped in / Out
Agriculture and Fisheries	Agricultural production (cross-cutting with socio-economics and soils), agricultural access arrangements, agricultural infrastructure such as irrigation network and polytunnels, crops	The majority of the land use of the proposed alignment is within agricultural production, either as intensively managed land or extensively grazed rangeland. There will be direct loss of agricultural land and risks of indirect effects on crops through soiling and impacts on agricultural infrastructure. Potential impacts also include severance of agricultural and livestock access, disruption to irrigation/drainage infrastructure, temporary construction disturbance, and effects on fisheries/aquatic resources at the Syr Darya/Shardara crossing.	In
Air Quality	Residential areas and their users along the proposed alignment, crops and ecosystems.	The number clusters of residential areas which may experience negative effects are limited. However, construction-phase impacts will include dust from earthworks, haul roads, material handling and batching activities, together with combustion emissions from construction plant and vehicles. During operational [phase the engines will be diesel powered leading to highly localized and transient change sin local air quality. At stations and passing points where trains may be held there is an increased risk of nuisance odors from diesel use.	In
Archaeology	There are known areas of burial mounds within the open steppe landscape	Potential direct loss of physical cultural resources in the form of the burial mounds. Indirect impacts on the setting of burial mounds.	In

Topic	Potential Receptors	Notes on Risk of Significant Impacts	Scoped in / Out
Biodiversity	Shardara Important Bird Area (IBA), local terrestrial flora and fauna and migrating bird species, river ecosystems	Other than the IBA, the remainder of the project area and surrounding landscape has limited biodiversity value. However, the required land take is significant and cumulatively the loss of even locally common habitats may add up to be significant. The river crossings will be sensitive locations. In addition, the loss of agricultural land will be compensated by the leasing of new areas of state land, if this is from the open grazed land areas which can be considered as semi-natural habitats, the loss to biodiversity will increase. The presence of internationally recognized biodiversity areas and Critical Habitat features requires detailed assessment against applicable Lender biodiversity requirements, including residual-impact and NNL/NG considerations.	In
Hydrogeology	The river and drainage systems within the project area	Potential alterations of flow rates and drainage patterns due to embankments. Potential significant changes at Shardara Reservoir where the formation may restrict seasonal flows of surface water and affect ground water regimes. Assessment also considers construction and operational risks to groundwater quality from fuel, chemicals, wastewater and hazardous-material releases.	In
Landscape and Visual	The open nature of the landscape, especially to the western end of the scheme where a steppe type landscape is found. Existing views within the landscape into and out of the road.	The new alignment will change the landscape within the project area, although at the western end of the route there are already a number of power transmission lines which detract from the open nature of the site	In - general comment on the landscape effects - a full landscape character and visual is not the norm for Kazakhstan.

Topic	Potential Receptors	Notes on Risk of Significant Impacts	Scoped in / Out
Land Use	Open land along new alignment and land between existing urban areas and rail alignment, local planning regulation	New railway alignment may present a risk of a number of secondary or induced impacts. These include the introduction of demand for additional development around stations and other facilities to meet demands for travel related services. Permanent and temporary land take, severance and changes in access are assessed in conjunction with the LARP and socio-economic assessment.	In, as far as general risk assessment and mitigation measures
Material Resources	Resources such as aggregates, steel, soils, concrete and local capacity to supply the project requirements	Risk to local supply if the project takes up a significant percentage of local supply capacity. The assessment also considers construction water demand and the availability of borrow material/aggregates relative to local supply capacity.	In
Noise and Vibration		Construction plant, piling, compaction, haulage and other works may affect nearby receptors; operational train movements may result in noise and vibration impacts at identified sensitive locations. Possible negative impacts on small number of receptors from new route alignment. Nighttime disturbance from standing trains at stations, passing loops and signals	In
Public Health and Safety	Local residents and wider public	Risk of incidents on operational rail line including level-crossing safety, hazardous-cargo risks and emergency preparedness during operation; construction-phase risks including public encroachment on active work fronts, traffic from haulage operations, and community exposure to construction activities and emergency response requirements.	In

Topic	Potential Receptors	Notes on Risk of Significant Impacts	Scoped in / Out
Labour and Working Conditions	Project workforce; local communities in proximity to worker accommodation camps	Occupational health and safety risks associated with high-risk construction activities (working at height, lifting operations, excavation, and work near water); labour and working conditions risks including recruitment, working hours, and access to a workers' grievance mechanism; and risks of sexual exploitation, abuse, gender-based violence, and harassment (SEA/GBVH) associated with a non-local, multi-subcontractor workforce.	in
Socio-Economics	Land owners and land managers, businesses, local residents	Risk to income to land managers who make a living from agricultural production, cross-cutting with agriculture. Severance of fields and production units, increased travel time, changes to irrigation systems. Other potential effects include temporary and permanent access restrictions, community severance, construction-related nuisance and Project-related employment/connectivity benefits.	In conducting a non-empirical risk assessment – LARP will cover detailed economic impacts
Soil and Groundwater Quality	Agricultural grade soils, soils in open steppe areas Ground water resources	Likely loss of productive healthy soil resources due to direct impacts during construction. Groundwater is also retained in scope because construction camps, fuel storage/refueling, batching plants, wastewater systems and hazardous-material handling provide credible contamination pathways, even where deep groundwater vulnerability is considered relatively low. Minor spills during construction are unlikely to affect deeper ground water supplies.	In
Traffic and Transport	Local traffic patterns	Changes to travel patterns around station areas. Construction haulage, temporary access disruption, road safety, interaction with local roads and level crossings, as well as longer-term regional connectivity benefits leading to Improved regional connectivity	In as far as the project represents a benefit for regional

Topic	Potential Receptors	Notes on Risk of Significant Impacts	Scoped in / Out
Waste Management	Landfill capacity	Risk of exceeding local capacity of licensed landfills, risk of creating unofficial landfills, risk of borrow pits becoming unlicensed waste disposal site as evidenced on site. Construction and operational waste streams are assessed using available Project and OVOS information, including risks associated with hazardous wastes, temporary storage, transport and disposal capacity.	In
Water Resources	Local rivers, irrigation systems (cross-cutting with agriculture and socio-economics) Water amount and water quality	Risk of changes in local water supply systems for irrigation. Risk of pollution of water courses. Risk of over abstraction for project needs	In

The type of investigations and assessment for the various topics scoped in are to some degree impacted by the level of detail of the project design and in particular construction details. The current IA process has endeavored to consider impacts and risks in as much detail as possible but in some cases the assessment is necessarily generic, based on known risks from similar projects.

7. Baseline Conditions

7.1 Introduction

This chapter presents the baseline environmental and social conditions of the Project. It characterizes the physical, biological, socio-economic, and cultural setting of the Project Area of Influence and provides the factual foundation against which the impact assessment and the management measures in Chapter 8 are developed.

The chapter is organized under the following sections:

- **Section 7.2 – Project Setting and Area of Influence**, which describes the regional and administrative context of the Project, defines the spatial extent of the Area of Influence (topic-specifically), and provides a visual summary of the alignment;
- **Section 7.3 – Physical Environment**, covering topography and geomorphology; geology and soils; climate, climate change and the greenhouse gas (GHG) context; air quality; noise and vibration; surface water resources and hydrology (including the Syr Darya River and Shardara Reservoir); groundwater resources; and natural hazards and seismicity;
- **Section 7.4 – Biological Environment**, covering designated and internationally recognised areas (including the Shardara Reservoir Key Biodiversity Area), habitats and flora, fauna, the Critical Habitat Assessment, and ecosystem services;
- **Section 7.5 – Socio-Economic Environment**, covering the administrative setting; population and demography; economy, employment, and livelihoods; land use and land tenure; infrastructure and public services (including transport and traffic); community health and wellbeing; and vulnerable groups, gender, and ethnic composition;
- **Section 7.6 – Cultural Heritage Baseline**, presenting the archaeological and cultural heritage receptors identified along the alignment, including sites classified as “emergency monuments” under national heritage legislation; and
- **Section 7.7 – Landscape and Visual Amenity**, describing the regional landscape character, the existing visual setting, and the principal sensitive viewpoints along the alignment.

The baseline has been developed using multiple sources of information, including Project feasibility and design documentation, the national environmental assessment documentation including the completed OVOS and its supporting technical studies, the ESCA, specialist environmental and social surveys and assessments undertaken for the Supplementary ESIA, publicly available national and regional datasets, stakeholder consultation, and observations made during Project site visits. Where construction has already altered baseline conditions, available pre-construction information has been used alongside observations of current conditions to distinguish, as far as reasonably practicable, between the pre-Project baseline and conditions influenced by works undertaken to date.

The methodology applied to the baseline characterization, including the relationship between baseline conditions, the Area of Influence and identification of Valued Environmental and Social Receptors (VERs), is set out in Chapter 5 (Assessment Methodology) and is not repeated here. The applicable national legal framework, Lender requirements and environmental and social standards used as benchmarks for the subsequent assessment are presented in Chapter 3 (Policy, Legal and Administrative Framework).

7.1.1 Approach to Baseline Characterization

The baseline has been compiled from a combination of secondary data, project-specific information, and site verification. The principal data sources used are summarized in Table 46. Secondary data have been triangulated against site observations and stakeholder consultations to confirm relevance to the alignment and the wider Area of Influence; where material data gaps remain, they are noted at the

relevant point in the chapter and addressed through follow-up monitoring and verification commitments in the Construction-phase ESMP.

Table 46: Principal Data Sources Used in the Baseline Characterisation

Category	Source	Use in the Baseline
National environmental assessment	National environmental assessment documentation, including the completed OVOS and supporting technical documentation prepared under the Environmental Code (2021).	Baseline characterization of physical, biological and socio-economic conditions; Project-specific information on emissions, discharges, waste, water use and other environmental parameters; and supporting national-standard environmental data.
National hydrometeorological data	RSE Kazhydromet long-term records (temperature, precipitation, wind, humidity, evaporation) for Turkistan Oblast meteorological stations, together with ambient air-quality monitoring data where available.	Climate baseline; air-quality baseline; natural-hazards baseline.
Cadastral and land-acquisition data	Land plot data, available cadastral maps, ownership records, and Akimat decrees made available by KTZ as of 30 April 2026.	Land use and land tenure; affected districts profile.
Socio-economic and demographic data	Bureau of National Statistics of the Republic of Kazakhstan (oblast and district statistical yearbooks and electronic publications); Akimat profiles; Ministry of Health regional data; Ministry of Education data, UN data, as well as data from the LARP census and socio-economic survey.	Socio-economic environment.
Biodiversity data	Red Book of Kazakhstan; Key Biodiversity Areas database; literature review.	Biological environment; priority biodiversity values.
Project documentation	Engineering and design documentation provided by KTZ and the design consultant; KTZ corporate environmental, OHS, labour, and stakeholder engagement documentation.	Project setting; project-related baseline conditions.
Site verification	Site visits conducted by the Consultant team in November 2025, January	Cross-cutting verification of secondary data; landscape and visual amenity.

Category	Source	Use in the Baseline
	2026, February 2026 and May 2026 across the alignment, the Syr Darya bridge works, stations, depots, borrow pits, worker accommodation facilities and selected affected areas.	
Stakeholder engagement	Meetings, focus groups, and informal discussions with Akimats, project-affected persons, community representatives, and KTZ / Integra personnel during site missions.	Socio-economic context; community health and wellbeing.
Parallel ESCA	Verified findings of the parallel Environmental and Social Compliance Audit, prepared under the same overall assignment.	Project-related baseline conditions where verified findings inform the description of conditions observed at the time of preparation.
Remote sensing and GIS data	Recent and pre-construction satellite imagery; alignment KMZ provided by KTZ; publicly available administrative, hydrological, and land-cover datasets.	Spatial definition of the Area of Influence; pre-disturbance conditions where ongoing works affect baseline interpretation.
Project biodiversity surveys 2025–2026	Winter ornithological survey 24–25 February 2025 (Kovshar, 2025a); Spring/early breeding survey 14–16 May 2025 (Kovshar, 2025b); Summer/breeding survey 27 June–2 July 2025 incl. drone surveys of inaccessible reedbeds (Kovshar, 2025c); Winter survey 8–11 January 2026 (ACBK, 2026a); Winter Vantage Point survey 24–25 February 2026 with six fixed observation points (ACBK, 2026b); Spring 2026 surveys; Habitat, flora and protected-species surveys February–May 2026.	Biological Environment baseline; Critical Habitat Assessment underpinning.
Critical Habitat Assessment	Independent CHA prepared in support of this Supplementary ESIA, applying ADB SPS as governing standard, IFC PS6 GN6 quantitative thresholds, and AIIB ESF requirements via co-financier alignment. Stakeholder consultation, IBAT/IUCN/CMS/Kazakhstan RDB review, scientific literature review, Project field data, and species-specific EAAA.	Biological environment; Biodiversity impact assessment.

Where alignment-specific instrumental monitoring is available, including ambient air quality, noise, water quality or soil monitoring undertaken through the national environmental assessment process or specifically for the Project, the resulting data are presented in the relevant subsection. Where alignment-specific monitoring data are unavailable, the baseline draws on relevant regional data, national environmental assessment information and other authoritative sources, with the resulting limitations identified where material to the assessment.

7.1.2 Caveats and Limitations

The following caveats apply to the baseline characterization in this chapter and have informed the structure and content of each section:

Existing disturbance from ongoing works. Construction of the Project commenced in 2024 and is well advanced at the time of preparation of this Supplementary ESIA (2026). The baseline conditions of the natural environment (Sections 7.3, 7.4, 7.6, and 7.7) have therefore been characterized, where possible, using pre-construction and regional data — including the national OVOS, Kazhydromet long-term records, prior environmental and social studies, and pre-construction satellite imagery — supplemented by site verification. Areas of existing disturbance from ongoing works are noted where they affect interpretation of the baseline.

In addition, the following limitations apply to specific elements of the baseline:

- **Seasonal constraints.** Site verification and biodiversity surveys have been undertaken across multiple seasons to support characterization of the biological baseline. Where seasonal or survey limitations remain relevant to the interpretation of particular biodiversity features, these are identified in Section 7.4 and the Critical Habitat Assessment.
- **Reliance on third-party data.** Land acquisition, cadastral, and compensation data are reliant on documentation provided by KTZ and the Akimats; statistical and demographic data are reliant on national and oblast-level published sources, available data provided by project area communities, as well as self-reported data collected from affected households and legal entities during census and socio-economic survey. Where reliance on a single source materially affects the baseline interpretation, this is noted at the relevant point.

These caveats and limitations have been considered in the formulation of the impact assessment in Chapter 8 and in the prioritization of monitoring and verification activities in the Construction-phase ESMP and the operational-phase framework ESMP.

7.2 Project Setting and Area of Influence

This section describes the regional and administrative context in which the Project is situated, defines the spatial extent of the AoI on a topic-specific basis, and provides a visual summary of the alignment from north to south. Together, these elements frame the geographic scope of the baseline characterization in Sections 7.3 to 7.7 and the impact assessment in Chapter 8.

7.2.1 Regional and Administrative Context

The Project is located in the Turkistan Region (Turkistan Oblast) of southern Kazakhstan. Turkistan Region is one of the most populous and agriculturally productive regions of the Republic, occupying approximately 117,300 km² in the south of the country. It borders Uzbekistan to the south and west, Kyzylorda Region to the north-west, Zhambyl Region to the north-east, and the city of Shymkent (a separate city of republican significance) at its centre. The administrative centre of Turkistan Region is the city of Turkistan, designated as the regional capital in 2018 following the elevation of Shymkent to the status of city of republican significance. The total population of Turkistan Region is approximately 2.1 million, predominantly rural in character, with a mixed Kazakh and Uzbek ethnic composition reflecting its long-standing Central Asian cultural and trade history.

The alignment crosses five rayons (administrative districts) of Turkistan Region. In order from north (the Darbaza area) to south (the Maktaaral area), these are: Saryagash District, Keles District, Shardara District, Zhetysay District, and Maktaaral District. A summary of each district, its position along the alignment, its administrative centre, principal land use along the corridor, and key project-related features is provided in Table 47. Detailed socio-economic profiles for the five districts are presented in Section 7.5.

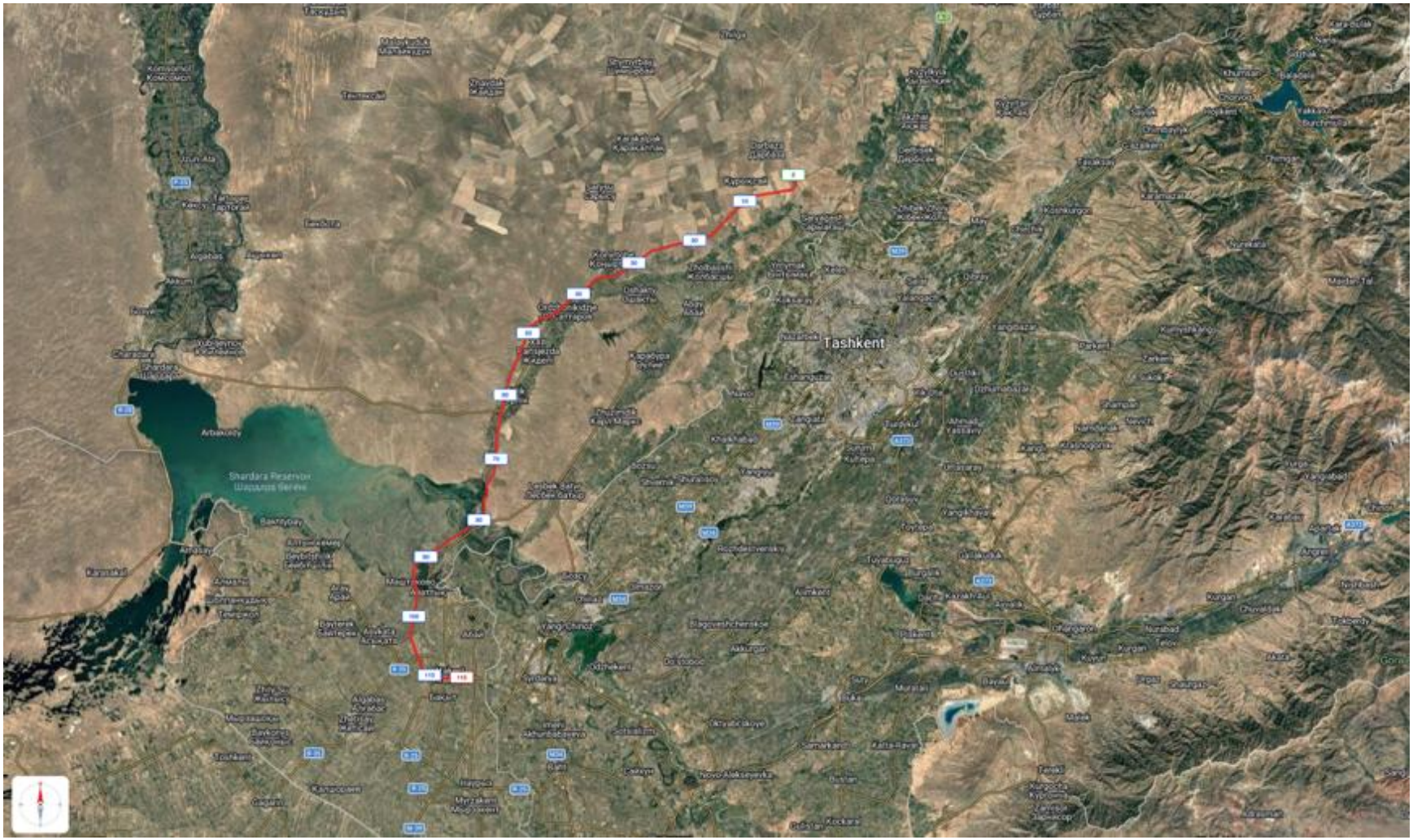
Table 47: Affected Districts of Turkistan Region (in Order along the Alignment)

District (Rayon)	Position along Alignment	Administrative Centre	Principal Land Use along the Corridor	Key Project-Related Features
Saryagash	Northern (start)	Saryagash town	Mixed agriculture, pastoral and rainfed cropping; settlements at the corridor edges and commercial land use	Northern terminus area; Yerdaut Station; works ongoing during inception-stage site visits; total of 43 land plots are affected.
Keles	North-central	Tasty / Abay	Agriculture (rainfed and irrigated); livestock; rural settlements	Total of 68 land plots are affected, including mostly leased agricultural land plots, as well as one land plots with affected residential and non-residential structures. Replacement land is expected to be provided in 33 cases, according to initial information provided by the Akimat
Shardara	Central	Shardara town	Reservoir-margin habitats; state lands within the inundation zone of the Shardara Reservoir; sparse agricultural use	Alignment runs in proximity to the Shardara Reservoir / Shardara Reservoir KBA; only one state-owned plot affected (within the reservoir inundation zone), to be transferred to the Project without formal acquisition
Zhetysay	South-central	Zhetysay town	Intensively cultivated irrigated agriculture, predominantly cotton; smaller plots; dense rural population	A total of 176 plots are affected, all comprising leased agricultural land plots used for cotton and wheat cultivation.
Maktaaral	Southern (end)	Atakent / Zhana-Ikan	Intensively cultivated irrigated agriculture, predominantly cotton; smaller plots; dense	A total of 84 land plots are affected, mostly leased plots used for cotton cultivation, as well as privately owned plots.

District (Rayon)	Position along Alignment	Administrative Centre	Principal Land Use along the Corridor	Key Project-Related Features
			rural population; proximity to Uzbekistan border	

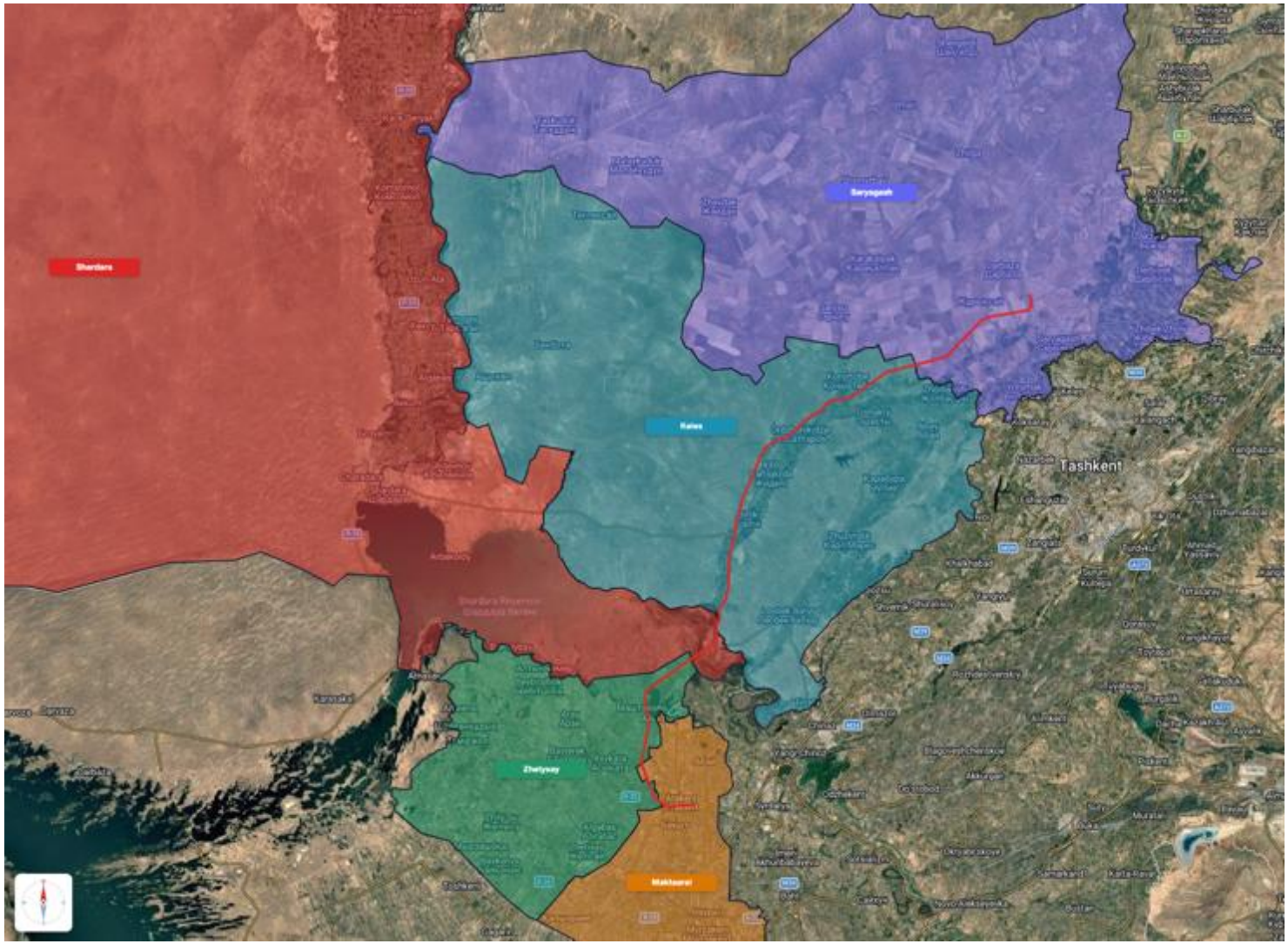
The land along the corridor transitions progressively from the more arid pastoral and rainfed cropland of Saryagash and Keles districts in the north, through the reservoir-margin landscape of Shardara District in the center, to the intensively cultivated irrigated farmland — predominantly cotton — of Zhetysay and Maktaaral districts in the south, where rural population densities are highest and agricultural plot sizes smallest. This north-to-south transition is reflected in the differing socio-economic and land-use character of the affected districts and shapes the spatial distribution of land-acquisition impacts, community-level interfaces, and biodiversity sensitivities along the corridor.

Figure 18: Regional Setting and Project Location – Project Alignment from Darbaza (Northern Terminus, KM 0) to Maktaaral (Southern Terminus, KM 115)



Source: VISTA Environment AB, based on KTZ-supplied alignment KMZ data on satellite imagery basemap.

Figure 19: Project Alignment Showing the Five Affected Districts of Turkistan Region (Saryagash, Keles, Shardara, Zhetysay, Maktaaral)



Source: VISTA Environment AB, based on KTZ-supplied alignment data and Turkistan Region administrative boundaries on satellite imagery basemap.

7.2.2 Spatial Definition of the Area of Influence

The Project AOI has been defined in accordance with the methodology set out in Chapter 5 (Assessment Methodology) and the lender frameworks summarized in Chapter 3. Consistent with IFC Performance Standard 1 and the ADB SPS (2009), the AOI is defined as the area within which environmental and social impacts of the Project may reasonably be expected to occur. The AOI is not a single geographic boundary but is defined on a topic-specific basis, reflecting the differing pathways and spatial extents over which environmental and social effects propagate.

Three categories of Area of Influence are recognized:

- **Direct Area of Influence:** the Project footprint (alignment, sidings, stations, depots, bridges, embankments, cuttings, traction power infrastructure) and its associated and ancillary facilities (worker accommodation camps, borrow pits, batching plants, access roads, and laydown areas), together with the immediate surroundings within which direct effects (e.g. noise, dust, in-river disturbance, vegetation clearance, land take) occur.
- **Indirect (Wider) Area of Influence:** areas beyond the direct footprint where impacts may propagate through environmental or social pathways — for example, downstream water bodies, ecological corridors, traffic networks used by project vehicles, or labour-market effects in the wider region.
- **Cumulative Area of Influence:** defined on a receptor-specific basis where a credible cumulative interaction is identified, taking account of the spatial extent of the Project impact and other sufficiently defined activities affecting the same receptor.

The topic-specific Areas of Influence applied in this Supplementary ESIA, distinguishing between the direct footprint and the wider area within which indirect, induced, and cumulative effects may occur, are summarized in Table 48. The values shown represent default working assumptions and are refined in the relevant baseline sub-sections (Sections 7.3 to 7.7) and impact-assessment chapter where receptor-specific considerations require a wider or more focused boundary.

These distances are used as screening boundaries rather than fixed limits to the assessment; where modeling, field data, receptor distribution or a defined environmental or social pathway indicates that an effect may extend beyond the indicative distance, the topic-specific Area of Influence is adjusted accordingly.

Table 48: Topic-Specific Definition of the Area of Influence

Topic	Direct Area of Influence (Footprint and Immediate Surroundings)	Wider Area of Influence (Indirect, Induced, and Cumulative)
Topography, geology, soils	Project footprint (alignment, sidings, stations, depots, bridges, embankments, cuttings) and ancillary facilities (worker camps, borrow pits, batching plants, access roads, laydown areas).	Adjacent areas potentially affected by erosion, sedimentation, slope instability, or contaminant migration; downstream drainage where cuttings or embankments alter surface flow.
Climate and GHG	Project footprint and ancillary facilities (construction emissions sources).	Regional climate baseline and Kazakhstan-level GHG context.
Air quality	Project footprint and 1 km buffer either side of the alignment, encompassing dust and combustion-	Wider receptors potentially affected by access-road traffic, hauling routes between borrow pits and work fronts, and emissions

Topic	Direct Area of Influence (Footprint and Immediate Surroundings)	Wider Area of Influence (Indirect, Induced, and Cumulative)
	emission dispersion to nearest sensitive receptors.	from concrete batching plants and worker camps.
Noise and vibration	Alignment and 500 m buffer either side, encompassing nearest residential, educational, and health receptors; site-specific buffers around bridge construction (Syr Darya), pile-driving locations, and stations.	Sensitive receptors along access roads and hauling routes; vibration receptors near borrow pits and rock-extraction operations.
Surface water and hydrology	Project footprint where it intersects watercourses, irrigation canals, and the Syr Darya River, including the 500 m bridge crossing and works within or adjacent to the Shardara Reservoir inundation zone.	Downstream Syr Darya reaches potentially affected by sedimentation, hydrocarbon releases, or in-river works; irrigation networks downstream of the alignment in Zhetysay and Maktaaral districts; hydrologically connected wetland habitats.
Groundwater	Project footprint and immediate surroundings, including borrow pits and worker camps with on-site sanitation.	Shallow aquifer system underlying irrigated farmland in Zhetysay and Maktaaral districts; groundwater-dependent ecosystems.
Biodiversity (general)	Alignment and 500 m buffer; ancillary facility footprints; vegetation clearance areas; in-river works at watercourses.	Wider habitat corridors and migratory routes intersected by the alignment; ecological connectivity across embankments and bridges; light- and noise-disturbance buffers from construction camps and stations.
Biodiversity (Shardara Reservoir KBA and priority biodiversity values)	Sections of the alignment within and immediately adjacent to the Shardara Reservoir KBA; embankment and access-road footprints in the reservoir margin; in-river works within the Syr Darya within the KBA.	Migratory bird flight corridors and seasonal habitats; functional connectivity between the reservoir, the Syr Darya, and adjacent wetland habitats;. Topic-specific Area of Influence is defined in the Critical Habitat Assessment.
Land use and land tenure	Alignment, station and depot footprints, ancillary-facility footprints, and access roads (permanent and temporary land take).	Surrounding farmland and pastoral land where access patterns, irrigation systems, or land productivity may be affected by the Project; severance impacts on agricultural holdings.
Socio-economic environment	Settlements within 1–2 km of the alignment, stations, depots, and worker camps; project-affected persons subject to land acquisition.	The five affected districts and Turkistan Region as a whole, including labour-market and supply-chain effects; communities along access roads; downstream economic

Topic	Direct Area of Influence (Footprint and Immediate Surroundings)	Wider Area of Influence (Indirect, Induced, and Cumulative)
		linkages (cotton processing, transport, freight).
Community health and safety	Settlements within 1 km of the alignment, stations, level crossings, hauling routes, and worker accommodation; pedestrian and livestock interfaces with the right of way.	Wider road network used by project traffic; emergency response coordination areas; communities affected by labour-influx interactions with the workforce.
Cultural heritage	Alignment and 500 m buffer (general); site-specific buffers around identified heritage receptors, including sites classified as "emergency monuments" under national legislation.	Wider cultural-heritage landscape; intangible heritage associated with affected communities; chance-finds along access roads, borrow pits, and ancillary facilities.
Landscape and visual amenity	Alignment, embankments, bridges (notably the Syr Darya 500 m bridge), stations, depots, and traction power infrastructure; viewpoints within 1–2 km.	Wider viewshed in flat steppe and reservoir-margin landscapes (up to 5 km); travelling viewpoints from existing roads; night-light effects from stations, depots, and worker camps.
Worker accommodation, OHS, labour	Worker accommodation facilities, work fronts, equipment yards, and rolling-stock movements during construction.	Communities adjacent to camps; transport routes used by workers; supply-chain workers engaged off-site.

7.2.3 Visual Summary of the Alignment

This sub-section provides a north-to-south walkthrough of the Project alignment, highlighting key features along the corridor and illustrating, through site photographs, the principal landscape and infrastructure contexts encountered. The walkthrough is intended to orient the reader in advance of the topic-specific baseline descriptions that follow in Sections 7.3 to 7.7 and the impact assessment in Chapter 8. References to chainage are indicative; precise alignment data are held in the project drawings provided by KTZ and the design consultant.

Northern section – Saryagash District (start of alignment, Darbaza area). The northern terminus of the new alignment lies in Saryagash District, in the Darbaza area, where the new line connects to the existing rail network. The corridor in this section runs through gently rolling semi-arid steppe, with mixed pastoral use and rainfed cropland, scattered settlements at the corridor edges, and isolated farmsteads. Yerdault Station, currently under construction, is the principal new station in this northern section; it is the location at which initial track-laying has been undertaken and at which 20 affected residential plots (of which 16 include structures) are concentrated. Embankment formation, track installation, and traction power gantries are visible across the open landscape (Figure 20); the predominant character is wide-horizon steppe with limited natural shelter and low-density human occupation.

Figure 20: Northern Section – Track-Laying and Traction Power Gantries near Yerdault Station, Saryagash District



Source: ESIA Team, 2026

North-central section – Keles District. South of Saryagash, the alignment passes through Keles District, characterized by a mixture of pastoral and agricultural land (rainfed and irrigated), rural settlements at intermediate spacing, and an established pattern of district roads and irrigation canals.

Central section – Shardara District and the Syr Darya / Shardara Reservoir crossing. In Shardara District, the alignment approaches and crosses the Syr Darya River, the major hydrological feature of the corridor and a defining ecological and social asset of southern Kazakhstan. The river is crossed by a new 500-metre bridge, the principal hydraulic structure of the Project. The alignment in this section is in close proximity to the Shardara Reservoir (Shardara Reservoir) — a large impoundment on the Syr Darya — which is recognized as a Key Biodiversity Area (KBA) under international biodiversity criteria. Reservoir-margin reedbeds, salt-tolerant scrub (including *Tamarix* and *Phragmites* spp.), and seasonally inundated wetlands provide the principal habitats for migratory and resident waterbirds (Figure 21 and Figure 22). The embankment construction along the reservoir margin is visible in Figure 23, illustrating the spatial relationship between the alignment, the wetland habitats, and the open water of the reservoir. In Shardara District, only one state-owned plot is affected (within the reservoir inundation zone), which will be transferred to the Project without formal acquisition; private-land impacts in this district are minimal.

Figure 21: Reedbed and Salt-Tolerant Vegetation along the Margin of the Shardara Reservoir, Shardara District



Source: ESIA Team, 2026

Figure 22: Open Water and Reedbed Mosaic, Shardara Reservoir, Shardara District



Source: ESIA Team, 2026

Figure 23: Project Embankment Construction along the Margin of the Shardara Reservoir, Shardara District



Source: ESIA Team, 2026

Figure 24: Syr Darya River Crossing at Low Flow



Source: ESIA Team, 2026

South-central section – Zhetysay District. South of the Syr Darya, the alignment enters Zhetysay District, where it crosses some of the most intensively cultivated and densely settled agricultural land along the corridor. The dominant land use is irrigated agriculture, with cotton as the principal crop, supported by a network of irrigation canals and small farmsteads. Plot sizes are small and agricultural use is intensive.

Southern section – Maktaaral District (end of alignment, Maktaaral Station area). The southern terminus of the alignment lies in Maktaaral District, close to the Kazakhstan–Uzbekistan border. The land-use character is similar to that of Zhetysay District — intensively cultivated irrigated cotton land, dense rural population, and small agricultural plots — with the additional feature of a concentration of mixed residential and small-scale commercial / agro-industrial structures (sunflower-oil refinery, storage facilities, mill, greenhouse, cattle farm) in the immediate vicinity of the planned Maktaaral Station. The feasibility study for Maktaaral Station is ongoing at the time of preparation of this Supplementary ESIA, with consequent uncertainty as to the precise final footprint. Existing rail infrastructure in the wider area, including intermediate stations on adjacent routes, illustrates the typical character of operating rail facilities in the region (Figure 25).

Figure 25: Existing Rail Infrastructure in Maktaaral



Source: ESIA Team, 2026

Together, the five district sections of the alignment illustrate a corridor that transitions progressively from open semi-arid steppe in the north, through the ecologically sensitive reservoir and river-crossing landscape in the center, to the densely settled and intensively farmed irrigated cotton zone in the south. This north-to-south gradient is reflected in the topic-specific baselines and Areas of Influence that follow.

7.3 Physical Environment

This section describes the physical environment of the Project Area of Influence, covering topography and geomorphology, geology and soils, climate, ambient air quality, noise and vibration, surface water resources and hydrology, groundwater resources, and natural hazards and seismicity. The characterization draws principally on the national environmental assessment documentation, including the completed OVOS and its supporting technical studies, RSE Kazhydromet long-term meteorological and air-quality records, project engineering and design data, publicly available hydrological and geological datasets, and observations from site verification undertaken during the November 2025, January 2026, and February 2026 missions.

7.3.1 Topography and Geomorphology

Regional physiographic setting. The Project corridor lies within the south-eastern margin of the Turan Lowland (Turan Plain), the extensive intracontinental sedimentary basin that occupies most of southern Kazakhstan and the adjoining states of Central Asia. To the north-east, the corridor is flanked

at distance by the Karatau Range, an extension of the Western Tian Shan that rises to elevations in excess of 2,000 m above sea level; to the south and south-west, the corridor opens into the Mirzachoel ("Hungry Steppe") alluvial plain, which extends across the border into Uzbekistan. The corridor itself does not enter any mountainous terrain; it traverses gently undulating steppe surfaces in the north, the broad alluvial valley of the Syr Darya River and the margin of the Shardara Reservoir in the centre, and the flat alluvial plain of the Mirzachoel in the south.

Topographic profile along the alignment. The alignment runs broadly north-to-south through Turkistan Region across a surveyed length of approximately 115 km of new single-track railway (with an additional 45 km of sidings and passing loops). Elevations along the corridor are moderate. The northern terminus area in the Darbaza–Yerdault section of Saryagash District lies at the highest part of the corridor, on gently rolling steppe surfaces at approximately 409 m above sea level (KM 0). From the north, the alignment descends progressively southward through Keles District, reaches its lowest point at the Syr Darya River crossing in Shardara District at approximately 248 m (around KM 78), and then rises modestly across the alluvial plain of Zhetysay and Maktaaral districts to approximately 265 m at the southern terminus near the Kazakhstan–Uzbekistan border (KM 115). The total vertical relief along the corridor is approximately 162 m. Longitudinal gradients are gentle throughout, consistent with railway design constraints (typically below 1.5%); steeper engineered slopes occur only locally in cuttings and at embankment approaches to bridges and overpasses.

The generally low-relief terrain limits large-scale slope-instability risks along most of the alignment, while the principal geomorphological sensitivities are associated with alluvial and floodplain environments, localized erosion and drainage pathways, and engineered embankments and cuttings.

Figure 26: Project Alignment with Elevation Annotations – Spot Elevations along the Surveyed Alignment from Darbaza to Maktaaral



Source: VISTA Environment AB, based on KTZ-supplied alignment data and Google Earth elevation data.

Figure 27: Longitudinal Elevation Profile of the Project Alignment



Source: VISTA Environment AB, derived from the surveyed alignment.

Geomorphological units and surface character. Five principal geomorphological units are recognized along the corridor, broadly corresponding to the five affected districts:

- **Piedmont-derived steppe surfaces (Saryagash District, north).** Gently undulating to slightly rolling surfaces underlain by piedmont alluvium and locally by loess and loessoid deposits derived from the southern flanks of the Karatau Range. Drainage is dominated by ephemeral channels that carry runoff only during snowmelt and intense rainfall events. Surface character is open semi-arid steppe with sparse vegetation cover; localised aeolian reworking has produced minor blowouts and weakly developed sand-sheet surfaces in places.
- **Transitional alluvial surfaces (Keles District, north-central).** Gentler relief than Saryagash, marking the transition from piedmont alluvium to the broader alluvial system of the Syr Darya basin. Slopes are very low and surface drainage is increasingly modified by the irrigation network supporting rainfed and irrigated cropping. Loamy and loessoid surface deposits predominate.
- **Syr Darya valley and Shardara Reservoir margin (Shardara District, central).** The principal hydromorphological feature of the corridor. The alignment crosses the Syr Darya River by means of a 500-metre bridge and runs in close proximity to the southern–south-eastern margin of the Shardara Reservoir, a large impoundment on the Syr Darya. Geomorphological elements include: (i) low alluvial terraces and modern floodplain of the Syr Darya, with fine-grained alluvial and over-bank deposits; (ii) the engineered margin of the Shardara Reservoir, including artificial embankments, mudflats exposed at low reservoir levels, and zones of seasonally inundated wetland fringed by reedbeds and salt-tolerant scrub; and (iii) areas of secondary salinisation and salt-pan (sor / takyr) features in the lower-lying parts of the reservoir-margin landscape. Reservoir water levels are regulated and vary seasonally, with associated changes in the spatial extent of the exposed shoreline and adjacent wetlands.
- **Mirzachoel alluvial plain (Zhetysay District, south-central).** Flat to very gently sloping alluvial plain, part of the wider Mirzachoel (“Hungry Steppe”) physiographic unit that extends southward into Uzbekistan. The natural surface has been extensively modified by an engineered irrigation drainage network that supports intensive irrigated cotton production. Surface relief is minimal; isolated takyr (clay-flat) features and small areas of surface salinisation occur in less intensively irrigated parcels.
- **Mirzachoel alluvial plain (Maktaaral District, south).** Continuation of the Mirzachoel alluvial plain to the southern terminus near the Kazakhstan–Uzbekistan border. Relief is very low and the surface is densely cultivated for irrigated cotton supported by the irrigation network. Loamy alluvial deposits dominate; surface salinisation is observable in places where irrigation drainage is impaired. The plain is continuous across the international border with the Mirzachoel proper in Uzbekistan.

Drainage and surface hydrography. The corridor is hydrographically dominated by the Syr Darya River, the second-largest river of Central Asia, which the alignment crosses in Shardara District. Other surface drainage along the corridor consists of (i) small ephemeral channels in the piedmont-derived steppe of Saryagash and Keles districts, draining seasonally toward the Syr Darya basin; (ii) a dense network of irrigation supply and drainage canals serving the cotton-producing areas of Zhetysay and Maktaaral districts; and (iii) the engineered shoreline and discharge structures associated with the Shardara Reservoir. Detailed hydrological characterisation, including flow regime of the Syr Darya at the bridge crossing and reservoir-level data for the Shardara Reservoir, is presented in Section 7.3.6.

7.3.2 Geology and Soils

Regional geological framework. The Project corridor lies on the Turan Platform, a stable epicratonic platform of Hercynian (Late Palaeozoic) consolidated basement, overlain by a thick Mesozoic–Cenozoic sedimentary cover and a continuous mantle of Quaternary deposits at the surface. More

specifically, the corridor sits within the *Syr Darya structural basin*, one of a series of basins extending from the higher Tien Shan mountains in the east toward the Caspian Sea in the west. The Syr Darya basin is bounded by three principal tectonic uplifts: the Big Karatau Uplift to the north-east, the Chatkal–Kuramin Uplift to the south, and the Central Kyzylkum Uplift to the south-west. The basin is occupied predominantly by continental (including pyroclastic) and minor marine sedimentary rocks with a thickness of up to 3,000 m. An upper stratigraphic–structural unit of Neogene–Quaternary sedimentary rocks unconformably overlies a lower stratigraphic–structural unit of Upper Cretaceous–Palaeogene sedimentary rocks of approximately 500 m thickness (IAEA, 2025; Project Feasibility Study). To the north-east, the corridor is flanked at distance by the Karatau Range, an extension of the Western Tian Shan that rises to elevations in excess of 2,000 m above sea level; to the south and south-west, the corridor opens into the Mirzachoel ("Hungry Steppe") alluvial plain, which extends across the border into Uzbekistan. The corridor itself does not enter any mountainous terrain and is structurally simple; it does not cross any active surface fault traces. The principal tectonic and seismic context, including the influence of the regional fault system on seismic hazard along the corridor, is addressed in Section 7.3.8.

The geological and soil conditions described above have practical implications for construction planning and environmental management. Where practicable, the biologically active topsoil horizon should be stripped separately from subsoil and stockpiled for reinstatement of temporarily disturbed areas in accordance with the Soil Management Plan. Excavated materials may be reused for embankment construction, backfilling or other engineering purposes where they are demonstrated to be geotechnically suitable and free from contamination or excessive salinity. Materials containing elevated sulfate or gypsum concentrations should be assessed before reuse because of their potential effects on earthworks performance and concrete durability. Any soils found during construction to contain elevated concentrations of hydrocarbons, heavy metals or other contaminants—including any contamination associated with historical agricultural activities—should be segregated, tested and managed in accordance with the Construction Environmental and Social Management Plan and applicable national waste management requirements.

Lithological character of the basin. Within the Syr Darya basin, the principal lithologies described in the project Feasibility Study comprise crystalline rocks, limestones, shales, and intrusive and effusive (volcanic) rocks; pure massive limestones are rare but where present retain steep precipices and peaks created by deep erosion or discharges over geological time. Clayey and sandy shales are essentially impermeable, with narrow cracks of limited depth (up to 30 m) and consequently low groundwater storage and yield. For convenience of hydrogeological characterization, the rocks of the basin are conventionally united into four water-physical groups based on their permeability, groundwater occurrence, and hydraulic features:

- **Group 1 – Friable Quaternary deposits** with pore-type water resistance, comprising pebbles, crushed stone, gravel, loam, loess, loess-like rocks, monotonous and interlaced clays, and (in higher-elevation areas elsewhere in the basin) loose rocks cemented by ice. This is the dominant group at the surface along the Project corridor.
- **Group 2 – Semi-loose (semi-rocky) Mesozoic, Paleogene, and Neogene rocks** with pore-cracked-type water resistance, comprising principally conglomerates, sandstones (clayey and siliceous), and clayey shales in interlayering. Encountered at depth beneath the Quaternary cover.
- **Group 3 – Carbonate and hydrochemical Paleozoic and Mesocainazoic rocks** with fracture-karst-type water resistance, comprising limestones interlayered with sandstones, clay shales, and gypsiferous and saline sediments, marl and sandstones. Characterised by the greatest fracturing, solubility, and karst development; areas of these rocks are characterised by high water availability and elevated groundwater mineralisation.
- **Group 4 – Metamorphic and eruptive rocks** of fractured-type water resistance, comprising shales with interlayers of sandstones and intrusive (and less commonly effusive) rocks.

Characterised by weak groundwater mineralisation and the greatest water availability, owing to monolithicity and lower fracturing than the carbonate group.

Surface geology along the alignment. Surface geology along the corridor is dominated by Group 1 friable Quaternary deposits of varying thickness, age, and provenance. Bedrock outcrops are absent along the alignment itself; older Neogene and Mesozoic strata (Group 2) occur at depth and may be encountered only in the deeper foundations of major structures, in particular the piers of the Syr Darya bridge. The principal Quaternary lithostratigraphic units encountered along the corridor are summarized in Table 49.

Table 49: Indicative Quaternary Lithostratigraphic Units Along the Project Corridor

District (Position)	Principal Surface Deposits	Genesis / Age	Engineering-Geological Character
Saryagash (north)	Loess and loessoid loams; piedmont alluvium and proluvium; subordinate aeolian sand-sheet deposits	Late Pleistocene–Holocene; piedmont and aeolian processes derived from the Karatau Range	Loose to medium-dense; collapsible on saturation (loess); locally susceptible to surface erosion under earthworks; bearing capacity moderate
Keles (north-central)	Alluvial–proluvial loams and silts; transitional facies between piedmont and Syr Darya basin	Late Pleistocene–Holocene	Variable consistency; generally suitable for embankment foundation with conventional preparation; localised collapsible loess horizons
Shardara (central)	Modern alluvium of the Syr Darya (sand, silt, clayey silt); over-bank and floodplain deposits; reservoir-margin lacustrine sediments; localised salt-pan (sor / takyr) deposits	Holocene; modern fluvial and reservoir-margin deposition	Soft to medium-stiff; variable bearing capacity; locally saturated and saline; bridge piers founded in deeper, denser alluvium or weathered Neogene strata
Zhetysay (south-central)	Alluvial loams, silts, and clayey silts of the Syr Darya / Mirzachoel system; buried alluvial channels	Holocene	Loamy to silty, generally medium-stiff; shallow groundwater; locally saline at depth; modified by intensive irrigation
Maktaaral (south)	Alluvial loams and silts of the Mirzachoel plain; subordinate aeolian and salt-pan deposits	Holocene	Similar to Zhetysay; surface salinisation observable in poorly drained parcels; foundation conditions generally favourable for shallow embankments

Detailed engineering-geological information for the alignment, including borehole logs, in-situ test data, and geotechnical recommendations, is held in the design documentation prepared by the design

consultant; the summary above is intended to characterize the regional setting rather than to substitute for site-specific geotechnical data.

Soil cover. Soil cover along the corridor reflects the climate-driven zonation of southern Kazakhstan, with progressive aridification from the piedmont in the north toward the alluvial plain in the south, modified locally by alluvial deposition along the Syr Darya and by long-established irrigation in the Mirzachoel. The principal soil types encountered along the corridor are:

- **Light sierozems.** Predominate in Saryagash and Keles districts on piedmont and transitional surfaces. Light-textured loamy soils developed on loess and loessoid parent material; low organic matter content (typically <1–1.5%); moderate to high carbonate content; weakly developed profile. Native vegetation cover is sparse semi-desert / dry steppe.
- **Meadow-alluvial and alluvial-meadow soils.** Occur along the Syr Darya valley and at the margin of the Shardara Reservoir in Shardara District. Developed on Holocene alluvium under fluctuating groundwater influence; loamy to clayey textures; locally saline; supporting the natural reedbed and salt-tolerant scrub communities described in Section 7.4.
- **Irrigated meadow-sierozems and cultivated alluvial soils.** Cover the great majority of Zhetysay and Maktaaral districts, where intensive irrigation over decades has produced a distinctive soil profile with elevated organic matter (relative to dryland sierozems), modified water regime, and frequent secondary salinisation in poorly drained parcels.
- **Solonchaks and solonetz.** Saline and alkali soils occur as patches throughout the southern part of the corridor, particularly in lower-lying parcels with shallow saline groundwater and impaired drainage. They also occur in zones of secondary salinisation at the margin of the Shardara Reservoir.
- **Takyr soils.** Hard clay-flat soils with low permeability, occurring locally on flat surfaces in the southern districts and at the reservoir margin. Limited agricultural use.

Engineering-geological characterization along the alignment

The TEO Volume 1 section5.1.5 provides authoritative engineering-geological characterization of the corridor based on the project geotechnical investigations:

- Middle Quaternary (Q_2) deposits dominate the piedmont sloping plains and watershed areas of the Kuryukkeles and Keles river basins. These deposits comprise loess-like rocks, sands, and gravel-pebble layers resting on Neogene-system bedrock. The characteristic feature of these deposits is their yellow coloration, high carbonate content, and high macroporosity in the upper horizons, which gives the loess collapsibility properties when wet. Total deposit thickness ranges from 15 to 200 m. Underlying gravel and pebble strata occur at 10–25 m depth below surface in the Syr Darya floodplain left-bank section.

- Upper Quaternary (Q_4) deposits of the Abay Formation are elluvial-proluvial in origin, infilling the Keles and Kuryukkeles river valleys. These comprise grey and yellow-brown silty loams (suglinki) and sandy loams (supesi) with interbedded sands, gravelly and pebbly soils. The upper part typically consists of silty loams and sandy loams while the lower part consists of gravel-pebble soils; the gravel-pebble layer is locally encountered at 2.0 m depth and at 4.0 m depth. Deposit thickness reaches 15–20 m. These deposits represent a potential source of coarse-fragment material for embankment fill or slope protection.

- Modern (Q_4^2) alluvial deposits form the Syr Darya floodplain. Total deposit thickness is 8–10 m, lying on Q_2 gravel-pebble bedrock. These deposits comprise a heterogeneous mixture of clayey and sandy soils, gravel-pebble layers, and silts, highly variable in depth and lateral extent. The upper soil horizons are saline owing to the close proximity of the groundwater table, with significant areas of the floodplain underlain by saline soils.

From an environmental perspective, the principal characteristics relevant to the impact assessment are therefore the susceptibility of loess-like soils to loss of strength when wetted, the heterogeneous

and locally saline alluvial deposits around the Syr Darya floodplain, and the potential for erosion or sediment mobilization where soils are exposed during construction.

Hydrogeological conditions along the alignment

Three hydrogeologically distinct sections are present along the alignment with materially different groundwater conditions:

Table 50: Hydrogeological Conditions

Section	Chainage	Depth to groundwater	Water quality	Notes
Section 1 (northern piedmont)	PK0 – PK85 (~0–28 km)	8–25 m	Fresh in dug wells	Groundwater encountered only in dug wells excavated in temporary watercourse beds (saiy / wadis)
Section 2 (Syr Darya floodplain)	PK85 – PK102 (~28–34 km)	0.2–1.0 m	Variable: fresh to weakly saline	Rises to surface during reservoir filling; very shallow groundwater table is the main cause of intensive solonchak (salt-pan) formation in the floodplain
Section 3 (irrigated zone)	PK102 – PK119 (~34 km onwards)	4–6 m typically; 2.0–2.5 m near canals	Sulphate-aggressive to concrete grade W4 under GOST 10178-85	During intensive irrigation periods, groundwater may rise to ground surface. The aggressivity requires sulphate-resistant cement in buried structures

The W4 sulphate-aggressivity classification for groundwater in the southern section has direct implications for the cement specification of buried structures (culverts, bridge piers, embankment drainage) along the alignment in Zhetysay and Maktaaral districts.

Physical-geological processes and hazards relevant to the corridor

The following physical-geological phenomena and processes are active along the corridor, distributed between the piedmont and the Syr Darya plain:

- Sheet erosion active on the lower piedmont and piedmont plains;
- Soil salinization and solonchak (salt-pan) formation on the piedmont plain (around inland depressions and on the alluvial-fan toes);
- Wetland formation along the alluvial-fan toes;
- Formation of extensive solonchak fields in lower-lying depressions and closed basins along the Syr Darya plain;
- Takyr (cracked-clay-flat) formation in closed depressions where clay material is washed in from the adjacent surface;
- Denudation processes shaping the current relief of the plain;
- Transport and reworking of aeolian sand forms at the margin of the Moyunkum–Kyzylkum desert areas to the west of the corridor.

These regional processes are consistent with the corridor's position south of the Karatau Range, on the alluvial plain of the middle Syr Darya. They do not include mountain-style mudflow processes, which in Kazakhstan are concentrated in the Trans-Ili (Zailiyskiy) Alatau and other high-Tian Shan ranges (see section6.3.8 Natural Hazards and Seismicity).

Soils and vegetation along the alignment (TEO Volume 1 section5.1.8). The TEO confirms the soil-vegetation associations summarized in the previous sub-section, with the following alignment-specific additions:

- Loess interfluves (between river valleys, on watersheds): grey-earth (sierozem) soils used for dry farming (богара), predominantly for cotton under irrigation; soil horizon thickness up to 0.2 m. Vegetation dominated by ephemerals (annuals) and Artemisia (wormwood); small dry watercourse beds frequently support mallow and camel-thorn. Grass cover is well utilized by small livestock for 10–11 months per year.
- Keles and Kuryukkeles river valleys: humified grey-earths, saline in floodplains, particularly along the Kuryukkeles floodplain.
- Syr Darya floodplain: tugai (riparian) soils developed predominantly on sandy and sandy-loamy alluvial deposits. Shallow groundwater coupled with intense evaporation is the principal driver of soil salinization; large areas of solonchak (salt-pans) occur within the tugai soil zone. Vegetation consists of grass-and-shrub communities, with sedge and reed beds in the wetter parts of the floodplain. Dominant shrubs include tamarisk (*Tamarix*), tugai poplar (*Populus euphratica*), Russian olive (*Elaeagnus*). Herbaceous species include adyrik, salsola (*selitryanka*), and camel-thorn; Salicornia / saltworts dominate strongly saline patches.
- Left bank of Syr Darya (which the Project alignment traverses through Zhetysay and Maktaaral districts): culturally-irrigated soils, anthropogenically modified through long irrigation; specific grey upper horizon coloration, 0.2–0.3 to 0.4 m horizon thickness.

The presence of tugai poplar (*Populus euphratica*) within the Syr Darya floodplain is consistent with the Critical Habitat Assessment's identification of Tugai riparian forest as a habitat type of conservation interest (CHA section Criterion 5; further described in section 6.4 Biological Environment).

Soil quality and contamination baseline. Two aspects of soil quality are of particular relevance to the baseline characterization:

- **Soil salinity.** Secondary salinisation associated with irrigation is a long-standing feature of the Mirzachoel plain in Zhetysay and Maktaaral districts, and of the reservoir-margin landscape in Shardara District. Salinity is an established constraint on agricultural productivity in the region and is a relevant consideration for embankment and cutting design (corrosion of buried infrastructure, impaired vegetative reinstatement) and for characterisation of the soil baseline at potential borrow-pit and laydown-area locations.
- **Legacy agrochemical contamination.** Long-established cotton cultivation in the southern districts has involved the use of fertilisers, herbicides, defoliants, and — historically — organochlorine pesticides (most of which have since been banned or restricted). Although surface concentrations have declined since the cessation of historical applications, residual contamination of soils with persistent organic pollutants, trace metals, and salts may be encountered locally where earthworks intersect long-cultivated parcels. The potential for such legacy contamination is considered a localized baseline condition associated with long-term agricultural land use rather than evidence of Project-related contamination. Where potentially contaminated soil is encountered during earthworks, it will be managed in accordance with the soil and waste management measures established for construction.

Mineral resources and borrow-pit context.

Construction of the Project requires significant quantities of common construction materials, including sand, gravel, crushed stone (ballast), structural fill, and loams for embankment construction. Common-mineral resources occur within and adjacent to the corridor and are regulated under the

Code on Subsoil and Subsoil Use (2017), requiring permits issued by the authorized subsoil authority or by the relevant Akimat, with associated rehabilitation obligations (see Section 3.8).

There are a number of existing licensed subsoil-use contracts in Saryagash District, Turkistan Region, summarized in Table 51 below. These existing operators provide a potential source of construction materials with a lower environmental footprint than the opening of new project-specific borrow pits, particularly where the materials sourced are loams (suglinki), sand-gravel mix, bentonite clays, or building stone.

Table 51: Existing licensed subsoil-use contracts in Saryagash District

Operator	Deposit / location	Material	Contract №	Valid to
TOO "Sahara-K"	m. Kelesskoye	Bentonite clays	105	09.11.2028
TOO "Asfalt"	uch. Keles-Kyzylzhar	Sand-gravel mix	265	19.04.2031
TOO "S.DEM"	m. Beshkuduk	Building stone (shell-stone)	509	01.06.2040
ChP "Baisupiyev"	pl. Kuryukkeles uch. №1	Loams (suglinki)	369	16.08.2032
TOO "Palinur"	m. Yntymak (Zhartytobinsky village council)	Loams (suglinki)	528	27.04.2042

Source: TEO Volume 1 section5.6 (Transproekt-K, 2023), Common Mineral Resources Users Register, Turkistan Region.

Construction water supply

Technical water for construction is supplied by AO "Теміржолсу" (Temirzholsu), a wholly owned subsidiary of KTZ JSC, drawing from water-extraction wells at the existing stations along the corridor. Where wells are absent, water is delivered by tanker from the nearest available station or settlement.

7.3.3 Climate, Climate Change and GHG Context

Climate classification and overview. The Project corridor lies within a sharp continental, semi-arid to arid climate zone classified, under the modern Köppen–Geiger system at 1-km resolution (Beck et al., 2018), predominantly as **BSk** (cold semi-arid steppe) in the northern districts and grading toward **BWk** (cold desert) in the southern districts of Zhetysay and Maktaaral. The earlier project Feasibility Study and the original ESIA draft alternatively classified the project area as **Dsa** (warm continental, hot dry summer) under an older Wikimedia Commons Köppen map; this classification is generally not supported by modern peer-reviewed Köppen–Geiger maps for southern Kazakhstan and is noted here for cross-reference with prior project documentation. Irrespective of the precise classification, the climate is characterized by hot, dry summers and cold winters with significant interannual variability, low annual precipitation concentrated in the spring months, high evaporation potential, and long hours of sunshine. Continentality is pronounced: the diurnal temperature range is large (typically 12–18°C in summer); the annual range between mean January and mean July temperatures exceeds 30°C; and summer maxima at Saryagash reach 39°C and above, with absolute long-term maxima in excess of +43°C (World Weather Online, 2025; Kazhydromet, 2024). The corridor experiences frequent dust events, occasional dust storms in spring and summer, and infrequent but intense convective rainfall events (ADB & WB, 2021). Snow cover is light to intermittent, with peak monthly snowfall depth at Saryagash typically below 10 cm in February (World Weather Online, 2025). Long-term meteorological data for the Project corridor are derived from the network of RSE Kazhydromet stations operating in Turkistan Region, including stations at Saryagash, Shymkent, Turkistan, and the Mirzachoel;

complementary monthly maximum, minimum, and mean temperature records and rainfall data for Saryagash for the period 2009–2025 have additionally been compiled from the World Weather Online platform.

Long-term climate norms. Long-term climatic norms for the corridor, summarized in Table 52, are derived from a combination of national observations published in the Kazhydromet Annual Climate Bulletin (Kazhydromet, 2024), the gridded CRU TS climatology (1991–2020) for southern Kazakhstan as compiled in the World Bank Climate Change Knowledge Portal (World Bank CCKP, 2024), the regional descriptions in the joint ADB / World Bank *Climate Risk Country Profile: Kazakhstan* (ADB & WB, 2021), and the Stage II OVOS Report on Possible (Potential) Impacts. The values shown are indicative of regional conditions.

Table 52: Indicative Long-Term Climate Norms along the Project Corridor

Climate Parameter	**Northern Section (Saryagash / Keles)**	**Southern Section (Zhetysay / Maktaaral)**
Mean annual air temperature	approximately +11 to +13 °C	approximately +13 to +15 °C
Mean January air temperature	approximately −5 to −8 °C	approximately −2 to −5 °C
Mean July air temperature	approximately +26 to +29 °C	approximately +28 to +30 °C
Absolute maximum air temperature (long-term)	approximately +43 to +45 °C	approximately +44 to +46 °C
Absolute minimum air temperature (long-term)	approximately −30 to −35 °C	approximately −25 to −30 °C
Frost-free period	approximately 190–210 days	approximately 210–230 days
Mean annual precipitation	approximately 300–400 mm	approximately 200–300 mm
Distribution of precipitation	Concentrated in spring (March–May, ~50–60% of annual total) and winter; summer is markedly dry.	Concentrated in spring (March–May); winter contribution lower than in the north; summer rainfall negligible.
Snow cover	Light, intermittent; typical duration 60–90 days; peak depth typically below 30 cm.	Very light and intermittent; typical duration <60 days; snow cover frequently absent in mild winters.
Mean annual relative humidity	approximately 55–65%	approximately 50–60%
Annual potential evaporation	approximately 1,200–1,500 mm	approximately 1,500–1,800 mm

Climate Parameter	Northern Section (Saryagash / Keles)	Southern Section (Zhetysay / Maktaaral)
Annual sunshine duration	approximately 2,700–2,900 hours	approximately 2,900–3,100 hours
Predominant wind direction (annual)	North-easterly to easterly in winter; variable in summer.	North-easterly in winter; "afgan"-type southerly winds in summer; localised dust events.
Mean annual wind speed	approximately 2–3 m/s	approximately 3–4 m/s

Sources: Kazhydromet (2024); World Bank CCKP (2024); ADB & WB (2021); Stage II OVOS Report. Indicative regional ranges; local Project-corridor conditions are further characterized using Kazhydromet data for MS Zhetysay and MS Shardara in Table 53.

Local meteorological station data. Specific climatological characteristics from the two Kazhydromet meteorological stations closest to the alignment — MS Zhetysay (Maktaaral District) and MS Shardara (Shardara District) — have been compiled in the TEO Volume 1 (section5.1.2) and are reproduced in Table 53 below. These stations are located on the Project corridor itself rather than at the regional reference points used in Table 52 and accordingly provide the authoritative local baseline for alignment-specific climatic conditions in the central and southern sections of the corridor.

Table 53: Local climatological data from MS Zhetysay and MS Shardara

Parameter	MS Zhetysay (Maktaaral District)	MS Shardara (Shardara District)
Mean maximum air temperature, hottest month (July)	+36.2 °C	+36.6 °C
Mean minimum air temperature, coldest month (January)	−2.5 °C	−3.1 °C
Number of days with snow cover	28	32
Number of days with liquid (ЖО) / solid (ТО) precipitation	65 / 14	68 / 11
Wind speed exceeded 5% of the year	4 m/s	6 m/s
Mean annual wind speed	1.8 m/s	2.4 m/s
Maximum recorded wind speed	20 m/s	20 m/s
Mean annual precipitation	295 mm	230 mm

Source: TEO Volume 1, section5.1.2 (Transproekt-K, 2023), citing Kazhydromet records for the two stations.

Table 54: Monthly precipitation distribution at the two stations (mm):

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual

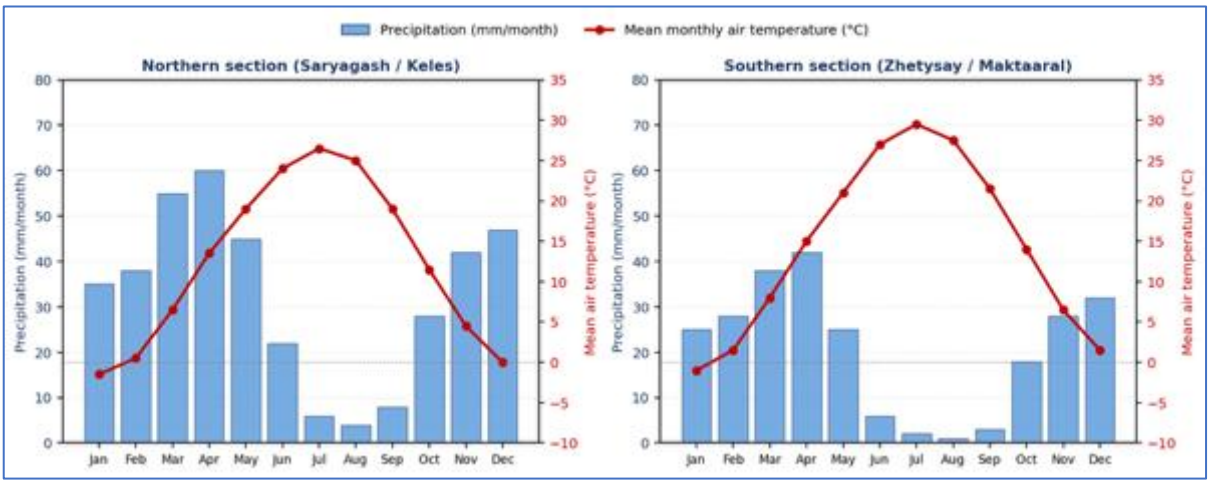
MS Zhetysay	38	47	47	40	26	7	1	2	3	13	34	39	295
MS Shardara	28	37	36	29	21	6	2	1	2	9	28	31	230

The monthly distribution confirms the strongly spring-dominant precipitation regime described in the previous paragraph, with virtually no rainfall in July–September (1–3 mm/month) and concentrated precipitation in February–May (146–161 mm or 50–55% of the annual total). The annual precipitation gradient from 295 mm at Zhetysay down to 230 mm at Shardara reflects the increased aridity towards the south-west of the corridor.

Wind regime at MS Shardara. The wind frequency distribution at MS Shardara is dominated by north (35%), south-east (20%), and north-west (13%) directions, with 13% calm conditions. These data are derived from the TEO Volume 1 section5.1.2 wind rose for MS Shardara and refine the regional bimodal description in Figure 29; the dominant northerly component reflects the cold-season influence of the Siberian High, while the south-easterly component reflects the warm-season afgan-type airflow from the Mirzachoel.

The seasonal cycle of temperature and precipitation for representative northern and southern sections of the corridor is illustrated in Figure 28. The figure illustrates the strong continentality of the corridor (large annual range of mean monthly temperature, with sub-zero mean temperatures in winter and mean monthly temperatures approaching +30 °C in July in the southern section) and the spring-dominant precipitation regime, with negligible summer rainfall in both sections.

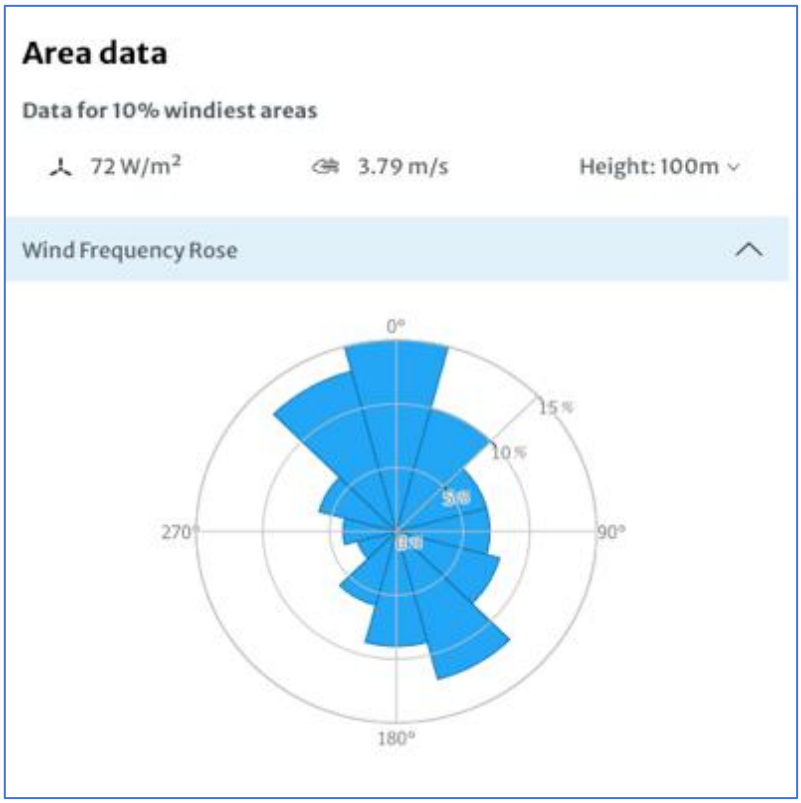
Figure 28: Climograph for Representative Northern and Southern Sections of the Project Corridor



Sources: World Bank CCKP (2024) CRU TS climatology 1991–2020 for southern Kazakhstan; ADB & WB (2021); Kazhydromet (2024). Indicative regional values; see Table 53 and Table 54 for local Kazhydromet station data from the Project corridor.

The prevailing wind regime over the Project corridor, illustrated in Figure 29, is bimodal, with the most frequent wind directions from the north / north-north-east (cold-season influence of the Siberian High) and from the south / south-south-west (warm-season “afgan”-type airflow from the Mirzachoel and Uzbekistan). Mean wind speeds at 100 m above ground for the 10% windiest portions of the corridor are reported by the Global Wind Atlas at approximately 3.79 m/s, with a corresponding wind power density of approximately 72 W/m² (Global Wind Atlas, 2024). Surface (10 m) wind speeds are lower than 100 m values and are the relevant metric for ambient air quality and dust dispersion modelling. Surface wind conditions relevant to the Project are characterized using the available Kazhydromet records for MS Shardara and MS Zhetysay presented above.

Figure 29: Wind Frequency Rose for the Project Corridor Area at 100 m above Ground (Long-Term Average; Bimodal North–South Predominance)



Source: Global Wind Atlas (2024). 100 m height; mean wind speed 3.79 m/s; wind power density 72 W/m² (10% windiest areas).

Climate variability and extremes. Interannual climate variability is significant in southern Kazakhstan and is reflected in the frequency of climatic extremes. The principal climate-related extremes relevant to the corridor are: (i) summer heat waves, with daytime maxima in excess of +40 °C occurring on an essentially annual basis and persisting over multi-day periods, with implications for outdoor working conditions, asphalt softening at access roads, and rail thermal expansion; (ii) winter cold spells and rapid temperature drops, with implications for track contraction, switch operation, and worker exposure; (iii) intense convective rainfall events in spring and early summer, with implications for embankment erosion and culvert capacity; (iv) dust events and dust storms, particularly in spring and following dry winters, with implications for ambient air quality and rolling-stock maintenance; and (v) drought, with implications for native and reinstated vegetation cover and for water availability at construction camps and operational facilities. [5] Extreme-event statistics for the corridor are documented in the Stage II OVOS and in Kazhydromet records.

Observed climate change. Kazakhstan is warming at a rate that is materially faster than the global average. National analyses, including the periodic National Communications and Biennial Update Reports submitted by the Republic of Kazakhstan to the UNFCCC and the Annual Climate Bulletin published by Kazhydromet, document a sustained rise in mean annual air temperature across Kazakhstan since the mid-twentieth century, with stronger warming in the cold season than in the warm season and pronounced spatial variation. [6] The principal observed trends, summarized in Table 55, include a rise in mean annual air temperature of approximately 0.28 °C per decade between 1941 and 2011, with seasonal warming rates of +0.35 °C/decade in winter, +0.32 °C/decade in autumn, and +0.18 °C/decade in summer; a small overall reduction in mean annual precipitation of approximately

5 Annual Bulletin on Monitoring of the Climate Status and Climate Change in Kazakhstan (most recent edition). Republican State Enterprise Kazhydromet, Astana / Almaty.

6 Salnikov, V., Turulina, G., Polyakova, S., Petrova, Y. & Skakova, A. (2015). Climate change in Kazakhstan during the past 70 years. Quaternary International, 358, 77–82.

0.5 mm/decade over the same period, but with a statistically significant increase in winter precipitation; and a reduction in the maximum duration of rainless periods, particularly in the north and south-east of the country. For southern Kazakhstan specifically, the additional observed trends relevant to the Project include earlier onset of the spring thaw, a shorter season of stable snow cover, an increase in the frequency and intensity of summer heat waves, and reductions in glacier extent in the upstream Tian Shan with consequences for the long-term flow regime of the Syr Darya (further addressed in Section 7.3.6).

Table 55: Observed Climate Change Trends in Kazakhstan, 1941–2011

Parameter	Observed Trend	Reference Period
Mean annual air temperature, Kazakhstan (national average)	+0.28 °C / decade	1941–2011
Mean winter (DJF) air temperature, Kazakhstan	+0.35 °C / decade	1941–2011
Mean autumn (SON) air temperature, Kazakhstan	+0.32 °C / decade	1941–2011
Mean summer (JJA) air temperature, Kazakhstan	+0.18 °C / decade	1941–2011
Mean annual air temperature anomaly, Kazakhstan	+0.3 to +1.4 °C warmer than baseline (varies by region)	1997–2010 vs 1971–2000
Mean annual precipitation, Kazakhstan	−0.5 mm / decade (≈0.3% / decade)	1941–2011
Winter (DJF) precipitation, Kazakhstan (most regions)	Statistically significant increase	1941–2011
Maximum duration of rainless periods, Kazakhstan (north and south-east)	Significant decrease	1941–2011
Stronger regional warming signal noted in	North, west, and south of Kazakhstan (corridor falls in the southern zone)	1941–2011

Sources: ADB & WB (2021); Salnikov et al. (2015); Kazhydromet (2024); Republic of Kazakhstan (2023b).

Projected climate change. Climate projections for Kazakhstan, drawn from the IPCC Sixth Assessment Report, [7] the Coupled Model Intercomparison Project Phase 6 (CMIP6) ensemble accessed through the World Bank Climate Change Knowledge Portal, [8] and the joint ADB / World Bank *Climate Risk Country Profile: Kazakhstan* (ADB & WB, 2021), indicate continued and accelerating warming through

7 IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., et al. (eds.)]. Cambridge University Press.

8 World Bank CCKP (2024). Climate Change Knowledge Portal: Kazakhstan. CRU TS climatology (1991–2020) and CMIP6 multi-model ensemble projections. World Bank Group, Washington, DC. https://climateknowledgeportal.worldbank.org/country/kazakhstan

the operational lifetime of the Project. Country-level temperature change projections under the Shared Socio-economic Pathway (SSP) scenarios most commonly applied for climate-risk assessment are summarized in Table 56. Under intermediate emissions scenarios (SSP2-4.5), country-level mean annual temperatures are projected to rise by approximately +1.5 to +2.5 °C by mid-century (2041–2060) relative to the late-twentieth-century baseline, with stronger warming under high-emissions scenarios (SSP5-8.5: +2.5 to +3.5 °C by mid-century, and total warming reaching approximately +5 °C or more by the 2090s; ADB & WB, 2021). The number of days per year with maximum temperatures above +35 °C is projected to increase substantially, the frost-free period to lengthen, and the frequency and intensity of heat waves to rise. Precipitation projections for Kazakhstan are subject to greater model uncertainty than temperature projections but indicate, on balance, a tendency toward more variable precipitation, longer dry spells, and a greater proportion of annual precipitation falling in fewer, more intense events.

Together, these projections indicate increased exposure of the Project to heat stress, drought-related vegetation loss and localized intense-rainfall events relevant to erosion, drainage and minor-stream culvert capacity. Potential changes to the Syr Darya flow regime are more complex and are influenced principally by upstream snow and glacier melt, reservoir regulation and regional water-management arrangements, rather than by localized rainfall along the Project corridor; these factors are considered further in Section 7.3.6.

Table 56: Indicative Climate Change Projections for Kazakhstan under CMIP6 SSP Scenarios

Variable	**Time Horizon**	**SSP1-2.6 (Low Emissions)**	**SSP2-4.5 (Intermediate)**	**SSP5-8.5 (High Emissions)**
Change in mean annual air temperature (°C, vs late-20th-century baseline)	Near-term (2030s)	approximately +1.0 to +1.5	approximately +1.0 to +1.5	approximately +1.5 to +2.0
	Mid-century (2041–2060)	approximately +1.2 to +2.0	approximately +1.5 to +2.5	approximately +2.5 to +3.5
	End-century (2081–2100)	approximately +1.5 to +2.0	approximately +2.5 to +3.5	approximately +5.0 to +5.5
Change in mean annual precipitation (% vs baseline)	Near-term (2030s)	−2 to +3	−2 to +3	−3 to +4
	Mid-century (2041–2060)	−3 to +5	−3 to +6	−5 to +8
	End-century (2081–2100)	−5 to +6	−3 to +8	−5 to +15 (high uncertainty; spatial heterogeneity)

Variable	Time Horizon	SSP1-2.6 (Low Emissions)	SSP2-4.5 (Intermediate)	SSP5-8.5 (High Emissions)
Frequency and intensity of summer heat waves	All horizons	Increase, modest	Increase, marked	Increase, severe
Number of days with Tmax > +35 °C (southern Kazakhstan)	All horizons	Increase	Substantial increase	Very substantial increase

Sources: World Bank CCKP (2024) CMIP6 ensemble; ADB & WB (2021); IPCC (2021). Values are country-level and indicative of plausible ranges for southern Kazakhstan; corridor-specific downscaled projections (e.g. CORDEX-CA) to be incorporated when available. Precipitation projections are subject to greater model uncertainty than temperature projections.

ADB Climate Risk Screening

ADB completed a Climate and Disaster Risk Screening for the Project in April 2026 using its Climate and Disaster Risk Screening Tool. The screening assesses baseline and projected climate-related hazard exposure over the design life of the railway and identifies the Project's overall climate risk as High. For the railway alignment, the screening identifies High climate risk associated with projected mean surface temperature increase, river flooding and rainfall-induced landslide. Heat stress is rated Moderate under both baseline and projected conditions, while drought increases from Low baseline risk to Moderate projected risk. Water scarcity and wildfire are rated Moderate risks.

For long-term temperature change, the ADB screening classifies the railway alignment as having High exposure, with projected mean surface temperature increase exceeding 2° C relative to the 1985–2014 reference period. Heat-stress exposure is classified as Moderate, with projected Wet Bulb Globe Temperature (WBGT) in the range of 25–32° C. Water-scarcity exposure is classified as High, with the Water Stress Index projected to exceed 40%.

These screening results are used to identify climate hazards requiring further consideration in the Project assessment and should be read alongside the more location-specific climatic, hydrological and engineering information presented in this ESIA.

Greenhouse gas (GHG) policy context. The Republic of Kazakhstan is a Party to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement. Under its updated Nationally Determined Contribution (NDC) submitted in 2023,[9] Kazakhstan has committed to an unconditional target of a 15% reduction in economy-wide greenhouse gas emissions by 2030 relative to a 1990 baseline, with a conditional target of 25% subject to international support. Kazakhstan has further announced a Strategy for the Achievement of Carbon Neutrality by 2060, adopted by Presidential Decree in 2023, [10] and operates a domestic Emissions Trading Scheme (Kazakhstan ETS) covering large emitters in the power, oil and gas, mining, metallurgical, and chemical sectors. National greenhouse gas inventories and progress reporting are presented in Kazakhstan's National Communications and Biennial Update Reports to the UNFCCC. [11] KTZ JSC reports its corporate carbon footprint and has adopted internal goals on energy efficiency and emissions reduction, as documented in the corporate environmental and ESG materials reviewed at inception stage.

9 Updated Nationally Determined Contribution of the Republic of Kazakhstan to the UNFCCC. Submission to the UNFCCC Secretariat.

10 Strategy for the Achievement of Carbon Neutrality by 2060, approved by Presidential Decree.

11 Eighth National Communication and Fifth Biennial Report of the Republic of Kazakhstan to the UNFCCC. Ministry of Ecology and Natural Resources, Astana.

7.3.4 Air Quality

Air quality context. The Project corridor is predominantly rural to semi-rural in character, traversing open semi-arid steppe in the north, the Syr Darya valley and Shardara Reservoir margin in the centre, and the intensively cultivated irrigated cotton zone of the Mirzachoel in the south. The corridor is distant from heavy industrial centres of Kazakhstan, with the closest major urban area, Shymkent, located approximately 120–180 km from the alignment depending on the section. Ambient air quality along the corridor is therefore influenced primarily by natural aeolian dust, agricultural activities, dispersed domestic heating in rural settlements, local road and rail transport, and — at the time of preparation of this Supplementary ESIA — the ongoing construction activities of the Project itself. The applicable national ambient air quality standards (Kazakhstan SanPiN maximum allowable concentrations, MAC) are summarized in Section 3.5.1; the principal lender benchmarks applied in this Supplementary ESIA are the WHO Global Air Quality Guidelines 2021 (WHO, 2021) and the IFC General Environmental, Health and Safety Guidelines (IFC, 2007).

Sources of air pollutants in the corridor. The principal existing sources of atmospheric emissions affecting ambient air quality along the corridor, identified through site verification and the national environmental assessment documentation, including the completed OVOS, are summarized in Table 57. The dominant background contributor is mineral aeolian dust, which is characteristic of the semi-arid and arid landscape and which is enhanced by surface disturbance, drought, and seasonal dust storms; in the southern districts of Zhetysay and Maktaaral, agricultural activities (tillage, harvesting, residue management) contribute additional fugitive particulate emissions, particularly during the cotton-harvest period. Combustion-related emissions are generated by domestic heating in rural settlements (predominantly using solid fuels in winter), road transport on the existing district road network, the existing rail network, and — in localized areas — small-scale agro-industrial operations such as sunflower-oil refining, milling, and storage facilities concentrated near the planned Maktaaral Station. There are no large stationary point sources of industrial emissions within the corridor itself.

Table 57: Indicative Existing Sources of Air Pollutants in the Project Corridor

Source Category	Specific Sources	Principal Pollutants	Distribution along Corridor
Natural / aeolian	Wind erosion of arid and semi-arid soils; mineral dust from exposed loess, alluvial, and salt-pan surfaces; long-range transport from Central Asian deserts; pollen and biogenic aerosols	PM10, PM2.5 (mineral and biogenic fraction)	Throughout the corridor; greatest contribution in northern steppe and southern Mirzachoel sections, particularly in spring and following dry winters
Agricultural	Tillage and harvesting; cotton harvest and post-harvest activities (Zhetysay and Maktaaral districts); livestock; localised crop-residue management	PM10, PM2.5 (fugitive dust); NH_3; biogenic VOCs	Predominantly southern districts (Zhetysay, Maktaaral); seasonal (autumn harvest peak)

Source Category	Specific Sources	Principal Pollutants	Distribution along Corridor
Domestic heating	Combustion of solid fuels (coal, wood, dung) and oil products in rural household heating during the winter period; small boilers in commercial / institutional buildings	PM2.5, PM10, SO_2, NOx, CO, polycyclic aromatic hydrocarbons (PAHs), black carbon	Settlements throughout the corridor; concentrated emissions in winter (October–March)
Road transport	Existing district road network; access tracks; project-related haulage on local roads; long-distance freight on the M-32 / regional road network	NOx, PM2.5, PM10, CO, SO_2, hydrocarbons	Adjacent to existing roads; locally elevated near intersections, settlements, and project access roads
Rail transport	Existing rail movements on the national network; localized emissions from diesel rolling stock at marshalling and intermediate facilities	NOx, PM2.5, PM10, SO_2, CO	Limited to existing rail network; transitional during the construction phase of the Project
Localized agro-industrial / commercial	Sunflower-oil refinery, mill, storage facilities, greenhouse, cattle farm, and other small commercial / agro-industrial structures (concentrated near the planned Maktaaral Station)	PM10, PM2.5, VOCs (depending on activity); NOx, SO_2 from on-site combustion	Localized in the Maktaaral Station area; smaller scattered facilities elsewhere
Project-related construction (existing baseline at time of preparation)	Earthworks, embankment formation, track-laying, bridge and overpass construction, borrow-pit operations, concrete batching plants, and movement of approximately 350 machinery units and project vehicles; worker accommodation facilities	PM10, PM2.5 (fugitive and combustion); NOx, CO, SO_2 (combustion); hydrocarbons	Distributed along the corridor at active work fronts and ancillary facilities; localized "hot-spot" emissions in the immediate vicinity of borrow pits, batching plants, and bridge construction sites

Sources: Site verification (Consultant team, November 2025, January 2026, February 2026); Stage II OVOS Report; KTZ engineering data on machinery deployment and ancillary facilities; ESCA findings (parallel deliverable). Indicative summary; alignment-specific source inventory and emissions estimates to be developed in Chapter 8 and the Construction-phase ESMP.

Ambient air quality. Long-term ambient air quality monitoring along the Project corridor itself is limited; the closest formal Kazhydromet monitoring station providing regular ambient air quality data is at Shymkent, with additional monitoring undertaken on an ad hoc basis at sub-regional level. Indicative ambient air quality reference values for rural southern Kazakhstan, drawing on regional

Kazhydromet records, the WHO Global Health Observatory database, [12] and aggregated regional data published in the IQAir World Air Quality Report, [13] are summarized in Table 58, alongside the applicable Kazakhstan SanPiN MAC values and the WHO 2021 Air Quality Guidelines. The principal pollutant of concern in the corridor is suspended particulate matter (PM10 and PM2.5), reflecting the combination of natural aeolian dust, agricultural fugitive emissions, domestic combustion in winter, and — currently — construction-related dust generation. Annual average PM2.5 concentrations across Kazakhstan have been reported to exceed the WHO 2021 annual guideline of 5 µg/m³ by a substantial margin in urban areas (with reported annual averages in Shymkent in the range 25–40 µg/m³ in recent years; IQAir, 2024); in rural settings such as the Project corridor, concentrations would generally be expected to be lower than in major urban areas, although particulate matter may remain elevated during dry and dusty conditions. In the absence of representative corridor-specific monitoring, the concentrations of individual pollutants at sensitive receptors cannot be reliably quantified from regional data alone.

Table 58: Indicative Ambient Air Quality Reference Values, Project Corridor (Rural Southern Kazakhstan)

Pollutant	**Averaging Period**	**Indicative Background – Rural Southern Kazakhstan**	**Kazakhstan SanPiN MAC (indicative)**	**WHO 2021 AQG**
PM10	Annual mean	approximately 30–60 µg/m³ (with episodic dust events to >200 µg/m³)	60 µg/m³ (24-hour average)	15 µg/m³ (annual); 45 µg/m³ (24-hour)
PM2.5	Annual mean	approximately 15–30 µg/m³	35 µg/m³ (24-hour average)	5 µg/m³ (annual); 15 µg/m³ (24-hour)
Nitrogen dioxide (NO_2)	Annual mean	approximately 5–15 µg/m³	40 µg/m³ (24-hour); 200 µg/m³ (1-hour MAC)	10 µg/m³ (annual); 25 µg/m³ (24-hour)
Sulphur dioxide (SO_2)	24-hour mean	<10 µg/m³ (rural background)	50 µg/m³ (24-hour); 500 µg/m³ (20-min MAC)	40 µg/m³ (24-hour)
Carbon monoxide (CO)	8-hour mean	<2 mg/m³ (rural background)	3 mg/m³ (24-hour); 5 mg/m³ (1-hour MAC)	4 mg/m³ (24-hour); 10 mg/m³ (8-hour)
Ozone (O_3)	8-hour daily max	approximately 80–130 µg/m³ (warm-season peaks)	30 µg/m³ (24-hour); 160 µg/m³ (1-hour MAC)	60 µg/m³ (peak-season 8-hour); 100 µg/m³ (8-hour)

12 WHO (2024). WHO Global Health Observatory: Ambient Air Pollution Data Repository. World Health Organization, Geneva. https://www.who.int/data/gho

13 IQAir (2024). World Air Quality Report 2023 (and antecedent annual reports). IQAir, Goldach, Switzerland. https://www.iqair.com/world-air-quality-report

Pollutant	Averaging Period	Indicative Background – Rural Southern Kazakhstan	Kazakhstan SanPiN MAC (indicative)	WHO 2021 AQG
Total suspended particulate (TSP)	Daily mean	Variable; locally elevated during dust events and during construction activities	150 µg/m³ (24-hour); 500 µg/m³ (20-min MAC)	Not specified in WHO 2021 (PM10 and PM2.5 used as indicators)

Sources: Indicative regional ranges based on Kazhydromet (2024), WHO Global Health Observatory (WHO, 2024), and IQAir (2024) regional and urban-area data; WHO (2021) Global Air Quality Guidelines; Kazakhstan SanPiN MAC values.

Project Specific Ambient Air Quality Data. No continuous Kazhydromet ambient air-quality monitoring stations are located within the Project corridor. The 2026 Project of Permissible Emission Standards (NDV) records that, according to information provided by RSE Kazhydromet on background pollutant concentrations, atmospheric air-quality observations are not available for the relevant Project settlements. The available national environmental documentation reviewed for this Supplementary ESIA therefore does not provide a sufficiently documented corridor-wide pre-construction ambient air-quality monitoring dataset from which representative baseline concentrations of PM10, PM2.5, NO_2, SO_2 and CO can reliably be established at the sensitive receptors assessed in Chapter 8.

Quantitative concentrations previously attributed to a 2021 OVOS-supporting monitoring round have not been relied upon in the baseline unless the underlying sampling records, locations and methodology can be verified. The Project corridor is predominantly rural and agricultural, although locally elevated particulate concentrations may occur due to wind-blown dust, unpaved roads, agricultural activities, existing road traffic, settlement activities and existing railway activity. Ongoing Project construction is now an additional source of particulate matter and therefore measurements undertaken after commencement of construction cannot necessarily be regarded as representative of the pre-Project baseline.

The 2026 NDV also includes atmospheric dispersion modeling for identified construction and operational emission sources. The assessment reports that predicted ground-level concentrations at residential-area and sanitary-protection-zone boundaries remain below 1.0 national MPC for the pollutants assessed. These results provide supporting information regarding compliance with national air-quality requirements but are not treated as measurements of existing ambient baseline conditions.

In the absence of a representative pre-construction monitoring dataset, the impact assessment does not assume substantial assimilative capacity for particulate matter and adopts a conservative approach to PM10 and PM2.5. Project-related emissions are assessed against the applicable national standards and WBG/WHO benchmarks, with monitoring during implementation used to verify performance at sensitive receptors where warranted.

7.3.5 Noise and Vibration

The principal existing sources of ambient noise along the corridor, identified through site verification and the national environmental assessment documentation, including the completed OVOS, are summarized in Table 59. Outside of settlements and the immediate vicinity of operating roads and the existing rail network, the soundscape is dominated by natural sources and the noise climate is characteristic of a low-activity rural environment. Within settlements, the soundscape is shaped by local road traffic, domestic activity, livestock, and — in larger villages and at agricultural processing facilities — small-scale agro-industrial machinery. Project-related construction activities generate localized elevated noise at active work fronts, on haul roads, and at borrow pits and batching plants.

The applicable national noise and vibration standards (Kazakhstan SanPiN noise limits; DIN 4150-3 thresholds for vibration as commonly applied in Kazakhstan) are summarized in Sections 3.5.3 and 3.5.4. The principal lender benchmarks applied in this Supplementary ESIA are the WHO Environmental Noise Guidelines for the European Region (WHO, 2018), the IFC General Environmental, Health and Safety Guidelines for noise (IFC, 2007), and — for vibration — ISO 14837-1 (ISO, 2005) for ground-borne vibration from railway operations and DIN 4150-3 (DIN, 2016) for vibration in buildings.

Table 59: Indicative Existing Sources of Ambient Noise in the Project Corridor

Source Category	Specific Sources	Indicative Sound Power / Pressure Levels	Distribution along Corridor
Natural	Wind in vegetation; birdsong and biota; precipitation events; ambient atmospheric noise	Background $L_{ae}q$ ~25–40 dB(A) (rural daytime, away from human activity)	Throughout the corridor; dominant outside settlements
Domestic and rural settlement	Household activity; livestock; small-scale combustion (heating, cooking) in winter; small generators; community gatherings	Settlement $L_{ae}q$ ~45–55 dB(A) daytime; lower at night	Settlements throughout the corridor; concentrated within and at the immediate edges of villages and farmsteads
Agricultural	Tractors and agricultural machinery (seasonal: tillage, harvesting, irrigation); mechanized cotton harvesting (Zhetysay, Maktaaral); livestock movement; small grain dryers and post-harvest processing	Activity-specific $L_{ae}q$ ~55–75 dB(A) at 10–15 m from source	Predominantly southern districts (Zhetysay, Maktaaral); seasonal peaks during sowing, harvest, and post-harvest processing
Road transport	Local traffic on the existing district road network; intermittent freight movements; project-related haulage on local roads at the time of preparation	Roadside $L_{ae}q$ at 10 m typically 55–70 dB(A) daytime; lower at night and on lesser roads	Adjacent to the existing road network; locally elevated near intersections and access roads
Rail transport	Existing rail movements on the national network; localized noise at marshalling areas and intermediate facilities; pass-by noise from locomotives and rolling stock	Pass-by $L_{ae}q$ at 25 m typically 60–75 dB(A) for diesel rolling stock; lower for electric traction	Limited to sections adjacent to existing operating rail; transitional during the

Source Category	Specific Sources	Indicative Sound Power / Pressure Levels	Distribution along Corridor
			construction phase
Localized agro-industrial / commercial	Sunflower-oil refinery, mill, storage, greenhouse operations, cattle farms, and other small commercial / agro-industrial structures (concentrated near the planned Maktaaral Station)	Site-specific; typically 55–70 dB(A) at 30–50 m from source during operation	Localized in the Maktaaral Station area; smaller scattered facilities elsewhere

Sources: Site verification (Consultant team, November 2025, January 2026, February 2026); Stage II OVOS Report; KTZ engineering data on machinery deployment and ancillary facilities. Sound levels are indicative of typical ranges for the source categories described and are not the result of project-specific measurements.

The 2021 measurements provide useful indicative information on the pre-construction acoustic environment at the sampled locations. As short-term daytime measurements, however, they do not constitute a continuous or seasonal baseline and should not be interpreted as representative of nighttime conditions or of every sensitive receptor along the alignment.

Short-term day time ambient noise sampling was undertaken at 22 locations along the alignment (2021 OVOS). Two measurements (denoted Noise 1 and Noise 2 in the original report) were taken at each of the 22 locations and have been compared against the applicable national daytime residential limit of 55 dB(A). The results indicate that, for most of the proposed alignment, existing noise levels are low and well within national and international standards: 17 of the 22 sampled locations recorded values at or below 35 dB(A), well below the 55 dB(A) limit. Where samples were taken near to the existing road network or within the confines of Saryagash City (locations 1 and 13–17 in the original numbering), noise levels were elevated and exceeded the 55 dB(A) limit, with values up to 65 dB(A). Vibration data were also recorded at the same locations; the monitoring used Hz units, indicating frequency-domain rather than peak-particle-velocity reporting, and these data are not directly comparable to the DIN 4150-3 (PPV-based) framework applied in this Supplementary ESIA.

Table 60: Summary of Prior Project Noise Sampling

Sampling Group	Number of Locations	Recorded Sound Level Range
Remote / open-steppe locations distant from existing roads and settlements	Approximately 17 of 22 sampled locations	20–35 dB(A) (Noise 1 and Noise 2 averages); well below the 55 dB(A) Kazakhstan SanPiN daytime limit
Locations 8 and 11 – transitional / semi-settled	2 of 22 sampled locations	Up to approximately 45–55 dB(A); within or close to the 55 dB(A) limit
Locations near the existing road network (location 1) and within Saryagash City (locations 13–17)	6 of 22 sampled locations	50–65 dB(A); exceeding the 55 dB(A) Kazakhstan SanPiN daytime limit at several locations

Vibration baseline. Vibration observations were recorded at the same 22 locations during the 2021 OVOS monitoring program; however, the results were reported in frequency (Hz) rather than peak particle velocity (PPV) and are therefore not directly comparable with the DIN 4150-3 PPV-based criteria applied in this Supplementary ESIA. The available data nevertheless indicate that the pre-construction corridor was generally characterized by low levels of vibration away from existing roads, railway infrastructure and other localized sources. Accordingly, the 2021 vibration data are used qualitatively to characterize the receiving environment rather than as a quantitative PPV baseline for the construction or operational vibration assessment.

7.3.6 Surface Water Resources and Hydrology

The Project corridor sits within the Syr Darya basin, the second-largest river basin in Central Asia and one of the two principal sub-basins of the wider Aral Sea basin. The Syr Darya is a transboundary river system shared by the Kyrgyz Republic, the Republic of Tajikistan, the Republic of Uzbekistan, and the Republic of Kazakhstan; transboundary water management is coordinated through the Interstate Coordination Water Commission (ICWC) and its executive bodies, including the Basin Water Organization (BWO) Syr Darya. The Syr Darya basin has a total area of approximately 402,760 km² and supports a population of approximately 20 million people, predominantly engaged in agriculture; agricultural use accounts for approximately 89% of water withdrawals from the basin (WEAP). [14] The corridor lies in the middle reach of the Syr Darya, downstream of the major upstream reservoirs of Toktogul (Kyrgyz Republic), Andijan (Uzbekistan), Bahri Tojik (Tajikistan), and Charvak (Uzbekistan), and immediately upstream of and adjacent to the Shardara Reservoir (Kazakhstan) on which the Project's principal hydraulic structure (the 500 m Syr Darya bridge) is located.

Flow regime of the Syr Darya basin. The Syr Darya and its tributaries are predominantly snowmelt-fed rivers, with secondary contributions from glacier and seasonal-snowfield melt and from rainfall. The upstream Tien Shan portion of the basin receives only 8–18% of annual precipitation in winter (December–March) and 41–57% in summer (June–August), while the Chirchik tributary basin (closer to the project corridor) receives 40–52% of annual precipitation in winter and only 6–18% in summer (Project Feasibility Study). As catchment elevation increases, the timing of the highest discharge of contributing rivers shifts from spring to summer: in low-altitude catchments, the principal volume of runoff occurs in spring and the first half of summer, fed mainly by seasonal-snow melt, rainfall, and groundwater, with short-duration storm floods of mudflow character; in high-altitude glacier-influenced catchments, the crest of the flood wave occurs in the second half of summer. Surface runoff from liquid precipitation is a small share of the annual basin runoff (approximately 6% basin-wide; about 1% in high-elevation catchments and 5–10% in lowland catchments). The wider basin flow regime is heavily regulated: approximately 90% of the mean annual flow of the Naryn / Syr Darya system is regulated by the Naryn–Syr Darya Cascade of upstream reservoirs. [15] Annual flows of the Syr Darya at the basin scale have averaged approximately 40.8 km³ in recent years (ICWC, 2024), [16] with significant interannual variability driven by upstream hydropower release patterns, agricultural demand cycles, and climate variability. Climate change is projected to alter the snowmelt-dominated regime over the operational lifetime of the Project (see Section 7.3.3).

Syr Darya and the Shardara Reservoir. The Syr Darya, the principal watercourse traversed by the Project, and feeds the Shardara Reservoir (Figure 21Figure 22), an earth-fill embankment -dam constructed 1964–1968. The reservoir water-body has a maximum storage capacity of approximately 5.4–5.7 km³ (with the lower value reported by BWO Syr Darya as effective transboundary

14 Saiko, T. A. (2010) (and successive updates). Water, Climate, Food, and Environment in the Syr Darya Basin. WEAP / Stockholm Environment Institute basin assessment.

15 Upstream Hydropower Development in the Syr Darya River Basin, Downstream Impacts, and Potential Opportunities. Water Diplomacy Aquapedia. https://aquapedia.waterdiplomacy.org/

16 Basin Water Organisation “Syr Darya”, Interstate Coordination Water Commission of Central Asia: Annual Water Allocation Decisions and Reservoir Operational Plans for the Syr Darya Basin. http://www.icwc-aral.uz/

management capacity and higher values reflecting total impoundment capacity), a surface area at full pool of approximately 783–900 km² (depending on reservoir level), a maximum length of approximately 70–80 km in the long axis, and a maximum width of approximately 25 km. Water levels fluctuate by up to 11 metres between seasonal maximum fill (October–March) and minimum (April–September).

The national environmental assessment reports a long-term average flow of approximately 626 m^3 /s in the Shardara system, with reported seasonal minimum flows of approximately 56.3 m^3 /s in summer and 137 m^3 /s in winter, illustrating the substantial seasonal and regulated variability of the river system.

The Shardara Reservoir IBA/KBA covers a designated area of 960,100 ha which is larger than the water-body footprint and includes the reservoir-margin reedbeds, salt-tolerant scrub, and seasonally inundated wetland habitats that form the principal biodiversity values of the IBA (further described in Section 7.4).

Table 61: Key Parameters of the Shardara Reservoir on the Syr Darya River

Parameter	Value
Watercourse impounded	Syr Darya River
Type of dam	Earth-fill embankment dam
Year of commissioning	Constructed 1964–1968 (Kazakh SSR)
Administrative location	Shardara District, Turkistan Region, Republic of Kazakhstan; close to the international border with Uzbekistan
Maximum storage capacity	Approximately 5.4–5.7 km³
Surface area at full pool	Approximately 900 km²
Primary purposes	Transboundary regulation; irrigation supply to the Kyzyl-Kum channel; hydropower
Hydropower station	Shardara Hydroelectric Power Station, 100 MW installed capacity (4 × 25 MW Kaplan turbines)
Recognized biodiversity status	Shardara Reservoir Important Bird Area (IBA) / Key Biodiversity Area (KBA) recognized by BirdLife International / KBA Partnership; further described in Section 7.4

Sources: BWO Syr Darya / ICWC (2024); KazWater Action Hub country profile (2024); reservoir technical documentation; Project Feasibility Study. The reported maximum storage capacity varies between sources (5.4–5.7 km³); the lower value is reported by the BWO Syr Darya as effective transboundary management capacity, while higher values reflect total impoundment capacity.

Other watercourses crossed by the alignment. In addition to the Syr Darya, the Project alignment crosses or runs in close proximity to a number of secondary watercourses and irrigation features. The principal secondary watercourse is the *Keles River*, a tributary that flows from the north-east to the south-west across the corridor. The Keles River is bridged by the Project in two locations. The river and its tributaries form a confluence with the Syr Darya downstream of the Shardara Reservoir before

flowing into the Republic of Uzbekistan. A smaller, more seasonal watercourse, the *Kurukkeles River*, flows from the north-east to the south-west on a convoluted path toward the Shardara Reservoir; site verification confirms that the Kurukkeles is used for irrigation water abstraction along its course and is seasonally dry, with limited flow outside the spring snowmelt period. The alignment also intersects a network of small ephemeral channels in the piedmont-derived steppe of Saryagash and Keles districts and a dense network of irrigation supply and drainage canals serving the cotton-producing areas of Zhetysay and Maktaaral districts (further described below). The principal watercourses and water bodies in or near the Project corridor are summarized in Table 62.

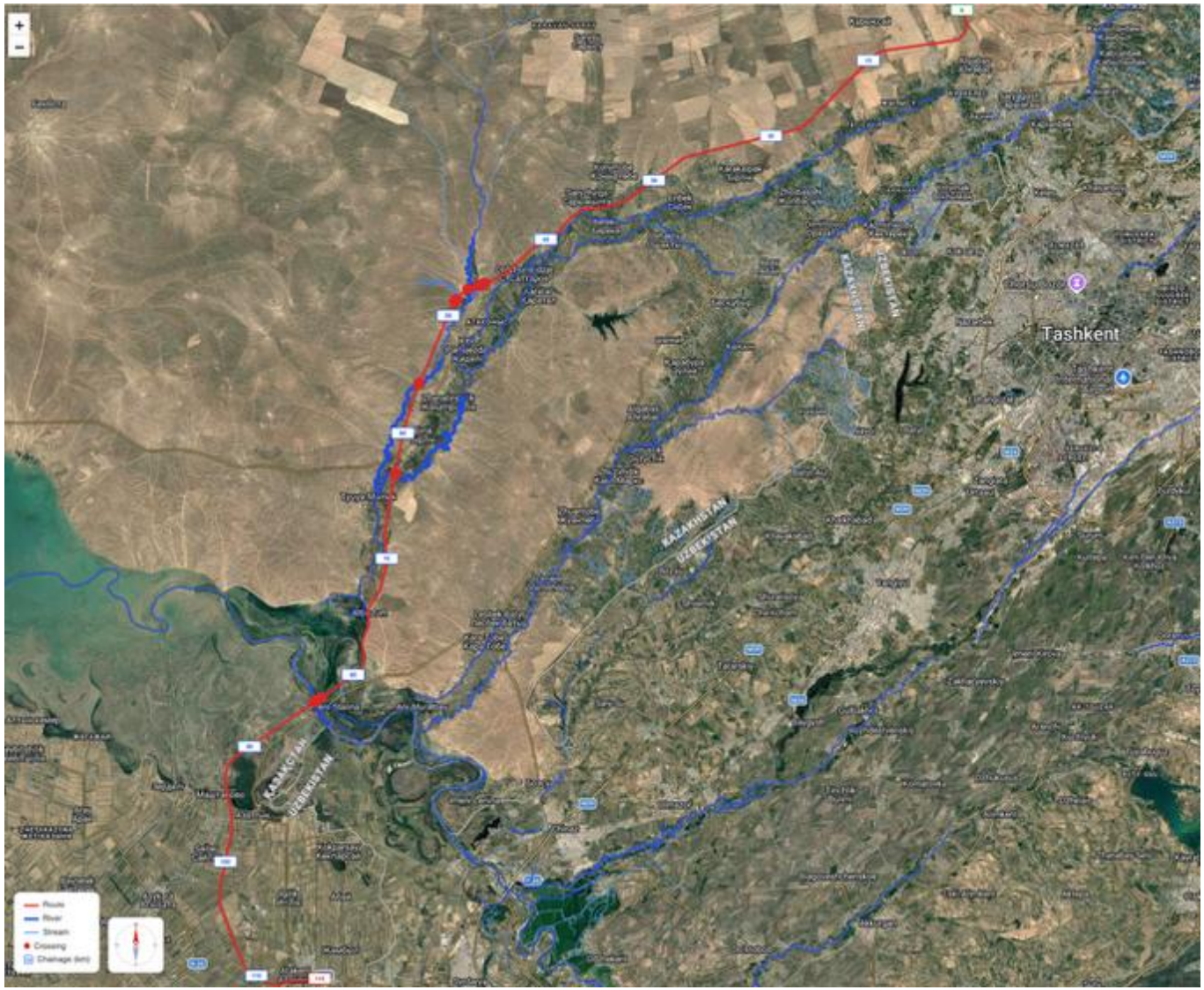
Table 62: Principal Watercourses and Water Bodies in or near the Project Corridor

Watercourse / Water Body	**Type**	**Location along Alignment**	**Project Interaction**
Syr Darya River	Major transboundary river; principal watercourse of the basin	Crossed in Shardara District (~KM 78, lowest point of the corridor)	Crossed by the new 500 m bridge — the principal hydraulic structure of the Project
Shardara Reservoir	Large impoundment on the Syr Darya; transboundary regulation, irrigation, hydropower; KBA	Approached closely by the alignment in Shardara District (south-eastern margin of the reservoir)	Embankment runs along the reservoir margin; potential interaction with reservoir-margin habitats and shoreline processes
Keles River	Tributary of the Syr Darya; flows NE to SW; perennial in upper reaches, more variable in lower reaches	Crosses the alignment in two locations in Keles / Saryagash districts	Crossed by two project bridges; confluences with the Syr Darya downstream of Shardara before crossing into Uzbekistan
Kurukkeles River	Smaller, seasonal watercourse; flows NE to SW on a convoluted path	Approaches and intersects the alignment in Keles / Shardara districts	Crossed by smaller bridge structure(s) and / or culverts; used for irrigation abstraction along its course
Ephemeral piedmont channels	Small ephemeral channels draining seasonally toward the Syr Darya basin	Throughout the northern (Saryagash and Keles) section of the corridor	Crossed by culverts; flow in spring snowmelt and intense rainfall events only
Irrigation supply and drainage canals	Engineered canals serving irrigated agricultural land	Throughout the southern (Zhetysay and Maktaaral)	Crossed by culverts and small bridges; locally affected by

Watercourse / Water Body	Type	Location along Alignment	Project Interaction
		section of the corridor; localized in Keles District	embankment / cutting drainage interactions

Sources: Project Feasibility Study; KTZ engineering and design documentation; site verification (Consultant team, November 2025, January 2026, February 2026); Project alignment KMZ data.

Table 63: Location of Main Rivers and Bridges



Irrigation network. Across the southern districts of Zhetysay and Maktaaral, and to a lesser extent in Keles District, the Project corridor traverses an extensive engineered irrigation network that supports the irrigated agriculture (cotton in the south, vegetables and orchards in the north and center) of Turkistan Region. The network comprises primary supply canals delivering water from the Syr Darya / Shardara system and from local sources (including the Kurukkeles), secondary distribution canals, tertiary field-level channels, and engineered drainage canals returning agricultural drainage water back to the river network. The pattern of canals and field channels is dense, with most agricultural plots having direct access to the network. Project crossings of the irrigation network are accommodated through culverts and small bridge structures designed to maintain canal continuity during construction and operation.

Surface water quality. Long-term water-quality monitoring along the Project corridor itself is limited; available information on surface-water quality for the Syr Darya and its tributaries has been reviewed from the national environmental assessment documentation and available Kazhydromet records. The applicable national surface-water-quality standards (Kazakhstan SanPiN water-quality MAC values) are summarized in Section 3.5.2; the principal lender benchmarks applied in this Supplementary ESIA are the WHO Guidelines for Drinking-water Quality (2017) and the IFC General EHS Guidelines for ambient water quality and effluent (2007). At the regional scale, the Syr Darya carries elevated suspended sediment loads and dissolved-mineral concentrations (notably salinity) reflecting the cumulative effect of upstream irrigation drainage returns, dust input from arid surrounding lands, geochemical contributions from saline soils along the middle and lower reaches, and — historically — contaminated drainage from agricultural land. Salinity along the middle Syr Darya has increased significantly since the development of large-scale irrigated agriculture in the Soviet era, with consequences for agricultural productivity, drinking-water treatment, and downstream ecology. [17] The Kurukkeles and other secondary watercourses receive irrigation drainage and likely exhibit elevated salinity, nutrients (nitrogen and phosphorus), and locally elevated agrochemical residues, particularly during the agricultural season.

Transboundary water management context. Water resources of the Syr Darya basin are managed under transboundary agreements between the riparian states. The principal framework instrument is the 1992 “Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan on Cooperation in the Field of Joint Management on Utilization and Protection of Water Resources from Interstate Sources”, signed in Almaty on 18 February 1992. [18] This established the Interstate Coordination Water Commission (ICWC) and its executive bodies, the BWO Amu Darya and BWO Syr Darya, which set annual and seasonal water-allocation limits among the riparian states and operational plans for key reservoirs. [19] The Project does not undertake new water abstraction from the Syr Darya, the Keles, or the Shardara Reservoir for permanent operational use; construction-phase water requirements (concrete batching, dust suppression, worker accommodation) are addressed against this transboundary management framework and the corresponding Kazakhstan national licensing regime under the Water Code of the Republic of Kazakhstan.

Alignment-specific hydrology by section.

TEO Volume 1 section 5.1.4 characterizes hydrological conditions section by section along the alignment, complementing the corridor-scale descriptions above:

[17] Saiko, T. A. (2010) (and successive updates). Water, Climate, Food, and Environment in the Syr Darya Basin. WEAP / Stockholm Environment Institute basin assessment.

[18] Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan on Cooperation in the Field of Joint Management on Utilization and Protection of Water Resources from Interstate Sources, signed in Almaty on 18 February 1992.

[19] Basin Water Organisation “Syr Darya”, Interstate Coordination Water Commission of Central Asia: Annual Water Allocation Decisions and Reservoir Operational Plans for the Syr Darya Basin. http://www.icwc-aral.uz/

- Yerdaut – Passing Loop 2 (PK 0 – PK 560). The alignment crosses the lower piedmont sloping plains. The hydrographic network in this section comprises ephemeral channels (small saiy / wadis) descending from the Karzhantau and Western Tian Shan piedmont towards the Syr Darya basin. These channels are dry for most of the year and convey concentrated flow only during spring snowmelt and intense convective rainfall events. Drainage at the existing road alignment alongside the route is provided by 1.0 m diameter culverts.
- Passing Loop 2 – PK 560. The alignment runs along the existing road alignment, essentially on the watershed between minor catchments. The hydrographic network in this section is represented by irrigation canals rather than natural watercourses, with no major lows or natural channels.
- PK 560 – Intermediate station. The alignment crosses the dissected piedmont relief. Watercourses are predominantly in dry valley beds (logs / saiy). The largest channels have catchment areas of 8–10 km²; the remaining channels are minor ephemeral watercourses with catchment areas of 0.5 to 5 km².
- Intermediate – ~100 km. The alignment crosses the Syr Darya floodplain within the Shardara Reservoir zone, including the 500 m bridge crossing of the Syr Darya itself.
- 0 km – 18 km section (Stage 2 — Maktaaral to Zhetysay). (Not within the current ESIA scope; included for hydrological-baseline completeness.) The hydrographic network is exclusively engineered, comprising irrigation canals, drainage collector canals, and watering arıks (small distribution channels). The largest engineered channel is the Severny ("Northern") Canal.

Hydrological regime of natural watercourses

TEO Volume 1 section5.4.1.2 describes the characteristic hydrological regime of the southern Kazakhstan rivers in the corridor. These TEO characteristics describe the natural watercourses of southern Kazakhstan at a regional level and are particularly relevant to the smaller, less-regulated catchments crossed by the Project. They should not be interpreted as describing an unregulated flood response of the Syr Darya at the Project crossing, where flows are substantially influenced by upstream reservoir operation and regional water-management arrangements.

- Snowmelt-dominated regime: 70–90% of annual flow occurs during the spring flood;
- Pronounced flood wave: maximum flood discharges in wet years exceed mean annual discharge by 5–10× even on the largest rivers;
- Low minimum discharges and seasonal drying: many channels in the dry-steppe portion of the corridor dry up entirely outside the spring snowmelt period;
- Annual precipitation in the corridor: 175–220 mm; 70–80% falls in the warm period.
- Maximum design water discharges for the project culverts and bridges are derived from this regime and are documented in detail in TEO Volume 1 section5.4.1.3 and in the detailed design drainage calculations.

7.3.7 Groundwater Resources

Hydrogeological setting

The hydrogeological setting of the Project corridor is determined by the geological framework described in Section 7.3.2. The corridor lies on the Turan Platform within the Syr Darya structural basin, which is occupied by a thick (up to 3,000 m) succession of continental and minor marine sedimentary rocks overlain by a continuous mantle of Quaternary deposits at the surface. Within this setting, four water-physical rock groups have been defined in project geological documentation:

- Group 1 (Quaternary friable deposits with pore-type water resistance) is the dominant unit at the surface along the corridor;
- Group 2 (Mesozoic–Paleogene–Neogene semi-loose rocks with pore-cracked-type water resistance) underlies Group 1 at depth;
- Groups 3 and 4 (Paleozoic–Mesocainazoic carbonate rocks with fracture-karst-type water resistance, and metamorphic / eruptive rocks with fractured-type water resistance) are confined to deeper crystalline basement and outcrop in the surrounding mountain belts but are not encountered along the corridor.

The groundwater regime along the alignment is dominated by Group 1; minor interaction with Group 2 may occur at the deeper foundations of major structures, in particular the piers of the Syr Darya bridge.

Aquifer systems along the corridor

The principal aquifer system relevant to the Project is the *shallow Quaternary alluvial aquifer* hosted in the alluvial, alluvial-proluvial, and proluvial deposits of the Syr Darya basin. This aquifer is unconfined to semi-confined, of generally moderate to good transmissivity in the well-sorted alluvium of the Syr Darya floodplain and the Mirzachoel alluvial plain, and of more variable and lower transmissivity in the loessic and loamy piedmont deposits of the northern (Saryagash and Keles) districts. Recharge is principally from (i) infiltration of seasonal precipitation in the spring period, (ii) seepage losses from the Syr Darya, the Shardara Reservoir, and tributary watercourses, and (iii) substantial irrigation return flows in the irrigated southern districts of Zhetysay and Maktaaral. Discharge is principally to the Syr Darya and tributary watercourses, to the engineered drainage network of the Mirzachoel irrigation system, by direct evapotranspiration where the water table is shallow, and through groundwater abstraction (rural water supply, irrigation augmentation, and small-scale industrial / commercial use). A deeper, confined or semi-confined aquifer system is hosted in the underlying Mesozoic–Paleogene–Neogene semi-loose sequence (Group 2 of Section 7); this deeper system is hydraulically separated from the shallow alluvial aquifer by intervening clay-rich aquitards in much of the corridor and is generally of lower yield and higher mineralization than the shallow aquifer.

Groundwater depth

Depth to the shallow Quaternary water table varies systematically along the corridor with topographic and land-use position:

- In the northern, more elevated steppe and piedmont sections of Saryagash and Keles districts, the depth to groundwater is generally moderate to deep (typically several metres to several tens of metres below ground level), reflecting the absence of large-scale irrigation and the higher topographic position of these areas;
- Along the Syr Darya valley and at the immediate margin of the Shardara Reservoir in Shardara District, the depth to groundwater is shallow (typically 1–3 m below ground level near the river and reservoir margin), reflecting hydraulic continuity with the surface water system;
- In the irrigated cotton-producing districts of Zhetysay and Maktaaral (the Mirzachoel “Hungry Steppe”), the depth to groundwater is characteristically very shallow (often within 1–2 m of the ground surface during the irrigation season and not infrequently within 0.5–1 m), reflecting decades of irrigation return flow on flat alluvial terrain with relatively poorly developed drainage; this shallow water-table condition is associated with the soil salinisation described in Section 7.3.2.

This regional depth-to-groundwater pattern is confirmed by the alignment-specific hydrogeological characterization in TEO Volume 1 section5.1.6, which divides the alignment into three distinct sections — the northern piedmont section (KM0 – KM85, groundwater 8–25 m, fresh in dug wells), the Syr

Darya floodplain section (KM85 – KM102, groundwater 0.2–1.0 m with rise to surface during reservoir filling and resultant intensive solonchak formation), and the irrigated zone section (KM102 – KM15, groundwater 4–6 m generally but 2.0–2.5 m near irrigation canals, with sulphate aggressivity to concrete grade W4 per GOST 10178-85). The sulphate-aggressivity classification in the southern section directly informs cement specification requirements for buried structures along that section of the alignment.

Groundwater quality

Groundwater quality along the corridor reflects a combination of hydrogeological setting, land use, and the cumulative effect of decades of irrigated agriculture in the southern districts:

- In the northern (Saryagash and Keles) sections, shallow groundwater hosted in piedmont and loessic deposits is typically of moderate mineralisation (TDS in the order of 1–3 g/L), with locally elevated hardness reflecting carbonate-rich source rocks. The deeper Mesozoic–Cenozoic system (Group 2) is generally of higher mineralisation;
- Along the Syr Darya valley and at the Shardara Reservoir margin in Shardara District, the shallow alluvial aquifer is in hydraulic continuity with the river and reservoir, and groundwater quality reflects the salinity, suspended-sediment, and dissolved-mineral composition of the surface water system, with TDS typically in the range 1–2 g/L away from the immediate reservoir / river margin;
- In the irrigated southern districts of Zhetysay and Maktaaral (the Mirzachoel), shallow groundwater is characteristically saline to highly saline (TDS commonly 3–7 g/L and locally exceeding 10 g/L), reflecting decades of irrigation return flow over evaporite-bearing parent material with poorly developed drainage. Elevated nutrients (nitrate and ammonium), agrochemical residues (organochlorines, organophosphates), and locally elevated trace metals may be present in shallow groundwater of these districts, reflecting historic and ongoing agricultural land use; this is consistent with the legacy agrochemical contamination of soils described in Section 7.3.2. This reflects the regional land-use context and potential contaminant pathways; it should not be interpreted as confirmation of site-specific groundwater contamination in the absence of analytical monitoring data.

The completed OVOS additionally identifies variable chemical aggressiveness of groundwater toward construction materials. Groundwater is reported as ranging from non-aggressive to strongly aggressive to ordinary Portland-cement concrete, while being non-aggressive to slag Portland cement and sulfate-resistant cement of the specified W4–W8 grades. Groundwater is also reported as having low to high corrosive aggressiveness toward lead cable sheathing and high aggressiveness toward aluminum cable sheathing.

Groundwater use. Groundwater is used along the corridor for (i) rural domestic water supply via shallow hand-dug wells and small-diameter boreholes serving individual households, farmsteads, and small settlements not connected to a centralized supply; (ii) localized irrigation augmentation from boreholes drilled into the Quaternary aquifer or, less commonly, the deeper Mesozoic–Cenozoic system; (iii) small-scale livestock watering; and (iv) localized industrial and commercial use, including at small agro-industrial facilities such as those concentrated in the Maktaaral Station area. Groundwater is not extensively used for centralized public water supply in the corridor districts, which are predominantly served by surface-water supply infrastructure.

Groundwater protection at operational facilities. The national environmental documentation includes engineered groundwater-protection measures at the principal station wastewater facilities, including geomembrane lining beneath storage ponds. Operational groundwater monitoring wells are also proposed at Yerdaut and Maktaaral to provide verification of groundwater conditions in the vicinity of these facilities.

7.3.8 Natural Hazards and Seismicity

Hazards overview. The Project corridor is exposed to a range of natural hazards reflecting its tectonic, geomorphological, hydrological, and climatic setting at the southern margin of the Turan Platform, in the piedmont and alluvial-plain belt south of the Western Tian Shan. The principal natural hazards relevant to the corridor are seismicity (earthquakes), wildfire, drought / water scarcity, extreme heat, and — to a lesser extent — river flooding, urban flooding (in settlement areas), and landslides / slope instability. Tropical cyclone hazard is essentially absent; tsunami hazard is not applicable (the corridor is not coastal); and the corridor is not within the permafrost zone of Kazakhstan.

The hazards baseline draws on (i) the ThinkHazard online platform of the Global Facility for Disaster Reduction and Recovery (GFDRR) for the two end-point districts of the corridor — Saryagash in the north and Maktaaral in the south, the latter of which on the ThinkHazard platform is represented by the adjacent Zhetysay administrative unit that contains the settlements proximate to the Project alignment; (ii) the CAREC Country Disaster Risk Profile for Kazakhstan (2023); (iii) the Kazakhstan national seismic building code and supporting Kazhydromet hazard records; and (iv) the project-specific geotechnical and hydrological investigations prepared by the design consultant.

ADB completed Project-specific climate and disaster risk screening in April 2026. The screening identifies the Project as having an overall High geophysical risk, principally associated with earthquake and liquefaction. Earthquake and liquefaction exposure are each classified as Moderate; however, the railway subsector is assessed as having High vulnerability to these hazards, resulting in a High overall risk rating for each. Seismic-induced landslide exposure is classified as Low, resulting in a Moderate risk rating.

Indicative hazard levels for the corridor are summarized in Table 64.

Table 64: Summary of Natural Hazards Relevant to the Project Corridor

Hazard	Indicative level — northern corridor (Saryagash)	Indicative level — southern corridor (Maktaaral / Zhetysay)	Notes for the Project
Earthquake	High	Medium	Regional screening indicates a north-to-south gradient in seismic hazard. The completed OVOS adopts a Project design seismicity of 7 points and Soil Category II for seismic properties; these national design parameters govern Project structural design.
Wildfire	High	High	Greater than 50% chance in any given year of weather conditions supporting a significant wildfire in either end of the corridor, reflecting the semi-arid steppe vegetation, dry summer conditions, and presence of agricultural residues.
Water scarcity / drought	High (CAREC national)	Medium (ThinkHazard, Zhetysay)	Droughts expected on average every 5 years at the national scale; corridor exposure is influenced by reliance on the Syr Darya and the Shardara Reservoir for water supply to the southern districts.
Extreme heat	Medium	Medium	Greater than 25% chance of at least one period of prolonged extreme heat exposure in the next five years; consistent with summer maxima of 39 °C

Hazard	Indicative level — northern corridor (Saryagash)	Indicative level — southern corridor (Maktaaral / Zhetysay)	Notes for the Project
			and absolute maxima above +43 °C documented in Section 7.3.3.
Urban flood	Medium	Very low	Settlement-level flooding in the northern corridor linked to intense convective rainfall and limited urban drainage capacity. Southern district settlements are within the irrigated agricultural zone with extensive irrigation drainage.
River flood	Low	Low (corridor scale)	Low at the corridor scale, but with documented historical incidents on the Syr Darya at the Shardara Reservoir (notably the February 2004 winter ice-flood event arising from upstream releases combined with downstream ice formation, NASA Earth Observatory, 2004).
Landslide	Low (corridor)	Low (corridor)	Within the gently undulating to flat alluvial corridor, landslide susceptibility is low; localized slope-instability concerns at engineered cuttings, embankment approaches, and borrow pits.
Cyclone	Very low	Very low	Tropical cyclone hazard is essentially absent at the latitude and continental position of the corridor.

Sources: ThinkHazard! platform (Global Facility for Disaster Reduction and Recovery), district-level outputs for Saryagash and Zhetysay (used as proxy for Maktaaral District); CAREC Country Disaster Risk Profile for Kazakhstan (2023); project geotechnical and hydrological investigations.

Seismicity. Kazakhstan as a whole experiences relatively limited seismicity, with active seismicity concentrated in the southern part of the country in proximity to the Western Tian Shan and Karatau structural belt (CAREC, 2023). The Project corridor lies south of the Karatau Range and on the Turan Platform; while the corridor itself does not cross any active surface fault traces, it is exposed to the regional seismicity of the Western Tian Shan piedmont and to possible secondary effects of more distant Tian Shan and Pamir–Tian Shan events.

The completed OVOS identifies the design seismicity of the Project site as 7 points, with the soils classified as Category II for seismic properties. This Project-specific design classification provides the applicable national engineering basis for seismic design of the railway structures and associated facilities.

The ADB screening independently classifies earthquake hazard exposure along the railway alignment as Moderate and indicates that earthquakes with peak ground acceleration (PGA) of approximately 0.05–0.2 g may occur at a 475-year recurrence interval. The ADB screening is regional in nature and does not supersede the Project-specific national seismic design parameters established through the engineering investigations and OVOS.

Figure 30: Seismic Risk in Saryagash	Figure 31: Seismic Risk in Maktaraal
	

Source: ThinkHazard!

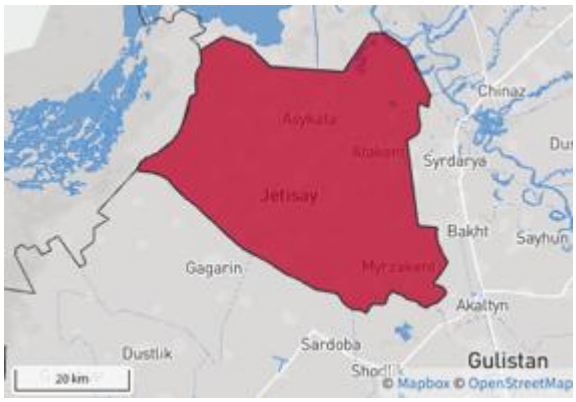
Secondary seismic effects relevant to the Project include (i) liquefaction susceptibility of saturated alluvial deposits along the Syr Darya valley, the Shardara Reservoir margin, and the irrigated southern districts; (ii) co-seismic settlement of loess and loess-like deposits in the northern piedmont; and (iii) possible earthquake-induced slope instability at engineered cuttings. These effects are addressed in the project geotechnical investigation documentation prepared by the design consultant. The applicable seismic design framework comprises the Kazakhstan national seismic building code (SP RK 2.03-30-2017 *Earthquake-resistant construction*), supplemented by international standards adopted by KTZ for railway engineering structures.

Liquefaction. ADB's Project-specific screening identifies Moderate exposure to earthquake-induced liquefaction along the railway alignment, corresponding to a susceptibility level of 3 in the screening dataset. Given the High vulnerability assigned to railway infrastructure, ADB consequently classifies liquefaction as a High geophysical risk for the Project. This screening result is particularly relevant to locations characterized by shallow groundwater and unconsolidated alluvial deposits and should be considered alongside the Project-specific geotechnical conditions described in Section 7.3.2.

Wildfire. Wildfire hazard along the corridor is classified as High in both Saryagash District and Maktaaral/Zhetysay District on the ThinkHazard platform, reflecting the combination of dry, hot summers, semi-arid steppe vegetation in the northern and central sections, and the presence of agricultural residues (notably cotton stubble and dry irrigation-canal-side vegetation) in the southern districts. Steppe wildfires propagate rapidly under hot, dry, windy conditions, often initiated by lightning, accidental ignition (discarded cigarettes, agricultural burning, sparks from machinery or rail-track interaction), or deliberate burning. Localised fires may also propagate along reedbeds at the Shardara Reservoir margin, particularly in autumn when reed material is dry. The intensification of summer heat and drought projected for southern Kazakhstan under climate change is expected to increase wildfire frequency and intensity over the operational lifetime of the Project.

Figure 32: Wild Fire Risk in Saryagash	Figure 33: Wild Fire Risk in Maktaraal





High
Low
Medium
Very low

Source: ThinkHazard!

ESCA observation: The parallel Environmental and Social Compliance Audit has documented an instance of unauthorized waste burning at the Yerdaut construction compound during a site visit. This is recorded as a non-compliance against the construction-phase waste management requirements and is addressed under the ESCA Corrective Action Plan, with corrective actions including reinforced waste-handling protocols, dedicated waste disposal arrangements, and worker awareness training. The observation does not constitute a wildfire event per se but is relevant to the wildfire baseline as it indicates the importance of preventing intentional or accidental ignition at construction compounds and along the alignment, particularly during the dry summer period and at the Shardara Reservoir margin where reedbed fire risk is heightened.

Implications for Project operations include (i) ignition risk from rail-track interaction with track-side vegetation, addressed through routine RoW vegetation control under the operational-phase ESMP; (ii) ignition risk from locomotive engine operation and exhaust spark arrestors; (iii) fire-spread risk from locomotive standing at passing loops and stations; and (iv) emergency-response planning for wildfire affecting the railway, including evacuation arrangements for trains caught in active fires. These are addressed in the operational-phase ESMP and the Emergency Response Plan, with reference to the Ministry of Emergency Situations for fire-service coordination.

River and surface-water flooding. River-flood hazard at the corridor scale is classified as Low in Saryagash District on the ThinkHazard platform, reflecting the gently undulating piedmont topography and the limited flow magnitude of small ephemeral channels in the northern sections. River flooding is, however, locally significant at the Syr Darya in Shardara District. The Syr Darya at the Project corridor is highly regulated by the Naryn–Syr Darya Cascade and by the Shardara Reservoir, which limits the magnitude of natural flood events; it is, however, exposed to operational flood events arising from coordinated reservoir releases combined with seasonal ice formation in the lower channel. The most prominent recent example was the February 2004 winter ice-flood event, in which higher-than-agreed releases from upstream Kyrgyz reservoirs combined with limited capacity of downstream channels and incomplete diversion to the Arnasay depression led to widespread overbank flooding (NASA Earth Observatory, 2004). As the event was primarily driven by reservoir operations and ice conditions rather than a natural hydrological flood, a conventional return-period estimate is not available from published sources. The 500 m Syr Darya bridge of the Project is designed for the relevant return-period design floods documented in the project hydraulic design documentation.

ADB's Climate and Disaster Risk Screening classifies river-flood exposure along the railway alignment as Moderate under both baseline and projected conditions. When combined with the High

vulnerability assigned to railway infrastructure, the resulting Project risk from river flooding is classified as High. This screening classification is based on regional/global hazard datasets and does not account for all site-specific hydrological controls. It is therefore considered together with the Project-specific hydrological information presented in Section 7.3.6, including regulation of the Syr Darya by the upstream reservoir system and the distinction between major-river flooding and localized rainfall-driven drainage events.

Figure 34: River Flood Risk in Saryagash

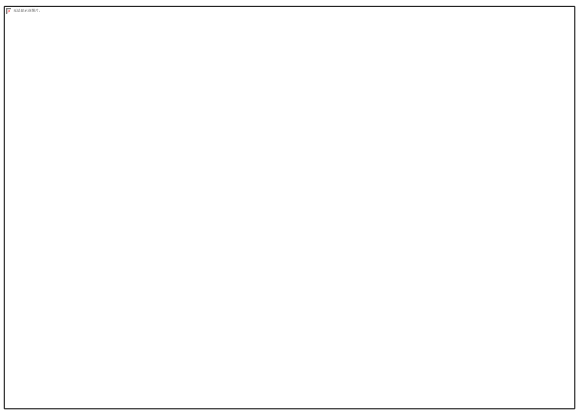


Figure 35: River Flood Risk in Maktaaral





Source: ThinkHazard!

Urban flooding. Urban-flood hazard at settlement scale is classified as Medium in Saryagash District and Very Low in Maktaaral/Zhetysay District on the ThinkHazard platform, reflecting the different drainage characteristics of the two areas. The northern corridor passes through settlements (notably Saryagash town and adjacent villages) where convective rainfall events can exceed urban drainage capacity; the southern corridor passes through the irrigated agricultural zone where extensive irrigation drainage networks reduce surface flooding in normal conditions but may transmit flooding from irrigation-canal failure or extreme rainfall events.

Figure 36: Urban Flood Risk in Saryagash



Figure 37: Urban Flood Risk in Maktaaral





Source: ThinkHazard!

Water scarcity, drought, and extreme heat. Drought and water-scarcity hazard is classified as High at the national level (CAREC, 2023) with droughts expected on average once every five years, and as Medium for Maktaaral/Zhetysay District on the ThinkHazard platform. Extreme heat hazard is classified as Medium along the corridor (ThinkHazard, 2024), reflecting the high probability of prolonged extreme-heat episodes within any five-year window. Both hazards are consistent with the climate baseline described in Section 7.3.3 and are projected to intensify under continued climate change.

Figure 38: Water Scarcity & Extreme Heat Risk in Saryagash



Figure 39: Water Scarcity & Extreme Heat Risk Risk in Maktaraal





Source: ThinkHazard!

Landslide, Mudflow and slope-instability hazard. Landslide susceptibility at the corridor scale is classified as Low for both Saryagash and Maktaaral/Zhetysay districts on the ThinkHazard platform, reflecting the gently undulating to flat alluvial-plain topography of the corridor. Kazakhstan as a whole has limited mudflow activity historically concentrated in the Trans-Ili (Zailiyskiy) Alatau near Almaty and in the high Tien Shan piedmont, where glacial lake outburst floods and intense orographic rainfall over steep, sediment-laden slopes produce the country's significant mudflow events. The Project corridor sits well outside this concentration zone: the Karatau Range, which is the local geological expression of the Western Tian Shan, lies to the north of the Syr Darya valley and its southern-slope drainage feeds northwards into the Muyunkum desert rather than southwards across the Project alignment.

At the corridor scale, mudflow hazard is therefore consistent with the ThinkHazard "Low" landslide classification and does not require corridor-wide mitigation measures. Localized slope-instability and small-scale debris/mud-flow concerns nonetheless arise at three project-specific locations:

- Engineered cuttings in the northern piedmont section near Saryagash, particularly where the alignment passes through loess and loess-like deposits. Loess is recognized globally as the source material most susceptible to mudflow initiation under intense rainfall and seismic loading, even at modest slope angles. The geotechnical design of cuttings in these materials addresses this through standard slope-stability provisions, drainage, and surface protection of cut faces.
- Crossings of ephemeral channels (sai / wadi-type drainages) descending from the Karzhantau and Western Tian Shan piedmont towards the Syr Darya in the northern section of the alignment. These channels are dry for most of the year but can carry concentrated, sediment-laden flow during extreme convective rainfall events in late spring and summer. Drainage

culverts at these crossings are designed for both clean-water flow and sediment-laden flow, with appropriately sized inlet protection.

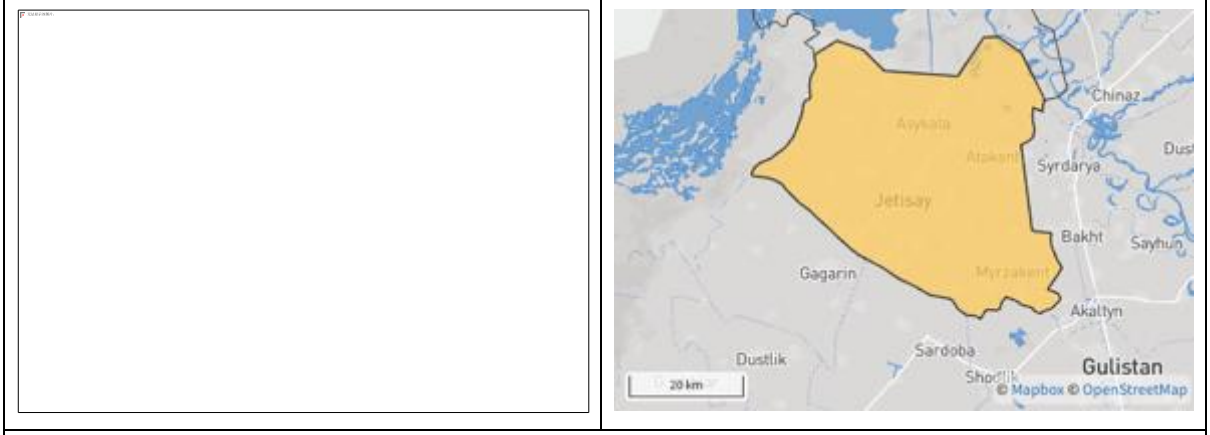
- Embankment approaches to the Syr Darya bridge and to major overpasses, and steeper temporary slopes at borrow pits during operation and pre-rehabilitation, where conventional slope-stability and erosion-protection measures apply.

The regional mudflow protection authority is РГКП Казселезащита (Kazselezashchita), the state mudflow-protection organization under the Ministry of Emergency Situations, with a South Kazakhstan regional office. While the Project corridor is not within an actively monitored mudflow basin, coordination with Kazselezashchita is appropriate for the construction-phase Emergency Response Plan and for any operational-phase incidents involving channel-crossing structures during extreme rainfall.

Climate change projections for southern Kazakhstan indicate a concentration of precipitation increases in winter and spring, with an increased frequency of intense convective rainfall events. This is expected to increase the residual risk of localized debris/mud-flow at engineered cuttings and at ephemeral-channel culvert crossings over the operational lifetime of the Project, even if the corridor-scale hazard classification remains Low.

Figure 40: Landslide Risk in Saryagash

Figure 41: Landslide Risk Risk in Maktaraal



Source: ThinkHazard!

ADB's screening assigns rainfall-induced landslide a High Project risk rating, reflecting Moderate mapped exposure combined with the High generic vulnerability assigned to railway infrastructure. This should be interpreted as a screening-level result rather than evidence of uniformly high landslide susceptibility along the alignment. The Project-specific topographic and engineering-geological baseline indicates generally low-relief terrain, with susceptibility concentrated at localized slopes, engineered cuttings and embankments, drainage pathways and other locations where erosion or instability could develop. ADB's climate-index screening does not indicate an increase in either maximum 1-day precipitation or the frequency of heavy-precipitation days (>10 mm) for the Project location.

Other natural hazards. Tropical cyclone / hurricane hazard is essentially absent at the latitude and continental position of the corridor. Tornado activity is rare and not a significant hazard for the Project. Volcanic hazard is absent — there are no active volcanoes in Kazakhstan or in the immediate region. Tsunami hazard is not applicable — the corridor is not coastal. Permafrost is not present — the corridor is well south of the permafrost belt of Kazakhstan. Extreme cold and ice loading are addressed under the climate baseline and as design considerations in the project structural design.

7.4 Biological Environment

This section describes the biodiversity baseline conditions relevant to the project. It identifies the protected or internationally recognized areas, habitats, and species that represent important biodiversity receptors. Such features are biodiversity that are particularly irreplaceable or vulnerable, and include critical and natural habitat, threatened or geographically restricted species, important migratory or congregatory species, and areas supporting key ecological functions and connectivity.

This biodiversity baseline has been developed through a combination of targeted field surveys, a review of available biodiversity datasets (e.g., IUCN, IBAT, national protected species, and published studies), consultation with national and international biodiversity experts, engagement with local communities, and coordination with relevant government agencies and conservation organizations. This approach ensures that both scientific data and local ecological knowledge inform the understanding of baseline conditions.

The completed national OVOS was also reviewed as part of the biodiversity baseline. The OVOS provides regional information on vegetation and fauna and identifies the potential for Project-related effects on biodiversity; however, for the purposes of this Supplementary ESIA, the Project-specific specialist surveys, Critical Habitat Assessment and updated information on the Shardara Reservoir IBA/KBA provide the primary basis for characterization of biodiversity receptors and their sensitivity.

The project biodiversity baseline summarizes the data collected and assessed and presents the most important biodiversity receptors relevant to the project, inclusive of protected areas, habitats, and species. Taken together, this establishes the biodiversity context against which the potential project impacts are assessed. In accordance with ADB's SPS, IFC's PS6 and AIIB's ESF, the project is required to protect and conserve biodiversity. Where adverse impacts cannot be avoided, appropriate mitigation measures must be applied in line with the mitigation hierarchy. The Mitigation for impacts on Critical Habitat must demonstrably achieve a Net Gain (NG) in biodiversity relative to the baseline. For impacts on natural habitat the mitigation must be designed to achieve at least No Net Loss (NNL) and preferably NG. The overarching objective is therefore to ensure the protection, management, and potential enhancement of all irreplaceable and vulnerable biodiversity.

The baseline first presents a summary of the Critical Habitat Assessment (CHA), which is followed by the legally protected and internationally recognized areas, then habitats and notable flora, and finally vulnerable and irreplaceable species. All field survey reports and assessments, including the full CHA are presented in the Annexes.

7.4.1 Critical Habitat

Under the ADB SPS, Critical Habitat refers to areas of exceptionally high biodiversity value that are essential for the survival of globally or regionally threatened species, restricted-range species, unique ecosystems, or migratory congregations. Identifying Critical Habitat early in project development is vital to ensure that sensitive biodiversity features are fully considered in project design, that avoidance and mitigation measures are properly targeted, and that compliance with SPS "no measurable adverse impact" obligation can be demonstrated.

The project CHA, which is presented in Annex F comprised a desk-based review of all available data including the IUCN and IBAT datasets and academic biodiversity data; field survey data; consultation with national and international experts; a review of the consultation minutes from the local communities and government biodiversity authorities; and the application of precautionary principle where data were limited.

Assessment framework. The CHA has been conducted in accordance with the ADB Safeguard Policy Statement (ADB SPS) as the primary governing standard, with the assessment framework and quantitative thresholds drawn from IFC Performance Standard 6 (PS6) and its Guidance Note 6. The

AIIB Environmental and Social Framework is applicable to the Project but accepts compliance with co-financier standards, so the ADB+IFC integrated approach satisfies AIIB requirements without separate methodology.

The ADB SPS and IFC PS6 Critical Habitat criteria are broadly aligned but not identical. The CHA restructures them to ensure full compliance with both standards. The six adopted criteria, with the IFC PS6 numerical thresholds applied, are:

- Criterion 1 — CR/EN species: areas supporting ≥0.5% of the global population AND ≥5 reproductive units of a CR or EN species (1a); Vulnerable species at the same threshold where loss would shift status to EN/CR (1b); or important concentrations of nationally listed EN/CR species (1c).
- Criterion 2 — endemic / restricted-range species: ≥10% of global population and ≥10 reproductive units of a geographically restricted species (EOO <50,000 km² for terrestrial; linear range <500 km for aquatic species in rivers).
- Criterion 3 — migratory / congregatory species: areas sustaining ≥1% of global population of a migratory or congregatory species at any life stage; or ≥10% during environmental stress.
- Criterion 4 — key evolutionary processes / ecosystem services: no numerical threshold; case-by-case based on best available evidence and expert opinion.
- Criterion 5 — highly threatened / unique ecosystems: ≥5% of the global extent of a formally assessed CR/EN ecosystem (IUCN RLE, 5a); or areas of high priority under recognized national/regional planning (5b).
- Criterion 6 — biodiversity of social / cultural / economic importance: areas where biodiversity is of significant importance to local communities.

The CHA drew on stakeholder consultation, desktop review (IBAT, IUCN Red List, Kazakhstan Red Data Book, CMS listings, scientific literature), Project ESIA field data, and targeted surveys during 2025 and 2026. Species-specific Ecologically Appropriate Areas of Analysis (EAAA) were defined for species considered likely to meet — or where it remained unclear whether they meet — the Critical Habitat thresholds.

Project and biodiversity context. Most of the Project alignment passes through a heavily modified landscape. Approximately the northern 80% of the alignment crosses a mosaic of intensive arable and horticultural cultivation, irrigated fields, degraded steppe and scattered settlements. The terrain is generally flat to gently undulating. Scattered waterbodies and small rivers are present, some supporting limited numbers of waterbirds, with tamarisk-dominated scrub in wetter ground. The habitat along the northern section is largely disturbed and unlikely to be sufficiently diverse to trigger Critical Habitat thresholds.

The southern section is where Critical Habitat is concentrated. A southern ~16 km long section of the alignment crosses the eastern end of the Shardara Reservoir and its associated wetland habitats. The reservoir is designated as an Important Bird Area (IBA) by BirdLife International and as a Key Biodiversity Area (KBA). The reservoir lies at the intersection of two major migratory flyways and provides important habitat for migratory and wintering waterbirds.

Two protected areas and three KBAs lie within 50 km of the Project: the Aydar-Arnasay Lakes system (40 km south-west), the Sayram-Ugam State National Nature Park (50 km north-west), and the Balykchi Fish Farm KBA in Kyrgyzstan (50 km west). The desk-based review identified 493 terrestrial and freshwater species potentially present within 50 km of the Project, 2 Critically Endangered, 8 Endangered, 15 Vulnerable, and 14 Data Deficient.

Criterion-by-criterion findings

Criterion 1 — Critically Endangered and Endangered species: ***triggered***

Syr-Darya shovelnose sturgeon (*Pseudoscaphirhynchus fedtschenkoi*). Critically Endangered (Possibly Extinct) on the IUCN Red List (2022) and endemic to the Syr Darya river system. Listed as Category I in the Kazakhstan Red Data Book as a very rare endemic relict on the brink of extinction. No quantitative global population estimate exists; confirmed records have been absent for decades. The 2017 and 2019 field expeditions by the Tennessee Aquarium, Eurasian Regional Association of Zoos and the Kazakh Fisheries Research and Production Centre reported reliable local sightings both upstream and downstream of the reservoir from local fishing communities, although no individuals were captured. Suitable gravel-bed spawning habitat has been identified on the Keles River, a Syr Darya tributary within 50 km of the Project. . The Kazakhstan Fisheries Research and Production Center further confirmed suitable spawning habitat within 20 km of the Project to the east. The expedition team has confirmed that if the species persists, it does so in the inter-dam reach from the confluence of the Angren River down to the Shardara Reservoir, including the reservoir itself. Applying the precautionary approach required under IFC PS6 GN14.1 ("absence of evidence shall not be treated as evidence of absence"), the species is presumed present. Any reach in which it persists would, by definition, hold an extremely high proportion of the near-zero global population. The species meets the thresholds under Criterion 1(a) and Criterion 1(c). A further field expedition is scheduled for late 2026 or early 2027.

Dalmatian pelican (*Pelecanus crispus*). Near Threatened globally (IUCN, global population 11,400–13,400 individuals), listed as Rare in the Kazakhstan Red Data Book, with a national breeding population of approximately 2,000 pairs. The Shardara Reservoir is recorded as a nationally significant wintering site. The ACBK long-term dataset (2003 to 2025) records wintering aggregations averaging 238 to 254 birds and peaking at 700 individuals in 2004, with counts of 400 to 500 in subsequent winters. The February 2025 Project survey recorded 88 Dalmatian Pelicans along a 15 km transect intersecting the alignment within the eastern corner of the reservoir. Although the count immediately adjacent to the Project alignment is below the 0.5% global threshold, when assessed at the reservoir-wide EAAA scale the historical winter peaks of 444–500 birds equate to approximately 3.9–4.4% of the global population. The species meets the threshold under Criterion 1(c). Two decades of consistent aggregations confirms functional reliance on the site.

Criterion 2 — Endemic and restricted-range species: ***triggered***

Three restricted-range species were assessed: the Syr-Darya shovelnose sturgeon, the Aral barbel (*Luciobarbus brachycephalus*), and the plant *Salvia korolkowii*. The Aral barbel and *S. korolkowii* do not meet Criterion 2 thresholds. The Syr-Darya shovelnose sturgeon's historical linear range exceeded 2,000 km, but the species' functional range has been severed by multiple dams along the Syr Darya. The likely surviving range — from the Angren River confluence down to the Shardara Reservoir — is less than 500 km, the IFC PS6 threshold for restricted range in aquatic species. Applying the precautionary approach, the species meets the threshold under Criterion 2. The Syr Darya River and the connected Shardara Reservoir therefore qualify as Critical Habitat for the species under Criterion 2.

Criterion 3 — Migratory and congregatory species: ***triggered***

Wintering bird assemblages and Dalmatian pelican. Shardara Reservoir is one of the most important waterbird wintering sites in Central Asia. Mid-winter counts have reached approximately 150,000 individuals, dominated by Mallard, Gadwall, Common Pochard, Tufted Duck, Greylag Goose, and Eurasian Coot. Of these, only the Dalmatian Pelican meets the 1% global threshold under Criterion 3(a), at the reservoir-wide EAAA scale (historical peak count of 500 birds = 3.9–4.4% of global population). None of the other previously IBA-qualifying species currently meets the 1% global threshold — for example, Greylag Goose numbers approached the threshold in the early 2000s but mass starvation during the extreme cold winter of 2011 reduced the population to well below 1% thereafter; Common Teal met the threshold only briefly in 2003 and 2013; and Tufted Duck came

closest in 2004 (~0.9%) but has declined substantially since. The original IBA was designated using BirdLife International's A4i regional-population threshold, which is more lenient than the global threshold required for Critical Habitat. The updated KBA assessment (KBA Partnership, 2026) cites only three trigger species — Dalmatian pelican, Greylag goose and Smew — compared with eight species in the original IBA designation, reflecting observed population declines.

Spring and autumn migration assemblages. The Project area is within the Central Asian Flyway, close to the boundary with the West Asian/East African Flyway. Project surveys recorded 77+ species during spring migration with multiple species in the hundreds or thousands. The largest concentration was Black-tailed Godwit (up to 1,640 individuals, 0.2–0.3% of global population). No passage species approaches the 1% threshold; the reservoir is one component of a network of stopover habitats across the flyway and does not trigger Critical Habitat for migratory passage assemblages.

Breeding bird aggregations and pygmy cormorant. A mixed heronry and cormorant breeding colony was recorded in June 2025 in the reedbeds at the southern end of the Project alignment, within the reservoir approximately 1 km north of Azattyk village and east of the Project alignment. The colony supports the following species nesting together: pygmy cormorant, great egret, little egret, grey heron, purple heron, spoonbill, glossy ibis, squacco heron, and cattle egret. The most numerous were pygmy cormorant (~1,500 pairs), glossy ibis (~1,000 pairs), and little egret (300–400 pairs). Pygmy cormorant counts equate to 2.6–3.4% of the global population (IUCN estimate 87,300–113,000 individuals), substantially exceeding the 1% threshold under Criterion 3(a). Glossy ibis numbers are below the 1% threshold. Pygmy cormorant meets the threshold under Criterion 3(a). Population estimates were derived from drone imagery analysed by professional ornithologists, with reference to 25 years of comparable aerial imagery from the Northern Caspian. Even allowing for ±50% error, the local population exceeds the 1% global threshold. The reedbed within the reservoir is therefore Critical Habitat for the congregatory pygmy cormorant.

Non-avian species. no mammal or fish species recorded within the EAAA meets Criterion 3 thresholds. Saiga Antelope routes do not align with the wetland landscape; snow leopard is confined to high-elevation systems absent from the Project area; the historical migratory pathway of the sturgeon has been severed by the Shardara Dam.

Criterion 4 — Key evolutionary processes and ecosystem services: ***not triggered***

No evidence of active speciation, environmental gradients driving evolutionary change, edaphic endemism, or active connectivity functions in the Project area. The Syr Darya's historical connectivity function for endemic fish has been irrecoverably severed by pre-existing dam infrastructure; the native fish community has been largely replaced by introduced species. The reservoir's importance to waterbirds reflects habitat resource rather than evolutionary process. Criterion 4 is not triggered.

Criterion 5 — Highly threatened and unique ecosystems: ***not triggered***

The only formally Collapsed ecosystem in this region under the IUCN Red List of Ecosystems is the Aral Sea, which is geographically and ecologically distinct from the Project area; Criterion 5(a) is not met. Two habitat types of conservation interest are present — Tugai riparian forest (including the Red Data Book-listed Populus pruinosa) and the reedbed breeding-colony habitat at the southernmost reaches of the reservoir. Both are recognised in policy or by virtue of their species composition but are not designated as national/regional conservation priorities sufficient to trigger Criterion 5(b). Criterion 5 is not triggered, although both habitats warrant management attention.

Criterion 6 — Biodiversity of social, cultural and economic importance: ***not triggered***

The significant ecosystem services in the broader area — Syr Darya basin irrigation, flood regulation, a fishery producing ~6,000 t annually dominated by ~33 introduced fish species — are functions of the dam infrastructure rather than of biodiversity in the Project area specifically. Most of the alignment

passes through modified and agricultural land providing locally-relevant provisioning services that are widespread across the wider landscape. Criterion 6 is not met.

Table 65: Summary of triggered Critical Habitat

Criterion	Species / feature	Conservation status	Critical Habitat feature	Trigger basis
1(a), 1(c)	*Syr-Darya shovelnose sturgeon*	CR (Possibly Extinct); single-river endemic; Cat. I KZ RDB	Syr Darya River + Shardara Reservoir	Precautionary; any surviving reach holds extreme proportion of near-zero global population
1(c)	*Dalmatian pelican*	NT globally; Rare in KZ RDB	Shardara Reservoir (wintering)	Historical winter peaks 444–500 birds at reservoir scale = 3.9–4.4% global population
2	*Syr-Darya shovelnose sturgeon*	CR; single-river endemic	Syr Darya River + Shardara Reservoir	Surviving range <500 km linear; restricted-range threshold met
3(a)	*Dalmatian pelican*	NT globally; Rare in KZ RDB	Shardara Reservoir (wintering aggregations)	Regular cyclical concentrations ≥1% global population at EAAA scale
3(a)	*Pygmy cormorant*	LC globally; not RDB listed	Reedbed breeding colony at SE reservoir (Azattyk area)	~1,500 breeding pairs = 2.6–3.4% global population

A further sturgeon field expedition is scheduled for late 2026 or early 2027. The pygmy cormorant breeding colony was identified for the first time during the 2025 surveys; multi-year monitoring is required to confirm the colony's persistence and to refine the population estimate.

7.4.2 Biodiversity Studies

Research and field surveys were completed to establish the biodiversity baseline and to inform the associated impact assessment. Desk-based research comprised private and publicly available biodiversity data, including but not limited to IUCN Red lists, the Kazakhstan Red data Book and IBAT data within the surrounding 50km, freely available natural and modified habitat maps, aerial photography and drone footage of the project site along with locally-available data on species and protected areas. Consultation supplemented the desk-based data and provided locally relevant information. A list of the primary consultees is summarized in Table 66.

Table 66: The Stakeholders consulted or approached as part of the Project ESIA process

Ref	Organisation / Expert	Type	Date	Purpose
1	Association for the Conservation of Biodiversity of Kazakhstan (ACBK)	Conservation NGO	January 2026, February 2026	Provided historical ACBK winter waterbird count series (2003–2025); conducted 2026 winter ornithological surveys (ACBK, 2026a, b); consulted on the CHA framework and trigger species.
2	Tennessee Aquarium and the Kazakh Fisheries Research and Production Centre	Research / fisheries	2025–2026 (correspondence)	Consulted on the Syr-Darya Shovelnose Sturgeon; provided findings of 2017 and 2019 field expeditions; confirmed the species' likely persistence in the inter-dam reach from the Angren River confluence to Shardara Reservoir; informed the CHA Criterion 1a/1c/2 precautionary trigger. A further expedition is planned for late 2026/early 2027.
3	Kovshar (ornithologist, lead surveyor 2025)	Independent expert	February–July 2025	Conducted winter (February 2025), spring/early breeding (May 2025), and summer/breeding (June–July 2025) ornithological surveys, including drone surveys of inaccessible reedbeds. Identified a previously undescribed mixed-species breeding colony at Azattyk. Referenced in Kovshar (2025a/b/c).
4	KBA Partnership / BirdLife International	Conservation partnership	2024–2026 (correspondence)	Provided IBA designation history and updated 2026 KBA assessment, including revised trigger species information (3 current trigger species compared to 8 in the original IBA designation). Informed the CHA Criterion 3 analysis.
5	Committee for Forestry and Wildlife (MOOC PK) and Akimat of Turkistan Region environmental departments	Government regulator	2025–2026 (meetings, correspondence)	Consulted on protected area status, Red Data Book listings, tree-cutting permits, and regional biodiversity context. Coordinated on the Preliminary Biodiversity Action Plan.

Targeted field surveys were conducted between February 2025 and May 2026. The principal survey effort was focused on the Shardara Reservoir IBA/KBA crossing, which represents the most ecologically sensitive section of the alignment. The surveys were documented in the following studies, which are provided in the ESIA appendices inclusive of all the field survey methods and results:

- Winter ornithological survey (24–25 February 2025): 15 km transect through the Syr Darya floodplain. (Kovshar, 2025a).
- Spring/early breeding ornithological survey (14–16 May 2025): morning and evening transects. (Kovshar, 2025b).
- Summer/breeding ornithological survey (27 June–2 July 2025): including drone surveys to locate and characterise breeding colonies in inaccessible reed beds (Kovshar, 2025c).
- Winter ornithological survey (8–11 January 2026): wider reservoir area (ACBK, 2026a).
- Winter ornithological Vantage Point survey (24–25 February 2026): provided six fixed observation points along a 55.4 km route (ACBK, 2026b).
- Winter and Spring ornithological surveys completed between January and May 2026.
- Habitat, flora and protected species surveys of the entire alignment between February and May 2026.

Desk-based studies comprised IBAT searches at 10 km and 50 km radii, a review of published English and Russian language literature including historical winter waterbird count series (Yerokhov et al., 2004–2008; Chalikova, 2024), and a review of the biodiversity surveys conducted for the adjacent Saryagash Bypass road project in 2020–2021 (KazhAvtoZhol, 2025), which provides data on the terrestrial and aquatic biodiversity of the surrounding landscape. A Critical Habitat Assessment (CHA) was prepared in support of the project and is referenced throughout this section (CHA, 2025).

7.4.3 Protected Areas

Shardara Reservoir Important Bird and Biodiversity Area and Key Biodiversity Area. The Shardara Reservoir (also referred to as the Shardara Reservoir) is a large artificial waterbody formed by damming the Syr Darya River at Shardara. The dam was constructed between 1964 and 1968 and the reservoir was filled progressively between 1965 and 1968. Its primary purpose is irrigation and hydropower generation via the 100 MW Shardara Hydroelectric Power Station (IHA/GIZ, 2011). The reservoir is 80 km long, and up to 25 km wide, with a surface area of approximately 783 km^2 and total storage capacity of approximately 5.7 km^3. Water levels fluctuate by up to 11 meters between seasonal maximum fill (October to March) and minimum (April to September) (Timirkhanov *et al*., 2010, cited in CHA, 2025). In the south-west, the reservoir is hydraulically connected to the Arnasay Lowland in Uzbekistan; a major flood event in 1969 resulted in the creation of the Aydar-Arnasay Lakes System, now designated as Ramsar Site No. 1841 (Ramsar, n.d.).

Despite its entirely artificial origin, the reservoir rapidly attracted nationally and internationally significant waterbird assemblages. In the first years after construction, more than 40,000 waterfowl were recorded wintering at the site (Auezov, 1972, cited in BirdLife International, 2024), and the reservoir established itself as the most important overwintering site for waterbirds in Kazakhstan. In more recent decades wintering assemblages have regularly exceeded 100,000 waterbirds, and the December 2003 survey recorded approximately 150,000 individuals of 31 species (Yerokhov and Belyalov, 2004). The site's significance is underpinned by its position within the Central Asian Flyways a major bird migratory route, combined with the reservoir's productive fishery and the adjacent croplands and grasslands (KazhAvtoZhol, 2025).

The Shardara Reservoir was designated as an Important Bird and Biodiversity Area (IBA) by BirdLife International, in partnership with the Association for the Conservation of Biodiversity of Kazakhstan (ACBK), based on count data from 2007 (BirdLife International, 2024). The designated IBA covers 960,100 ha (960.1 km^2) and meets three IBA criteria (see Table 68):

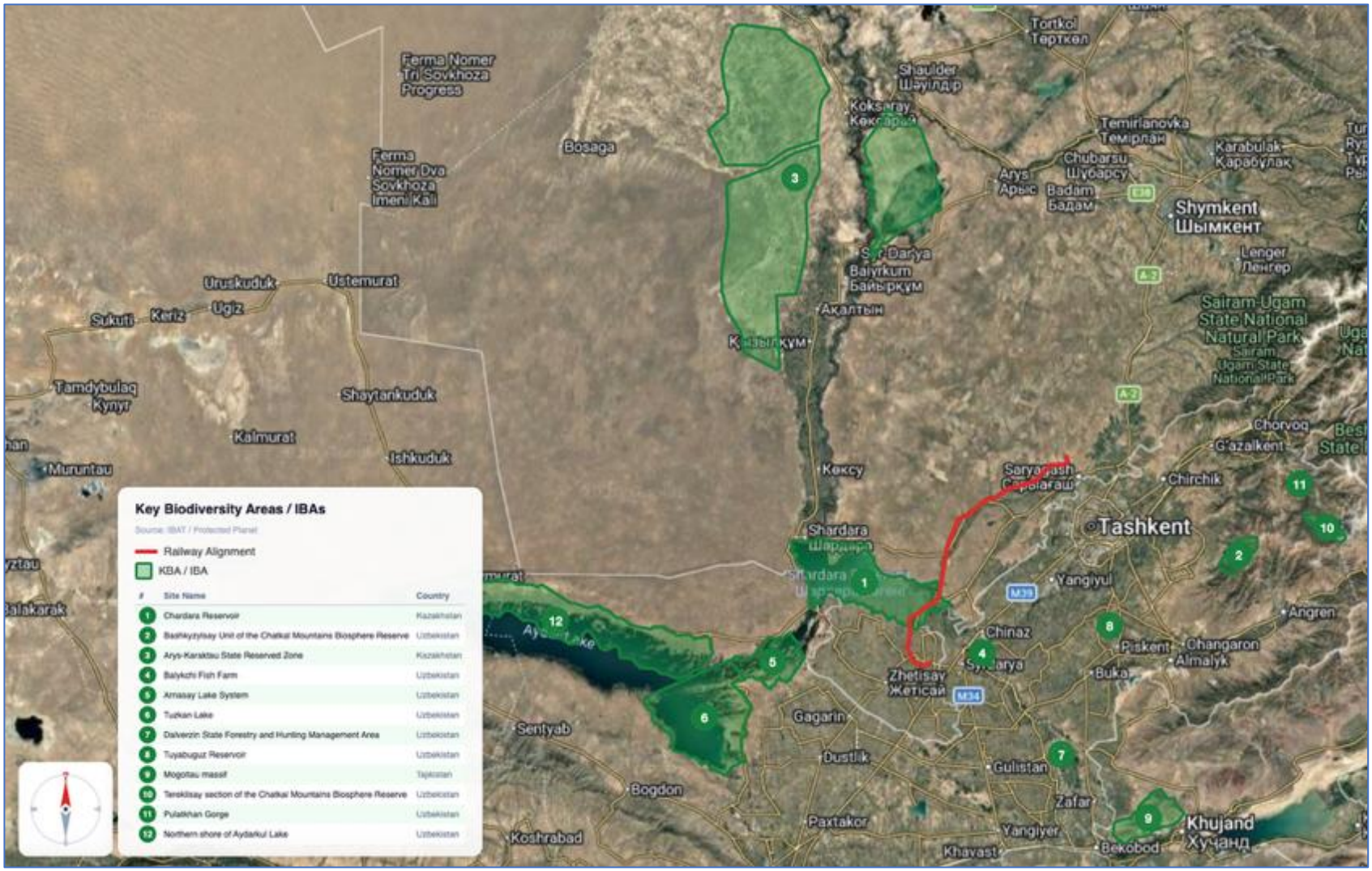
- Criterion A1 (globally threatened species — Dalmatian Pelican)

- Criterion A4i (congregatory waterbird species — seven species regularly exceeding 1% of their biogeographic populations), and
- Criterion A4iii (waterbird assemblage of ≥20,000 individuals).

The IBA is co-listed as a Key Biodiversity Area (KBA) under the global KBA Standard administered by the KBA Partnership (KBA Partnership, 2022). Despite its international designation, the Shardara Reservoir IBA has no formal statutory protection under Kazakhstan law (KazhAvtoZhol, 2025).

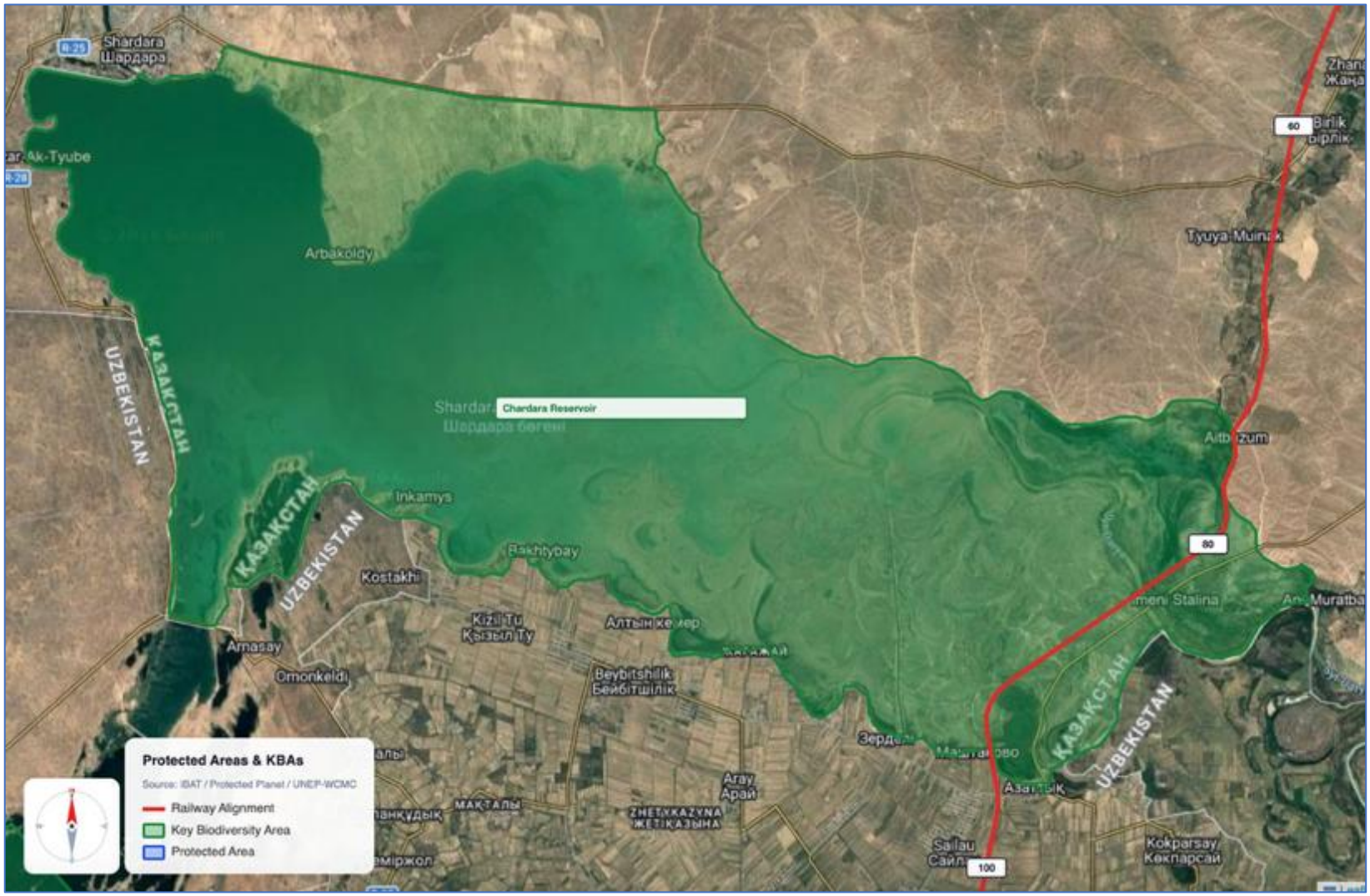
Given the IBA/KBA's ecological importance and that the proposed project passes directly through it, the reservoir is confirmed as an important ecological receptor and taken through to the impact assessment.

Figure 42: KBA/IBAs



Source: IBAT, 2026

Table 67: Shardara IBA/KBA



Source: IBAT, 2026

Table 68: IBA and KBA qualifying species of Shardara Reservoir (BirdLife International, 2024).

Common Name	Scientific Name	IUCN	Kazakhstan RDB	Population (2007 Assessment)	IBA Criterion
Dalmatian Pelican	*Pelecanus crispus*	NT	Rare	50–1,000 ind.	A1, A4i
Pygmy Cormorant	Microcarbo pygmaeus	LC	–	20–500 ind.	A4i
Greylag Goose	Anser anser	LC	–	500–50,000 ind.	A4i
Mallard	*Anas platyrhynchos*	LC	–	1,000–50,000 ind.	A4i
Tufted Duck	*Aythya fuligula*	LC	–	1,000–20,000 ind.	A4i
Goosander	*Mergus merganser*	LC	–	50–2,000 ind.	A4i
Common Teal	*Anas crecca*	LC	–	1,000–30,000 ind.	A4i
Smew	*Mergellus albellus*	LC	–	100–3,000 ind.	A4i
Bird Assemblage		–	–	>20,000 ind.	A4iii

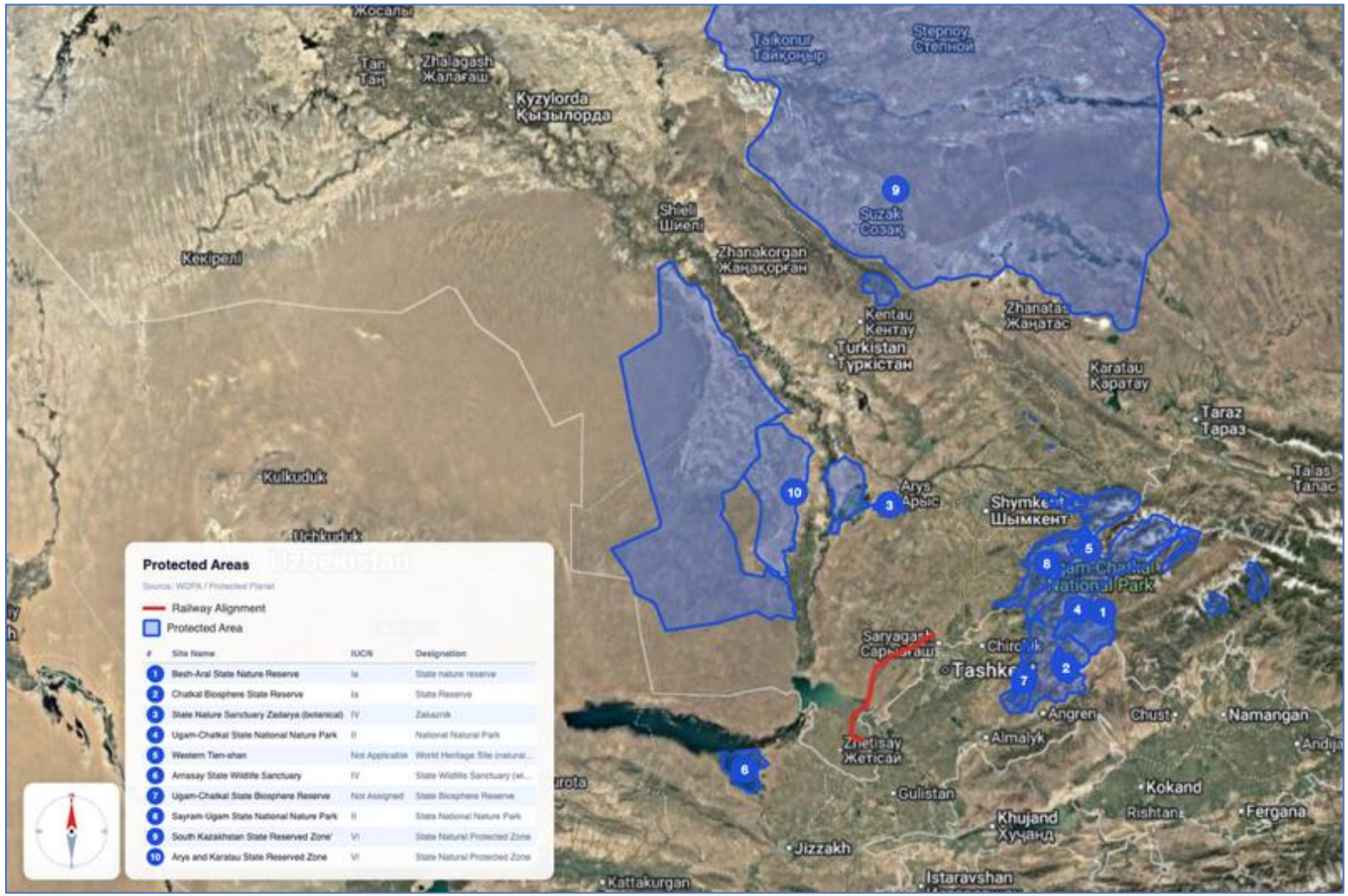
IBA criteria: A1 = globally threatened species; A4i = ≥1% of biogeographic population of a congregatory waterbird species; A4iii = ≥20,000 waterbirds of one or more species.

Other Protected and Recognized Areas. The Aydar-Arnasay Lakes System Ramsar Site (No. 1841), located across the border in Uzbekistan, is hydraulically connected to the Shardara Reservoir and provides additional context for the regional significance of the project area for waterbirds (Ramsar, n.d.). However, given the volume of water within the Shardara Reservoir and the dilution effect of this, it is considered highly unlikely that the Project could have any meaningful impact on the Ramsar site and, as such, it is not considered as a receptor in the impact assessment.

There are no nationally protected areas within the immediate project area. Two State Reserved Zones and a Regional Park lie to the north of the Shardara Reservoir, but these are understood to have no formal protection currently.

The nearest formally protected area is the Ugam Chatkal State National Nature Park, approximately 45 km south-east of the project, in Uzbekistan (KazhAvtoZhol, 2025). Within 50 km, two further IBAs/KBAs are located in Uzbekistan: the Arnasay Lake System and the Balykchi Fish Farm KBA. Given the distance from the Project site and lack of potential impact pathway, however, none of these sites are taken forward as a receptor within the impact assessment.

Figure 43: Nationally Protected Areas



Source: IBAT, 2026

7.4.4 Birds

The Shardara Reservoir IBA and its surrounding floodplain support a nationally and internationally important bird communities throughout the year, with the greatest conservation significance concentrated in the winter. This section summarizes the data obtained through consultation and the survey work completed to inform this baseline focused on characterizing the bird populations within and around Project as it passes through the IBA.

Long-Term Trends. Winter waterbird counts have been conducted at Shardara Reservoir since 2003, primarily by ACBK (Yerokhov *et al*., 2004–2008; Chalikova, 2024). Count data vary considerably between years, reflecting genuine population changes, weather and hydrology, and variation in survey effort and coverage. The data relate to the reservoir as a whole rather than the specific Project area where it crosses the IBA. However, they provide important context for population trends in IBA qualifying species.

Key trends identifiable from the long-term data include: a dramatic decline in Mallard from peaks of 60,000 to 150,000 in 2009 to 2014 to fewer than 2,000 in recent years; a persistent decline in Greylag Goose, which suffered mass starvation in the severe winter of 2011 and has never fully recovered (Chalikova, 2024); a general declining trend in Common Pochard, from 50,000 in 2006 to approximately 110 individuals in 2024; and a declining trend in wintering White-tailed Eagle average 21 individuals between 2017 and 2022 compared to an average of 69 between 2003 and 2016 (Chalikova, 2023).

Winter Birds. A summary of the peak bird counts recorded during the winter surveys completed as part of this ESIA, i.e. in the project's area of influence only is presented in Table 69. The February 2025 surveys recorded 38 species, with total counts of approximately 3,133 and 4,440 individuals on the two survey days respectively, from a 15 km transect through the Syr Darya floodplain. The winter avifauna is numerically dominated by Eurasian Coot (1,300–1,380 individuals), Gadwall (up to 1,309), Great Cormorant (450–469), Pygmy Cormorant (270–286) and Common Teal (up to 196). Dalmatian Pelican was recorded with a peak count of 88 individuals. Four species listed in the Kazakhstan Reddata Book were recorded: Dalmatian Pelican (IUCN NT), Ferruginous Duck (IUCN NT), White-tailed Eagle (7–8 individuals), and Peregrine Falcon (2 individuals).

The February 2026 survey recorded 30 species, including Steppe Eagle (IUCN EN) and White-tailed Eagle as Red data Book species. It must be noted that the 2026 survey was completed whole the construction operations along the embankment and particularly on the railway bridge section over the river was ongoing.

The wintering bird assemblage is ecologically notable and the primary reason that the IBA was designated. Wintering birds as a receptor is important and is taken into the impact assessment.

Table 69: Bird species recorded during winter surveys (February 2025 and January/February 2026).

Common Name	Scientific Name	IUCN	KZ RDB	Feb 2025	Jan/Feb 2026	Status
Great Crested Grebe	*Podiceps cristatus*	LC	–	6	–	W, MB
Dalmatian Pelican	*Pelecanus crispus*	NT	Rare	88	6	W
Great White Pelican	*Pelecanus onocrotalus*	LC	–	-	6	M
Great Cormorant	*Phalacrocorax carbo*	LC	–	469	500	W, M
Pygmy Cormorant	*Microcarbo pygmaeus*	LC	–	286	–	W, MB
Great Egret	*Egretta alba*	LC	–	106	3	W, MB
Grey Heron	*Ardea cinerea*	LC	–	7	1	W, MB
Greylag Goose	*Anser anser*	LC	–	140	30	W
Mute Swan	*Cygnus olor*	LC	–	105	40	W, MB

Common Name	Scientific Name	IUCN	KZ RDB	Feb 2025	Jan/Feb 2026	Status
Whooper Swan	*Cygnus cygnus*	LC	Rare	–	present	W
Ruddy Shelduck	*Tadorna ferruginea*	LC	–	–	2	W, MB
Mallard	*Anas platyrhynchos*	LC	–	146	30	W, MB
Common Teal	*Anas crecca*	LC	–	196	10	W
Eurasian Wigeon	*Mareca penelope*	LC	–	–	1	W
Gadwall	*Anas strepera*	LC	–	1,309	–	W
Northern Pintail	*Anas acuta*	LC	–	144	10	W
Northern Shoveler	*Anas clypeata*	LC	–	9	–	W
Red-crested Pochard	*Netta rufina*	LC	–	54	–	W, MB
Common Pochard	*Aythya ferina*	VU	–	10	–	W
Ferruginous Duck	*Aythya nyroca*	NT	Cat. III	9	–	W, MB
Tufted Duck	*Aythya fuligula*	LC	–	35	–	W
Smew	*Mergellus albellus*	LC	–	–	–	W
Goosander	*Mergus merganser*	LC	–	1	–	W
Western Marsh Harrier	*Circus aeruginosus*	LC	–	18	2	W, MB
Hen Harrier	*Circus cyaneus*	LC	–	1	–	W
Steppe Eagle	*Aquila nipalensis*	EN	Cat. II	–	2	W
White-tailed Eagle	*Haliaeetus albicilla*	LC	Cat. III	8	1	W
Peregrine Falcon	*Falco peregrinus*	LC	Cat. II	2	–	W
Common Kestrel	*Falco tinnunculus*	LC	–	3	–	W, MB
Eurasian Coot	*Fulica atra*	LC	–	1,380	present	W, MB
Northern Lapwing	*Vanellus vanellus*	NT	–	–	9	W, M
Pallas's Gull	*Larus ichthyaetus*	LC	Cat. III	5	–	W
Black-headed Gull	*Larus ridibundus*	LC	–	23	–	W
Caspian Gull	*Larus cachinnans*	LC	–	20	–	W
White Stork	*Ciconia ciconia*	LC	Cat. III	–	1	M
Eurasian Sparrowhawk	*Accipiter nisus*	LC	–	–	3	W
Long-legged Buzzard	*Buteo rufinus*	LC	–	–	1	W, MB
Crested Lark	*Galerida cristata*	LC	–	2	5	R
Eurasian Skylark	*Alauda arvensis*	LC	–	–	30	W, MB
Masked Wagtail	*Motacilla personata*	LC	–	15	1	W, MB
Common Starling	*Sturnus vulgaris*	LC	–	50	15	W, MB
Rook	*Corvus frugilegus*	LC	–	5	50	W, R
Carrion Crow	*Corvus corone*	LC	–	32	2	R
Hooded Crow	*Corvus cornix*	LC	–	18	1	R

Status: W = winter visitor; MB = migratory breeder; M = migrant; R = resident. IUCN: EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern.

Breeding Birds. The peak counts of the spring and summer breeding surveys from May and June/July 2025 are summarized in Table 70. The data shows marked changes between winter and summer in the species presence and abundance. As water levels were drawn down through spring and summer, the floodplain transitions from predominantly open water to a mosaic of shallow pools, channels, wet grassland, mudflats and reed beds that creates a diversity of habitats favorable to breeding and migrating waterbirds and waders.

The most significant finding of the summer surveys was the discovery and characterization of a large mixed-species breeding colony of waterbirds within an extensive reed bed at the southern end of the

floodplain crossing, at coordinates 40°57'56"N, 68°27'7"E (Figure 44). The colony was located using drone surveys, as the site was inaccessible by land or water. It comprised two adjacent areas, located 450 m west of the main highway and 900 m from the western outskirts of the village of Azattyk (Figure 45). The nearest point of the proposed railway alignment is approximately 1.2 km from the colony.

Figure 44: The location of the breeding bird colony at the southern end of the project alignment (show in purple to the east) at in the south-eastern corner of the reservoir, near the village of Azattyk, approximately 1 km to the south.

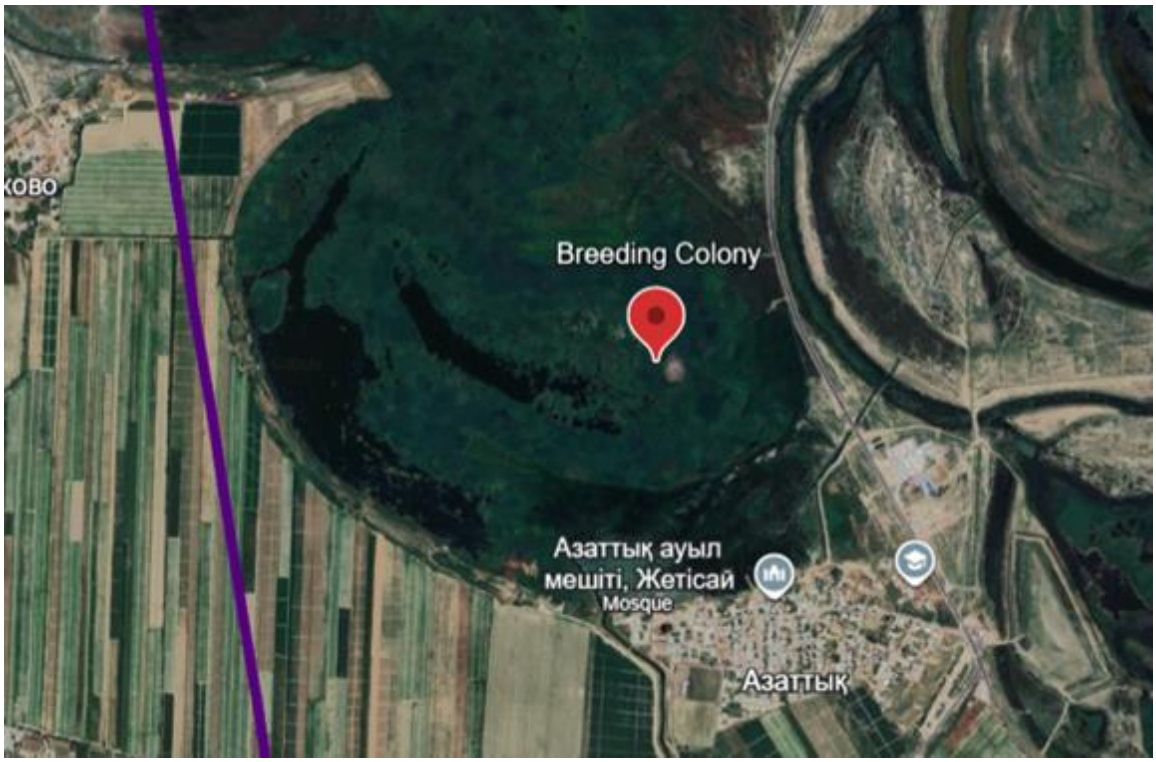


Figure 45: Ariel imagery of one of the breeding bird colonies in the reedbeds.



Egrets can be seen on the left of the photo. This colony is one of several in the area and measures 100 m by 65 m in size. Photo taken from drone footage during project surveys in 2025

The colony was estimated to contain approximately 1,500 pairs of pygmy cormorant, 1,000 pairs of glossy ibis, and 300 to 400 pairs of little egret, together with breeding grey heron, purple heron, great egret, spoonbill, night heron, squacco heron, and cattle egret. This colony represents a previously undescribed breeding interest for the IBA. The numbers of glossy ibis and little egret may represent a significant proportion of the national reported breeding populations (approximately 1,000 pairs and 500 pairs respectively in the Kazakhstan RDB), though the published national figures are believed to significantly underestimate actual breeding numbers (Kovshar, 2025c). The abundance of pygmy cormorant is likely to be of international significance with c.3,000 individuals being equal to between 2.6% to 3.4% of the global population.

The breeding bird assemblage in the project area is ecologically notable as are the species-specific abundances of the pygmy cormorant, the glossy ibis and the little egret. These receptors are taken into the impact assessment.

Table 70: Bird species recorded during spring surveys (May and June/July 2025)

Common Name	Scientific Name	IUCN	KZ RDB	May 2025 Peak	Jun/Jul 2025 Peak	Status / Notes
Pygmy Cormorant	*Microcarbo pygmaeus*	LC	–	80	160	MB (~1,500 pr colony)
Night Heron	*Nycticorax nycticorax*	LC	–	12	16	MB
Squacco Heron	*Ardeola ralloides*	LC	Cat. IV	6	5	B (colony)
Cattle Egret	*Bubulcus ibis*	LC	Cat. IV	–	2	B (colony)
Great Egret	*Egretta alba*	LC	–	40	50	MB (colony)
Little Egret	*Egretta garzetta*	LC	Rare	16	250	MB (~300–400 pr colony)
Grey Heron	*Ardea cinerea*	LC	–	20	200	MB (colony)
Purple Heron	*Ardea purpurea*	LC	Cat. IV	78	120	MB (colony)
Eurasian Spoonbill	*Platalea leucorodia*	LC	Cat. IV	18	40	MB (colony)
Glossy Ibis	*Plegadis falcinellus*	LC	VU (RDB)	350	600	MB (~1,000 pr colony)
White Stork	*Ciconia ciconia*	LC	Cat. III	36	600	M (passage)
Great White Pelican	*Pelecanus onocrotalus*	LC	–	6	–	M
Ruddy Shelduck	*Tadorna ferruginea*	LC	–	26	28	MB
Red-crested Pochard	*Netta rufina*	LC	–	20	30	MB (broods)
Ferruginous Duck	*Aythya nyroca*	NT	Cat. III	26	24	MB (broods confirmed)
Black Kite	*Milvus migrans*	LC	–	3	2	M
Western Marsh Harrier	*Circus aeruginosus*	LC	–	9	6	MB
Long-legged Buzzard	*Buteo rufinus*	LC	–	1	1	MB
Shikra	*Accipiter badius*	LC	–	1	2	MB
Eurasian Hobby	*Falco subbuteo*	LC	–	1	–	MB
Eurasian Coot	*Fulica atra*	LC	–	30	120	MB (broods)

Common Name	Scientific Name	IUCN	KZ RDB	May 2025 Peak	Jun/Jul 2025 Peak	Status / Notes
White-tailed Lapwing	*Vanellochettusia leucura*	LC	–	30	42	MB (nest confirmed)
Black-winged Stilt	*Himantopus himantopus*	LC	–	8	44	MB (nest confirmed)
Collared Pratincole	*Glareola pratincola*	LC	–	150	66	MB (colony)
Black-tailed Godwit	*Limosa limosa*	NT	–	–	800	M
Common Tern	*Sterna hirundo*	LC	–	15	18	M
European Roller	*Coracias garrulus*	LC	–	20	30	MB
Blue-cheeked Bee-eater	*Merops superciliosus*	LC	Cat. IV	140	140	MB (~70+ pr at cliff colony)
European Bee-eater	*Merops apiaster*	LC	–	18	6	MB

Raptors and Vultures. A total of 11 raptor and vulture species were recorded in the project's areas of influence during the 2025 and 2026 surveys (Table 71). Western marsh harrier *Circus aeruginosus* was the most abundant and frequently recorded raptor across all seasons, present in peak numbers of 18 during the winter survey and recorded regularly during spring and summer, likely breeding within the IBA reed beds.

White-tailed eagle (*Haliaeetus albicilla*, Kazakhstan RDB Category III) was the most regularly recorded eagle species, with 7–8 individuals in February 2025, substantially fewer than the historical peak of 120 and consistent with a long-term declining trend in the wintering population (Chalikova, 2023). Steppe eagle (*Aquila nipalensis*, IUCN Endangered, Kazakhstan RDB Category II) was recorded in the 2026 surveys (peak of 2 individuals).

A number of species have been recorded historically but were not observed during current surveys including two IUCN Vulnerable eagle species, Eastern imperial eagle and greater spotted eagle; two IUCN Endangered species, Pallas's fish-eagle (*Haliaeetus leucoryphus*, Kazakhstan RDB Category I) and saker falcon (*Falco cherrug*, Kazakhstan RDB Category I, CITES Appendix I); and two vulture species Cinereous vulture (*Aegypius monachus*, NT) and griffon vulture (*Gyps fulvus.* LC).

Table 71: Raptors and Vultures (2025-2026 Surveys)

Common Name	Scientific Name	IUCN	KZ RDB	Migratory Status	Survey Record	Notes on Occurrence
Steppe Eagle	*Aquila nipalensis*	EN	Cat. II	M / W	Observed (2026)	2 individuals in Feb 2026 monitoring survey; also in Jan 2026 ACBK census. IUCN Endangered; globally declining.
White-tailed Eagle	*Haliaeetus albicilla*	LC	Cat. III	M / W	Observed (2025 & 2026)	7 to 8 individuals Feb 2025; 1 Feb 2026. Historical peak 120. Declining trend: average 21 birds 2017 to 2022 vs 69 during 2003 to 2016 (Chalikova, 2023).
Black Kite	*Milvus migrans*	LC	–	M / MB	Observed (2025)	Peak 3 in May 2025; 2 in Jun/Jul 2025.
Western Marsh Harrier	*Circus aeruginosus*	LC	–	M / MB	Observed (all surveys)	Most abundant raptor. Peak 18 in Feb 2025. Key source of bird disturbance at site.

Common Name	Scientific Name	IUCN	KZ RDB	Migratory Status	Survey Record	Notes on Occurrence
Hen Harrier	*Circus cyaneus*	LC	–	M / W	Observed (2025)	1 individual Feb 2025.
Eurasian Sparrowhawk	*Accipiter nisus*	LC	–	M / W	Observed (2026)	3 individuals Feb 2026.
Shikra	*Accipiter badius*	LC	–	M / MB	Observed (2025)	Small numbers May and Jun/Jul 2025.
Long-legged Buzzard	*Buteo rufinus*	LC	–	M / MB	Observed (2025 & 2026)	Recorded all seasons; up to 3 individuals.
Peregrine Falcon	*Falco peregrinus*	LC	Cat. II	M / W	Observed (2025)	2 individuals Feb 2025.
Eurasian Hobby	*Falco subbuteo*	LC	–	M / MB	Observed (2025)	1 individual May 2025.
Common Kestrel	*Falco tinnunculus*	LC	–	M / MB / R	Observed (2025 & 2026)	Most consistently recorded small raptor; all survey seasons.

Bird Summary. Based on the desk-based research and surveys completed, a range of bird species of conservation concern have been recorded within the Project site and in the surrounding landscape. To ensure that the impact assessment is succinct, the species recorded in each ecological niche with the highest conservation status has been chosen to represent that niche. As such, the following species are considered as receptors within the impact assessment:

- Dalmatian pelican (IBA citation species)
- Pygmy cormorant
- Wintering assemblage
- Migratory assemblage
- Breeding assemblage
- Raptor and Vulture assemblage
- Waterfowl and Waders
- Other species (including Yellow eyed-pigeon)

7.4.5 Flora and Vegetation

Landscape overview. The project area lies within the semi-arid lowlands of the Syr Darya basin, an intensively managed agricultural landscape where natural and semi-natural vegetation has been substantially reduced through cultivation, irrigation and grazing. The dominant land-use types along the Project alignment are irrigated cropland, heavily grazed steppe grasslands, and urban and peri-urban areas. The floodplain section of the route within the Shardara IBA supports a more diverse flora associated with the seasonal wetland mosaic, including extensive reed beds dominated by common reed (*Phragmites australis*), sedges, rushes, and riparian scrub. The surrounding loess cliffs and steppe support drought-adapted communities including species of stipa, festuca, artemisia, salsola and calligonum. Along water courses, tamarisk (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), white poplar (*Populus alba*) and sea buckthorn (*Hippophae rhamnoides*) are characteristic and dominant.

Habitats. Under SPS, habitats within the project area must be distinguished between Modified or Natural based on their ecological condition and degree of human influence. Projects affecting Natural habitat must avoid significant adverse impacts and achieve at least No Net Loss. SPS defines Natural Habitat as:

'Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions.'

SPS defines Modified Habitat as:

'…the natural habitat has apparently been altered, often through the introduction of alien species of plants and animals, such as in agricultural areas…'.

Differentiating between Natural and Modified Habitat within a project area is critical to determining the extent of anthropogenic influence and corresponding existing ecological value of habitats present.

The Project alignment and proposed permanent footprint is 115 km long and 100 m wide. The total land take is therefore an area approximately 1160 ha in extent. Habitats present pre-construction within the Project footprint and associated earth works have already been lost following the on-going construction activities. Using a combination of publicly-available aerial photography, site photographs and drone footage taken by contractors and consultants during construction, and habitat verification surveys, the habitats that were present and their extent have been assumed and mapped.

Figure 46: An exemplar map illustrating the habitat mapping completed along the Project alignment. This map is focused on the Syr Darya River at the northern end of the Reservoir.



Most of the route comprises heavily modified and grazed and managed steppe grassland with intermittent arable land particularly along and near the few water courses close to the alignment. The entirety of the Project alignment was assessed using two separate sources of ariel imagery, one of which was assessed twice with 2025 ariel data and 2023 ariel data. The assessment identified agricultural practices including for example crop planting and narrow parallel tram lines left by agricultural machinery that are indicative of modified land. The assessment confirmed that the vast majority of the steppe/semi desert land to the north of the reservoir was or had recently been heavily managed. Subsequent field surveys targeted the few areas of uncertainty, e.g. near water courses, and ground truthed the data, thus confirming it Is Modified. All such habitats are considered Modified. The extent of Modified habitat was circa 990ha.

Within the Reservoir and associated wetland, habitats comprised open water, reedbed, Tugai riparian scrub and floodplain grassland cover (all shaded blue in Table 72). the Syr Dara river itself has been classified as open water for the purposes of this indicative assessment. Although some habitats are used extensively by local communities for the grazing of sheep, cattle and horses during the spring and summer months, on a precautionary basis, they are considered Natural given they comprise native flora composition and regenerate extensively each spring.

The reedbeds comprised large, dense stands dominated by common reed *Phragmites australis*. Lesser reedmace *Typha angustifolia* and bulrush *Schoenoplectus lacustris* were frequently recorded in the shallower, more open areas. The Tugai habitat was characteristic Central Asian riparian woodland and dominated by Euphrates poplar *Populus euphratica* and oleaster *Elaeagnus angustifolia*, with *Tamarix* spp. as a common shrub layer, particularly near the margins of the Syr Darya. The grassland is seasonally flooded, mainly during the winter months but this seems to vary year on year and was flooded during the spring of 2026. It Is mainly present to the north, east of the reservoir. The Natural habitat within the permanent land take area is equal to 150ha. On this basis, Natural Habitat is an important receptor that has been included in the impact assessment.

Table 72: Habitat extent within the Project footprint

Habitat Type	Natural / Modified	Area (ha)	% Cover	Comment
Arable	Modified	338.90	29.11%	Agricultural habitats (arable, developed land)
Bare ground	Modified	0.72	0.06%	Bare and disturbed ground
Braided channel complex	Natural	128.17	11.01%	Natural Habitat: Aquatic, wetland and riparian habitats (open water, braided channel, alluvial sediment, marsh/reedbed, reedbed, riparian vegetation)
Exposed alluvial sediment	Natural	0.28	0.02%	
Marsh / Reedbed	Natural	1.39	0.12%	
Open water	Natural	17.81	1.53%	
Reedbed	Natural	9.00	0.77%	
Riparian vegetation	Natural	10.95	0.94%	
Scrub	Modified	13.23	1.14%	Terrestrial habitats (steppe, steppe pasture, scrub, tree belt)
Scrub / Grassland / Bare ground mosaic	Modified	6.90	0.59%	
Steppe pasture	Modified	623.65	53.56%	
Tree belt	Modified	1.29	0.11%	

Habitat Type	Natural / Modified	Area (ha)	% Cover	Comment
Developed land	Modified	12.23	1.05%	Agricultural habitats (arable, developed land)
Total		**1164.52**	**100.00%**	

Floral Species of Conservation Significance. A range of flora species of conservation significance have been recorded in the wider landscape (Table 73). The IBAT 10 km desk study identified one plant species of IUCN conservation concern: *Salvia korolkowii* (Vulnerable, criterion C1+2a(i)), a Central Asian endemic of loess slopes and semi-desert habitats, which could potentially occur on undisturbed loess cliff formations at the north-east end of the IBA crossing. The dataset also identified four Near Threatened tulip species (*Tulipa korolkowii, T. borszczowii, T. lehmanniana, T. kaufmanniana*), characteristic spring-flowering geophytes of the Central Asian steppe. None of the species were recorded, however, during field surveys. 62 plant species were recorded during the 2026 field surveys but no of the above threatened species were identified.

The biodiversity survey for the adjacent Saryagash Bypass road project recorded 88 higher plant species along a broadly similar alignment. The only species of national conservation significance was Lehmann's Eminium (*Eminium lehmannii*), listed in the Kazakhstan Red Data Book. This species occurs in sandy deserts, loess slopes and rocky hillsides of Central Asia and could be present along the steppe and loess sections of the railway alignment, however, it was not recorded during the 2026 field surveys.

Table 73: Flora of conservation significance identified within the IBAT 10 km search area and adjacent road survey, although none were recorded along the Project alignment.

Common Name	Scientific Name	IUCN	Kazakhstan RDB	Trend	Notes
–	*Salvia korolkowii*	VU	–	Decreasing	Loess slopes, rocky semi-desert; Central Asian endemic. Potentially present on undisturbed loess cliffs.
–	*Tulipa korolkowii*	NT	–	Decreasing	Spring geophyte; steppe and semi-desert.
–	*Tulipa borszczowii*	NT	–	Decreasing	Sandy and loess semi-desert.
–	*Tulipa lehmanniana*	NT	–	Decreasing	Steppe and sandy desert margins.
–	*Tulipa kaufmanniana*	NT	–	Decreasing	Foothill steppe and rocky slopes.
Lehmann's Eminium	*Eminium lehmannii*	–	RDB (Kazakhstan)	–	Not on IUCN Global Red List. Kazakhstan RDB. Recorded in adjacent road survey. Araceae; loess and sandy habitats.

IUCN status: VU = Vulnerable; NT = Near Threatened; LC = Least Concern.

The above referenced species have high conservation status, as such, and in accordance with the precautionary approach, they are all ecologically important and together rare flora is taken into the impact assessment as a key receptor.

Mammals. The IBAT 10 km dataset identified 54 mammal species, of which three are of IUCN conservation concern. Goitered Gazelle (*Gazella subgutturosa*, VU, Kazakhstan RDB Category III) is the most ecologically relevant, potentially occurring in the open steppe sections of the alignment as a species of semi-desert and steppe habitats. Marbled Polecat (*Vormela peregusna,* VU, Kazakhstan RDB Category III), a small mustelid carnivore of semi-arid steppes, could also be present in undisturbed

steppe sections. Snow Leopard (*Panthera uncia*, VU) is included in the IBAT dataset by virtue of its broad range polygon but is restricted to high mountain ranges and is not considered a realistic occurrence within the lowland project footprint.

The 2020 to 2021 Saryagash Bypass survey recorded nine mammal species along it's broadly parallel alignment, all Least Concern, including golden jackal red fox, Asian badger, Tolai hare, least weasel, yellow ground squirrel (observed awakening from hibernation at the IBA crossing in February 2026), long-eared hedgehog, northern mole vole, and non-native muskrat. Bats were recorded foraging around water courses but were not identified to species level. On this basis, the following Mammals are taken forward as receptors in the impact assessment, both on a precautionary basis:

- Goitered Gazelle
- Marbled Polecat

Reptiles and Amphibians. The IBAT 10 km dataset identified 33 reptile species, reflecting the high diversity characteristic of the Central Asian semi-desert zone. Two species are IUCN Near Threatened: Eastern steppe viper (*Vipera renardi*, NT, Kazakhstan RDB Category II), a venomous viper of steppe and agricultural margins; and central Asian cobra (*Naja oxiana*, NT, Kazakhstan RDB Category I), a venomous elapid of sandy desert and riparian habitats.

The 2026 field surveys recorded 7 reptile and amphibian species: Central Asian tortoise (*Testudo horsfieldii*, IUCN VU, Kazakhstan RDB Category II, CITES Appendix II), European Glass Lizard (*Pseudopus apodus* and listed in the Kazakhstan RDB), Transcaspian Bent-toed Gecko (*Mediodactylus russowii*), Steppe Ratsnake (*Elaphe dione*), Dice Snake (*Natrix tessellate*), European Green Toad (*Bufotes viridis)* and Eurasian Marsh Frog (*Pelophylax ridibundus*), which are all common species. The Central Asian Tortoise was only recorded incidentally, outside of the formal reptile survey area. This is likely due to the time of the surveys, when the species are less frequently encountered on the surface, particularly during the day when the air temperatures are high. One dead tortoise was recorded temporary and permanent burrows characteristic of this species were observed at many locations.

Surveys to inform the Saryagash Bypass identified central Asian tortoise (*Testudo horsfieldii,* IUCN VU, Kazakhstan RDB Category II, CITES Appendix II) as the most significant reptile species, confirmed as present in the broadly similar surrounding landscape. It is a herbivorous tortoise threatened primarily by collection for the international pet trade and habitat loss. Additional Least Concern reptile species recorded in the road survey include small sand boa, Alaai lidless skink, even-fingered gecko, and tessellated water snake.

At this stage, the only reptiles or amphians that is taken forward as a receptor on the basis of suitability of habitat within the Project area are the Central Asian Tortoise and the European Glass Lizard.

Fish. The Syr Darya river system at the Shardara Reservoir has been profoundly altered by the construction of the dam and associated hydrological management. Despite this, the IBAT 10 km dataset identifies two fish species of significant conservation concern. The Syr-Darya Shovelnose Sturgeon (*Pseudoscaphirhynchus fedtschenkoi*, IUCN CR) is a small sturgeon endemic to the Syr Darya River, assessed as Critically Endangered due to the dam construction and associated river flow modification (for example, the dam repairs in 2017-2018 and associated changes to the river flow reduced the Syr Darya to 10 cm depth in places causing widespread ecological collapse), pollution (from agriculture, in particular), and overfishing. Research suggests that there have been no recent records of the species. A joint American/Kazak expedition in 2019 did not record any species, but discussions with three local fishermen suggested it had been caught in 2015 and 2016 (Life on Earth 2019). Although it is possible that the species may be extinct, records within the last 10 years suggest that it may be under recorded and, as such, is considered within this assessment as a receptor.

Aral Barbel (*Luciobarbus brachycephalus* IUCN EN) was confirmed in the adjacent Saryagash road survey fish sampling, demonstrating its continued presence in the Syr Darya and its tributaries within

the broader project area. This species is threatened by habitat degradation, flow modification, pollution and overfishing. Given it's known presence within the river, this species is also taken forwards as a receptor.

Invertebrates. The IBAT dataset includes two species of conservation significance: waved pincertail (*Onychogomphus flexuosus*, VU) and Aral bluetail (*Ischnura aralensis*, NT), both damselflies associated with the water bodies of the Aral Sea basin including the Syr Darya system, and potentially present in the wetland and riparian habitats of the IBA crossing area. On the basis of similar habitat requirements, the more sensitive Waved Pincertail is taken forward as a receptor to represent damselfly species.

Non-Native and Invasive Species. The project area and surrounding landscape support several established non-native and potentially invasive species (Table 74). Muskrat (*Ondatra zibethicus*) was confirmed in the nearby Saryagash road surveys and is widespread in wetland habitats throughout Kazakhstan, potentially causing damage to irrigation infrastructure through burrowing. Common Myna (*Acridotheres tristis*) was regularly recorded during all Project surveys and is listed by the IUCN as one of the world's 100 worst invasive species, with potential to displace native cavity-nesting birds. Zebra Mussel (*Dreissena polymorpha*) is recorded in the IBAT dataset and could be present in the reservoir and river system, representing a risk to water infrastructure.

The fish community of the Shardara Reservoir has been substantially transformed by the deliberate introduction of at least 33 non-native species, contributing to the decline of native fish species. Invasive plant species of note recorded within the IBAT data include Hydrilla (*Hydrilla verticillata*), a globally problematic aquatic plant likely present in irrigation channels and slow-moving water bodies. Tamarisk species (*Tamarix ramosissima, T. hispida*) and Russian Olive (*Elaeagnus angustifolia*) were also recorded in the IBAT data.

Table 74: Non-native and invasive species of note within the project area.

Common Name	Scientific Name	Group	Source / Status	Notes on Invasion Risk
Muskrat	*Ondatra zibethicus*	Mammal	Saryagash Road surveys	Established invasive from North America; burrowing damages irrigation infrastructure.
Common Myna	*Acridotheres tristis*	Bird	Project surveys	IUCN 100 worst invasives; resident; competes with native cavity-nesters.
Zebra Mussel	*Dreissena polymorpha*	Mollusc	IBAT (likely present)	Can foul water infrastructure; present in Syr Darya system.
Common Carp + introduced fish	*Cyprinus carpio + 32 spp.*	Fish	Literature (confirmed)	33 non-native fish introductions have transformed the reservoir fish community.
Hydrilla	*Hydrilla verticillata*	Aquatic plant	IBAT (likely present)	Globally problematic aquatic invasive; impedes water flow; reduces dissolved oxygen.
Tamarisk spp.	*Tamarix ramosissima / hispida*	Shrub	Saryagash Road surveys / research	Expanding in disturbed riparian habitats; reduces habitat diversity.
Russian Olive	*Elaeagnus angustifolia*	Tree/shrub	Saryagash Road surveys / research	Widespread along canal margins; can dominate disturbed riparian habitats.

Although not ecological receptors per se, invasive species are included in the impact assessment due to their potential impact within the ecosystems present.

7.4.6 Ecosystem Services

Ecosystem services are the benefits that people obtain from nature. They are generally categorized into four main types. Provisioning services include the goods ecosystems provide, such as food, freshwater, fuelwood, and medicinal plants. Regulating services are the natural processes that help maintain environmental stability, including water purification, climate regulation, and soil stabilization. Supporting services underpin these systems by sustaining nutrient cycling, soil formation, and primary production (e.g. plant growth). Finally, cultural services encompass the non-material benefits that nature provides, such as recreation, spiritual value, and traditional knowledge. Together, these services are essential for human well-being, economic security, and the long-term functioning of natural ecosystems.

The Shardara Reservoir provides a suite of provisioning services that are fundamental to the economy and livelihoods of the Turkestan Region and the wider Syr Darya basin. Its primary designed purpose is irrigation and flood regulation, with hydropower generation as an additional benefit (IHA/GIZ, 2011). It also provides drinking water to approximately 32,000 residents of Shardara city. The Reservoir's role as a fishery is equally significant: it is one of the largest fisheries in Kazakhstan, supporting three fish processing plants and 28 fish farms that collectively produce around 6,000 tons of fish annually, the majority of which are exported for human consumption (Graham et al., 2022, citing Rustam, 2017). Local fishing communities maintain traditional practices along the Reservoir's shores, contributing to the regional food supply and economic sustainability (BirdLife International, 2024).

The Reservoir delivers important regulating services, most notably flood control and hydrological regulation. Originally designed for irrigation, the Shardara Reservoir has proven a valuable asset in protecting downstream communities from devastating floods (CDRI, 2025). Rare high-flow events on the Syr Darya are managed through the reservoir's surcharge storage capacity, cutting flood peaks in the lower reaches of the river (BWO Syr Darya, n.d.). The Reservoir also plays a critical role in transboundary water management as the terminal storage facility for the Naryn-Syr Darya cascade, helping to balance the competing demands of hydropower generation in upstream Kyrgyzstan against the irrigation needs of downstream agricultural users in Kazakhstan and Uzbekistan. The Shardara Hydroelectric Power Station has a generating capacity of 100 MW provides an important source of electricity to southern Kazakhstan (IHA/GIZ, 2011), helping stabilize regional energy supply and reduce the dependence on imported electricity during peak demand periods.

The seasonal drawdown regime of the Reservoir creates a diverse and ecologically productive mosaic of habitats that underpins a range of supporting and regulating services of considerable biodiversity value. As water levels fall through spring and summer, the exposed floodplain supports extensive areas of marsh, shallow pools, mudflats and riparian vegetation that function as feeding and breeding habitat for large numbers of waterbirds, supporting internationally important populations of migratory species across the Central Asian and Afro-Eurasian flyways. The extensive reed beds that fringe the north-eastern and south-eastern shores, and the floodplain vegetation of the Syr Darya, provide carbon storage, water filtration and sediment trapping functions.

Further, the Shardara Reservoir supports cultural ecosystem services that, while less formally documented, are of recognized as being important to local communities. The site supports resorts, hotels and campsites, and hunting and fishing are significant seasonal activities, reflecting the cultural importance of the Reservoir as a recreational resource for local and regional populations (BirdLife International, 2024). The site's ecological importance, recognized through its designation as an Important Bird and Biodiversity Area and Key Biodiversity Area, also generates indirect cultural value through its potential for birdwatching and ecotourism, which remain largely undeveloped. The combination of provisioning, regulating and cultural services provided by the Reservoir makes it a strategically significant natural asset for the Turkestan Region, the economic and social value of which is closely dependent on the maintenance of adequate water quality and a sufficiently stable hydrological regime, both of which are subject to increasing pressure from upstream water

management decisions, climate change impacts on Tien Shan glacier melt, and agricultural water demand (CDRI, 2025; Rivers.Help, 2025).

In addition, the Steppe grassland and other grazed and farmed areas within and adjacent to the RoW provide numerous provisioning services that are of local importance to the communities.

On this basis, therefore, although there are other services provided by the local habitats, given the trans-national benefits derived from the Reservoir, ecosystem services are taken forward as a receptor within the impact assessment.

7.4.7 Summary of ecological receptors

The important or most sensitive or vulnerable sites, habitats and species that are relevant to the impact assessment are presented in Table 75.

Table 75: The most sensitive and vulnerable protected areas, habitats and species relevant to the impact assessment.

Biodiversity Receptor	Value/sensitivity	Reason for selection
Shadara Reservoir IBA/KBA	International	Internationally recognized area (IBA/KBA) and the Project passes through its eastern end .
Natural Habitat	National	Natural Habitat within Reservoir (various wetland habitats)
Dalmatian pelican	International	IBA citation species
Pygmy cormorant	International	Bird of importance
Wintering bird assemblage	International	Assemblage of international importance due to diversity of species and abundance of each species.
Migratory bird assemblage	International	Assemblage of international importance due to diversity of species and abundance of each species.
Breeding bird assemblage	National	Breeding bird assemblage within IBA unrecorded previously and of national importance.
Raptor and vulture population	International	Includes species of Endangered status such as Steppe Eagle (EN)
Other bird species	National	Includes species such as Little Bustard and Yellow-eyed Pigeon
IUCN and Kazak Red-Listed Flora	National	Four species of tulip all Near Threatened, one species of Eminium listed in the Kazak RDB
IUCN Red-Listed Mammals	National	Two species of mammals, both Vulnerable
IUCN Red-Listed Reptiles	National	Includes Central Asian Tortoise (VU)
IUCN Red-Listed Fish	International	Includes Syr-Darya Shovelnose Sturgeon (CR)
IUCN Red-Listed Invertebrates	National	Two species of Odonata, includes Waved pincertail (VU)
Invasive species	International	Considered as threat to biodiversity
Ecosystem services	International	Considered given degree of reliance of local population on services provided by Reservoir

7.5 Socio-Economic Environment

7.5.1 Administrative Setting

Republic of Kazakhstan. The Republic of Kazakhstan is a unitary, presidential republic, divided administratively into 17 regions (oblasts) and three cities of republican significance (Astana, Almaty, and Shymkent). Each region is administered by an Akimat (regional government) headed by an Akim appointed by the President of the Republic. Regions are subdivided into districts (rayons), each headed by a District Akim, and into cities of regional and district significance. The lowest level of administrative-territorial organization comprises rural districts and rural settlements (auls / villages). Local self-governance is exercised through Maslikhats (local representative councils) at regional, district, city, and settlement levels, alongside the Akimat hierarchy.

Turkistan Region. The Project corridor lies entirely within Turkistan Region (Turkestan Oblast), in the south of the Republic. Turkistan Region borders Karaganda Region to the north, Kyzylorda Region to the west, Zhambyl Region to the east, and shares an international border with the Republic of Uzbekistan to the south. The Syr Darya River traverses the region (cross-reference Section 7.3.6). The total area of the region is approximately 116,280 km² (since July 2018 [20]), corresponding to approximately 4.3% of the territory of the Republic of Kazakhstan. The region is administered from the City of Turkistan, which became the regional administrative center in June 2018 following the elevation of Shymkent to a city of republican significance and its withdrawal from the Region. The Region comprises districts — Baidibek, Kazygurt, Maktaaral, Ordabasy, Otyrar, Sairam, Saryagash, Sauran, Suzak, Tolebi, Tyulkubas, Zhetysay, Shardara, and Keles — and three cities of regional significance (Arys, Kentau, and Turkistan), as well as four cities of district significance and 794 villages[21].

Project-affected districts. The Project alignment traverses five (5) of the fourteen (14) districts of Turkistan Region: Saryagash, Keles, Shardara, Zhetysay, and Maktaaral, ordered from north to south along the alignment (further detail in Table 47, Section 7.2.1). The original Project ESIA draft, prepared on the basis of an earlier and shorter alignment terminating at approximately km post 103, identified only Saryagash and Keles as the affected districts; the current 115 km surveyed alignment additionally traverses Shardara, Zhetysay, and Maktaaral districts, reflecting the southward extension of the alignment into the Mirzachoel irrigated cotton-producing zone and the approach to the international border with Uzbekistan. Each affected district is administered by its respective District Akimat and Maslikhat. Sub-district structures relevant to land acquisition, public consultation, and grievance redress — in particular the rural districts (selsovets) and individual settlements traversed by the alignment — are listed in the LARP and are reflected in the project Stakeholder Engagement Plan.

Settlements along the corridor. Data on settlements was collected from information available on the websites of the Turkestan Region Akimat, as well as the websites of the relevant district Akimats and maslikhats.

Saryagash District - established in 1939. The administrative centre of the district and principal urban centre is Saryagash City, located adjacent to the railroad corridor. Keles District - established in 1928. The administrative centre of Keles District is the village of Abai. Shardara District - established in 1969. The district covers an area of 13,000 km², and the administrative center is Shardara City. Maktaaral District - established in 1939, later incorporated into Maktaaral District and separated again in 2018. The administrative center of the district is Myrzakent.

[20] Resolution of the Government of the Republic of Kazakhstan dated 17 July 2018 No. 431 "On Establishing the Boundary of Turkestan Region"; https://adilet.zan.kz/rus/docs/P1800000431

[21] Administrative-Territorial Units of the Republic of Kazakhstan (as of the 1 January 2026), Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan;
https://stat.gov.kz/ru/industries/social-statistics/demography/publications/476642/

Within Shardara District, the Project corridor passes only through a section of the Shardara Reservoir area, with no nearby communities identified within the Project impact area. Information was collected from a total of 13 rural okrugs and settlements located along or near the railroad alignment in four districts, including Darbaza, Kurkeles, Tegisshil, Birtilek, Oshakty, Birlik (Keles), Sh. Dildabekov, Zhyly Su, Yntymak, Kazybek Bi, Birlik (Maktaaral), Maktaaral Okrug, and Atakent settlement. The Maktaaral Okrug passport additionally includes sub-passports for 16 settlements: Bereke, Kokaral, Tulpar, Madeniet, Bakhyt, Shattyk, Orkeniet, Akaltyn, Al-Farabi, El-Konys, Amangeldy, Igilik, Esentaev, Zhuldyz, Engbekshi, and Azattyk. The Zhyly Su passport similarly includes settlement-level information for Zhyly Su, Baikonys, Al-Farabi, Seifullin, Myrzashoky, and Bakkonys settlements.

The Project area is predominantly rural in character, with livelihoods strongly dependent on irrigated agriculture, livestock breeding, agricultural processing, and small-scale commerce. Atakent is the only predominantly urban settlement identified within the study area.

The socio-economic baseline for the Project was developed using a combination of official statistical information and community-level administrative data. District-level demographic, economic, labour, agricultural, and social indicators were primarily obtained from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and other official regional and district-level statistical sources.

To complement the regional- and district-level statistics and provide a more detailed understanding of conditions within the immediate Project Area of Influence, the ESIA team additionally collected and reviewed the most recent available community passports prepared by local Akimat administrations for settlements located along the proposed railway alignment. These included information from a total of 13 rural okrugs and settlements and, where available, associated settlement-level sub-passports. The assessment was based primarily on the most recent data available at the time of preparation of the ESIA, with most datasets reflecting 2025 or 2026 information. In some cases, however, the latest available official information was limited to 2024 or 2023 data, which is referenced accordingly throughout the report.

These community-level data are used to distinguish conditions within the immediate Project Area of Influence from broader district- and regional-level socioeconomic trends and to identify locally sensitive receptors relevant to the impact assessment in Chapter 8.

The community-level materials provided supplementary information on population characteristics, livelihoods, land use, social infrastructure, utilities, local development priorities, and community-specific conditions relevant to the assessment of Project-related environmental and social impacts. Where relevant, the analysis was also supplemented by socioeconomic information collected during the census and survey of PAPs undertaken as part of the LARP preparation process, in order to support the assessment of local livelihood (Section 7.5.6) conditions, household characteristics, vulnerability aspects, and Project-related social risks and impacts within affected communities.

7.5.2 Population and Demography

Regional population. Turkistan Region is one of the most populous regions of the Republic of Kazakhstan. The total resident population of the Region was approximately 2,146,000 people as of 1 April 2026 (Bureau of National Statistics, 2026), comprising approximately 541,100 urban residents (25.4%) and 1,601,600 rural residents (74.6%). The dominant centers of population are the Region's three cities (Arys, Kentau, and Turkistan), the cities of regional significance (notably Saryagash City), and the dense rural settlement of the irrigated southern districts.

District-level population. The five Project-affected districts together host approximately 0.77 million residents in 2025, with Saryagash District representing the largest district population (223,000 persons), followed by Zhetysay District (182,800 persons). Keles, Shardara, and Maktaaral districts host populations of approximately 131,000, 103,800, and 127,400 persons respectively. Key

demographic indicators for the five Project-affected districts are summarized in Table 76 and the analysis is presented further in this section.

Table 76: Population Indicators in Project-Affected Districts (2025)

Indicator	Saryagash	Keles	Shardara	Zhetysay	Maktaaral
Resident population (thousand persons)	223.0	131.0	103.8	182.8	127.4
Births (persons)	5,123	3,078	1,766	3,927	2,800
Deaths (persons)	1,022	584	599	817	609
Natural increase (persons)	4,101	2,494	1,167	3,110	2,191
Marriages (number)	1,122	625	441	929	634
Divorces (number)	268	129	111	200	122
Net migration balance (persons)	-4,964	-4,331	-2,808	-6,111	-3,840

Indicator	Saryagash	Keles	Shardara	Zhetysay	Maktaaral
Resident population (thousand persons)	223.0	131.0	103.8	182.8	127.4
Births (persons)	5,123	3,078	1,766	3,927	2,800
Deaths (persons)	1,022	584	599	817	609
Natural increase (persons)	4,101	2,494	1,167	3,110	2,191
Marriages (number)	1,122	625	441	929	634

Indicator	Saryagash	Keles	Shardara	Zhetysay	Maktaaral
Divorces (number)	268	129	111	200	122
Net migration balance (persons)	-4,964	-4,331	-2,808	-6,111	-3,840

Sources: *Bureau of National Statistics, 2025.*

All five districts demonstrate positive natural population growth, reflecting the comparatively young demographic structure characteristic of southern Kazakhstan. This natural population growth occurs despite negative net migration across all five Project districts. The demographic baseline therefore indicates communities characterized by relatively high natural population growth but continued outward migration, a pattern relevant to the availability of local labor, household livelihood strategies and the potential importance of Project-related employment opportunities.

Settlement-level population. According to the information collected for 13 rural okrugs located in project area, the total population of the assessed communities is approximately 194,000 persons. Several communities include multiple smaller settlements and villages dispersed across large agricultural territories. Larger settlements include Kurkeles (29,525 persons), Birtilek (22,645 persons), Atakent (19,098 persons), Maktaral okrug (18,385 persons), Kazybek bi (18,124 persons), and Oshakty (16,973 persons). Population data for the 13 rural okrugs is summarized in Table 77.

Table 77: Communities within the Project Area of Influence

Community	District	Population	Households
Darbaza	Saryagash	8,252	1,273
Kurkeles	Saryagash	29,525	4,768
Tegisshil	Saryagash	7,313	1,416
Birtilek	Keles	22,645	3,002
Oshakty	Keles	16,973	2,340 dwellings / 3,178 families
Birlik (Keles)	Keles	5,759	871
Sh. Dildabekov	Zhetysay	12,728	1,889
Zhyly su	Zhetysay	13,344–14,644	2,017–2,514
Yntymak	Zhetysay	14,016	Not stated
Kazybek bi	Zhetysay	18,124	2,415
Birlik (Maktaaral)	Maktaaral	10,174	1,564

Maktaral okrug	Maktaaral	18,385	2,765
Atakent	Maktaaral	19,098	1,181 dwellings

Source: Bureau of National Statistics, 2025.

Ethnic composition. Turkistan Region is multi-ethnic in composition. Based on data reported for 2019 (Akimat of Turkistan Region, 2020), the population of the Region comprises approximately 76.0% ethnic Kazakhs, 17.1% ethnic Uzbeks (the highest concentration of ethnic Uzbeks in Kazakhstan, reflecting historical and trans-border cultural connections with the Republic of Uzbekistan), 1.9% ethnic Russians, 1.9% ethnic Tajiks, 0.9% ethnic Azerbaijanis, 0.8% ethnic Turks, 0.4% ethnic Tatars, and approximately 1.2% other ethnic groups across more than 40 nationalities present in the Region.

A review of the community passports collected for the 13 rural okrugs and settlements located within or near the Project Area of Influence indicates that the Project area is also predominantly ethnic Kazakh; however, several communities demonstrate considerable ethnic diversity, particularly within Zhetysay and Maktaaral districts. Significant Tajik, Uzbek, Azeri, Persian, Russian, Korean, Turkish, and other minority populations are present within the Project area.

7.5.7Maktaaral Okrug was identified as the most ethnically diverse community within the reviewed settlements, with Kazakhs representing approximately 48.6% of the population, followed by Tajik (28.3%), Azeri (7.6%), Persian (6.4%), and Uzbek (4.3%) populations. Atakent settlement also demonstrates substantial ethnic diversity, with 36 ethnic groups documented in the community passport.

Several communities contain concentrated ethnic minority populations at the sub-settlement level. For example, Al-Farabi village within Zhyly Su Okrug contains a predominantly Tajik population, while Kokaral settlement within Maktaaral Okrug also demonstrates a high proportion of Tajik residents. Other communities, including Kurkeles, Birtilek, Sh. Dildabekov, and Zhyly Su, similarly include notable minority populations, primarily represented by Tajik, Uzbek, Azeri, and Turkish households.

While the broader Project Area of Influence demonstrates considerable ethnic diversity, the census and socio-economic survey undertaken for the LARP identified a significantly less diverse profile among directly affected households. Based on information collected from 314 PAPs during the census and socio-economic survey process, all affected persons except one household identified themselves as ethnically Kazakh, while one respondent identified as Azeri. No respondents indicated that they consider themselves disadvantaged or marginalized due to their ethnic background. Kazakhs constitute the native local population, while other ethnic groups present within the wider Project area have been settled in the region for many years and generally have equal access to institutions, land, services, and economic opportunities.

7.5.3 Economy, Employment and Livelihoods

Regional economy. The economy of Turkistan Region is structurally dominated by primary-sector activity — in particular, irrigated agriculture in the southern districts (cotton in Zhetysay and Maktaaral; vegetable crops, fruits, and orchards in Saryagash, Keles, and the more northerly parts of the corridor) and extensive livestock grazing across the steppe of Saryagash, Keles, and Shardara districts — supplemented by small-scale agro-industry, services, and (regionally) the oil-refining and metallurgical activities concentrated in Shymkent (now a city of republican significance, separately administered). The Region's industrial base outside Shymkent is limited; large stationary industrial facilities are not present along the Project corridor itself. Recent economic data indicate that gross agricultural output in Maktaaral District alone reached approximately 76.5 billion tenge in the first ten months of 2024, with cotton planted on approximately 33,700 hectares (out of a district total of approximately 60,600 hectares of crops in 2024); the southern Mirzachoel cluster of Maktaaral and Zhetysay districts collectively accounts for approximately 80,000–85,000 hectares of cotton annually,

representing a substantial proportion of national cotton output (Bureau of National Statistics, 2025; Akimat of Turkistan Region, 2025).

Project area economy and livelihoods. The economy of the Project area is predominantly based on irrigated agriculture and livestock production. Agricultural activities constitute the principal economic sector across all five Project-affected districts, with agricultural gross output in 2025 ranging from approximately KZT 71.7 billion in Shardara District to KZT 137.2 billion in Saryagash District. Key sectoral economic indicators for the Project-affected districts are presented in Table 78 below.

Table 78: Sectoral Economic Indicators (2025)

Indicator	Saryagash	Keles	Shardara	Zhetysay	Maktaaral
Agriculture gross output (KZT million)	137,179.8	85,152.3	71,699.6	119,472.9	85,719.9
Industrial production (KZT million)	30,466	7,125	26,210	24,686	24,562
Mining output (KZT million)	104	11	n/a	n/a	n/a
Manufacturing output (KZT million)	18,572	3,193	19,204	19,499	20,142
Light industry (KZT million)	66	11	4,334	18,344	19,079
Construction works/services (KZT million)	55,776	19,283	27,131	22,472	27,804
Retail trade (KZT million)	78,230.7	16,057.0	8,336.4	40,111.2	11,872.4
Wholesale trade (KZT million)	57,766.1	14,669.1	615.5	60,497.1	15,726.8

Source: Bureau of National Statistics, 2025.

Direct district-level employment-by-sector statistics for 2025 are not yet published by BNS; sectoral economic output is presented as a proxy for sectoral importance to the local economy.

The structural pattern of district economies in 2025 confirms the predominance of agriculture across the Project corridor and a comparatively more diversified economic structure in Saryagash district. Agricultural gross output substantially exceeds industrial production across all five Project-affected districts, reflecting the predominantly rural and agriculture-oriented economic profile of the corridor area. Agriculture therefore represents the principal economic sector and livelihood source for a substantial proportion of the population within the Project Area of Influence.

The southern section of the corridor, particularly within Zhetysay and Maktaaral districts, demonstrates strong dependence on irrigated agriculture and cotton cultivation. Cotton represents the dominant cash crop within the southern districts, supported by extensive irrigation infrastructure and associated agricultural-service activities. Community-level information indicates the presence of multiple cotton-receiving stations, large irrigated cropland areas, and extensive canal systems serving agricultural production. These baseline conditions indicate a high degree of livelihood dependence on irrigation infrastructure and uninterrupted access to agricultural land.

The northern section of the alignment, particularly within Saryagash and Keles districts, demonstrates a livestock-and-mixed-arable agricultural profile characterized by extensive pasture use and sheep breeding. Livestock production therefore represents an additional important component of rural livelihoods within the northern part of the corridor.

Industrial production remains comparatively limited relative to agriculture and trade across most Project-affected districts, indicating relatively low diversification of the regional economy. Manufacturing activity is concentrated primarily in food production, beverages, rubber and plastics, non-metallic mineral products, and, in Shardara and Maktaaral districts, electricity, gas, and steam supply activities. Light industry output remains comparatively limited in absolute terms across most districts, although comparatively higher values are reported in Zhetysay and Maktaaral districts.

Trade and small business activity additionally represent important components of the corridor economy. Retail trade volumes are highest in Saryagash district, consistent with its comparatively large population and commercial role within Turkistan Region. Wholesale trade activity is concentrated in Saryagash and Zhetysay districts, reflecting their role as cross-border and regional commercial hubs associated with agricultural trade flows and proximity to Uzbekistan. These characteristics indicate the importance of transport connectivity and uninterrupted freight movement for the regional economy.

Construction volumes remain comparatively significant in Saryagash, Shardara, and Maktaaral districts, reflecting ongoing infrastructure, housing, and regional development activity. At the same time, the absence of published district-level cargo and passenger transport indicators limits quantitative assessment of transport-sector activity within the Project corridor.

The socio-economic survey undertaken as part of the LARP preparation further confirms the predominantly rural and agriculture-based character of livelihoods within the Project area. Among affected household heads, self-employment in agriculture represents the dominant occupational category, reported by 120 household heads (48.0%), followed by retired persons accounting for 114 household heads (45.6%), many of whom continue participation in agricultural and family-based livelihood activities. Among economically active employed respondents, agricultural self-employment accounts for approximately 63.6% of all employed persons. The findings indicate relatively limited formal employment opportunities within the Project area and continued dependence of affected households on agriculture, informal economic activities, and diversified household income strategies involving multiple income earners.

Regional revenue and fiscal dependency. Total revenue of Turkistan Region was reported at approximately 1.48 trillion tenge in 2024–2025, of which approximately 82.9% was derived from State transfers from the central budget; only approximately 13% (192.2 billion tenge) was generated as own-source tax revenue. This dependency on State transfers reflects the limited regional industrial and commercial tax base. Approximately 52.5% of total budget expenditure is allocated to education, with the remainder distributed across health, social protection, infrastructure, agriculture, and general administration. Per-capita tax collection is unevenly distributed across the 13 districts of the Region: among the five Project-affected districts, Shardara District is among the higher-collecting (approximately 56,000 tenge per capita), while Keles, Maktaaral, and Zhetysay are among the lowest-collecting (approximately 25,600–31,500 tenge per capita) (EconomyKZ, 2025).

The comparatively limited own-source revenue base and continued dependence on agriculture and State transfers indicate the importance of transport connectivity and infrastructure investment for regional economic development, while also reflecting comparatively limited economic resilience within several Project-affected districts.

Employment. The economically active population of Turkistan Region was reported at approximately 842,296 people in 2023. Of these, approximately 800,598 were employed (approximately 427,250 in formal employment as employees, and approximately 373,348 self-employed); approximately 487,132 people were classified as economically inactive, and approximately 41,698 were registered as unemployed.

Available district-level labour market statistics indicate that the economy of the Project-affected districts remains strongly dependent on self-employment, agriculture, and informal economic

activities. Across all five Project-affected districts, self-employed workers account for a substantial proportion of the employed population, ranging from approximately 41.9% in Shardara district to 52.3% in Keles district. This labour profile reflects the predominantly rural and agriculture-oriented character of the regional economy and the continuing importance of family-based and small-scale economic activities within Turkistan Region.

Official unemployment rates reported by the Bureau of National Statistics remain relatively stable across the Project-affected districts at approximately 4.9-5.0%, while youth unemployment rates range from 0.8% in Maktaaral district to 2.5% in Saryagash district. At the same time, the districts demonstrate a comparatively large economically inactive population outside the formal labour force, particularly in Saryagash, Zhetysay, and Maktaaral districts. This group includes retired persons, homemakers, students, seasonal workers, and other economically inactive population groups not formally reflected within employment statistics.

Labour market indicators for the region and for Project-affected districts are presented in Table 79.

Table 79: Labour Market Indicators in Project-Affected Districts (2023)

Indicator	Saryagash	Keles	Shardara	Zhetysay	Maktaaral	Region total
Hired workers (persons)	43,172	25,387	18,479	36,694	24,412	427,250
Self-employed (persons)	36,586	27,794	13,346	36,115	22,050	373,348
Unemployed (persons)	4,148	2,766	1,691	3,838	2,470	41,698
Unemployment rate (%)	4.9	4.9	5.0	5.0	5.0	5.0
Youth unemployment rate, 15-34 (%)	2.5	0.9	1.8	1.8	0.8	2.8
Outside labour force (persons)	48,939	26,119	18,551	38,321	33,267	487,132

Source: Bureau of National Statistics, "Indicators of the labour market by districts of Turkistan Region" (2014-2023 panel). The latest published district-level labour market statistics available from BNS are for 2023; district-level labour-force survey data for 2024-2025 were not yet published at the time of preparation of this ESIA.

Community-level information further confirms the strong dependence of the Project area on agriculture-based livelihoods and self-employment. The southern section of the corridor, particularly within Zhetysay and Maktaaral districts, is heavily dependent on irrigated agriculture and cotton production. Community passports document extensive agricultural activity supported by irrigation systems, peasant farms, cotton-processing facilities, and cotton-receiving stations. Dildabekov community reports 861 peasant farms and six cotton-receiving stations, Yntymak reports 952 peasant farms and five cotton-receiving points, while Maktaral okrug reports 1,252 peasant farms and approximately 6,578 hectares of cotton cultivation. Kazybek bi community additionally reports one cotton-processing plant and nine cotton-receiving points.

The northern section of the corridor, particularly within Saryagash and Keles districts, demonstrates a livestock-and-mixed-arable agricultural profile characterized by extensive pasture use and sheep breeding. Birlik (Keles) community reports approximately 83,376 sheep and more than 85,000 hectares of pastureland, while Darbaza and Oshakty communities report approximately 65,492 and

41,307 sheep respectively. Community passports additionally indicate the importance of small-scale trade and local service activities, including shops, cafés, hairdressers, agricultural services, and local commercial enterprises.

The livelihood baseline therefore varies materially along the corridor. In the northern section, livestock grazing and mixed agricultural production are particularly important, while the southern section is characterized by intensive irrigated crop production and associated cotton-processing and collection activities. Project effects on agricultural access, irrigation infrastructure, livestock movement and land connectivity may consequently affect communities differently depending on their location and livelihood system.

The reviewed community passports additionally indicate relatively limited large industrial employers within the corridor area and continued dependence on informal and family-based economic activities. Community-level information from Oshakty specifically notes high self-employment levels, with 2,622 self-employed persons reported within the community. The findings confirm the importance of agriculture, livestock breeding, agricultural processing, trade, and informal economic activities as the principal livelihood sources within the Project area.

The LARP socio-economic survey also supports the information on predominance of agriculture-based and self-employed livelihoods within the immediate Project area. Among affected household heads, self-employment in agriculture represents the dominant occupational category, reported by 120 household heads (48.0%), while among the economically active employed population, agricultural self-employment accounts for approximately 63.6% of employed persons. The survey additionally indicates relatively limited formal employment opportunities within the Project area, with livelihoods concentrated primarily in agriculture, informal economic activities, state-budget employment, and retirement income. Among adult household members, employment in state or budget institutions accounts for 91 persons (7.91%), while unregistered unemployed persons not actively seeking employment account for 153 persons (13.29%), predominantly represented by women engaged in unpaid domestic responsibilities and household activities.

The LARP socioeconomic survey further demonstrates the importance of land-based livelihoods to directly affected households. Agriculture and livestock were reported as a source of household income by approximately 74% of surveyed affected households with income data. Household livelihood strategies are commonly diversified, with agricultural income frequently supplemented by pensions, social allowances, salaried employment and other forms of self-employment.

Wages and household incomes. Wage levels within Turkistan Region demonstrate substantial variation between economic sectors and districts, reflecting differences in economic productivity and the predominantly agriculture-oriented structure of the regional economy. Sectoral wage statistics indicate that the highest average monthly nominal wages are reported in health and social services (approximately 465,020 KZT), followed by agriculture, forestry and fishing (approximately 281,898 KZT), finance and insurance activities (approximately 249,402 KZT), construction (approximately 236,040 KZT), transport and storage (approximately 235,378 KZT), and information and communication (approximately 232,209 KZT). The comparatively lower wage levels associated with agriculture and rural economic activities are relevant to the Project corridor, where livelihoods remain strongly linked to agriculture, self-employment, and small-scale economic activities. Sectoral wage indicators for Turkistan Region are presented in Table 80 below.

Table 80: Average Monthly Nominal Wages by Economic Sector in Turkistan Region

Economic Sector	Average Monthly Nominal Wage (KZT)
Health and social services	465,020

Agriculture, forestry and fishing	281,898
Finance and insurance activities	249,402
Construction	236,040
Transport and storage	235,378
Information and communication	232,209

Source: Bureau of National Statistics, socio-economic indicators of Turkistan Region, 2023.

District-level wage statistics additionally indicate comparatively lower wage levels across several Project-affected districts compared to the regional average. Average monthly nominal wages within the Project-affected districts range from approximately 221,289 KZT in Shardara district and 223,779 KZT in Saryagash district to approximately 235,378 KZT in Zhetysay district, 246,951 KZT in Keles district, and 249,402 KZT in Maktaaral district, against a regional average of approximately 270,660 KZT. The comparatively lower wage profile of several Project-affected districts is consistent with the predominance of agriculture, self-employment, small-scale trade, and other lower-wage rural economic activities within the corridor area. District-level wage indicators for the Project-affected districts are presented in Table 81.

Table 81: Average Monthly Nominal Wages in Project-Affected Districts

Economic Sector	**Average Monthly Nominal Wage (KZT)**
Health and social services	465,020
Agriculture, forestry and fishing	281,898
Finance and insurance activities	249,402
Construction	236,040
Transport and storage	235,378
Information and communication	232,209

Source: Bureau of National Statistics, district-level labour and wage statistics for Turkistan Region, 2023.

The socio-economic survey undertaken as part of the LARP preparation further confirms the relatively moderate income profile and predominantly agriculture-based livelihood structure within the immediate Project area. Among 278 surveyed households with available income data, the average reported monthly household income was approximately 287,860 KZT, with the majority of households (71.58%) reporting monthly income within the 200,001-300,000 KZT range. The findings indicate a comparatively concentrated household income distribution largely associated with agriculture and related rural economic activities.

The survey additionally confirms the importance of diversified and combined livelihood strategies among affected households. Agriculture and livestock activities represent the dominant source of income, reported by 201 households (72.30% of households with income data), followed by pension income reported by 141 households (50.72%), social allowances reported by 75 households (26.98%), and salary employment reported by 59 households (21.22%). The findings indicate continued

dependence of affected households on combined income sources, particularly agriculture, pensions, social support mechanisms, and informal or self-employed economic activities.

The survey additionally identified the presence of outstanding loans or credit obligations among 31 surveyed households (10.73% of households providing expenditure information), primarily associated with productive or livelihood-related investments including vehicles and agricultural machinery. The findings indicate that temporary livelihood disruption associated with Project implementation may have increased significance for households with ongoing credit obligations and limited income diversification.

Poverty, social assistance and economic vulnerability. The poverty profile of the Project Area of Influence was assessed based on official statistics published by the Bureau of National Statistics of the Republic of Kazakhstan, including indicators on the population with incomes below the subsistence minimum, poverty depth, and receipt of Targeted Social Assistance. The analysis was supplemented by information from community passports and the LARP socio-economic survey of affected households.

The poverty depth in Turkistan Region was reported at 1.1% in 2025. The proportion of the population with incomes below the subsistence minimum was approximately 5.0 % nationally in Q4 2025 – the number did not change since 2024. In the meantime, the proportion of the population with incomes below the subsistence minimum in the regions of Kazakhstan is highest in Turkistan Region, reaching 8.7%, including approximately 23,492 households composed of 187,162 persons. Of these, 0.1% (382 households comprising 3,053 persons) have income below the cost of the food basket.

The official subsistence minimum represents the estimated minimum cost of food and essential non-food goods and services and is commonly used as a reference indicator for poverty assessment, social assistance eligibility, and minimum household consumption requirements. According to the Law "On Republican Budget for 2026-2028" No. 239-VIII ZRK dated 8 December 2025, the monthly minimum salary for 2026 is 85,000 KZT, and the subsistence minimum used for calculation of social payments is 50,851 KZT; the minimum pension is 69,049 KZT.

While urban poverty in Turkistan Region reaches 5.1% (the second highest level among the regions of Kazakhstan after East Kazakhstan Region with 5.6%), rural poverty reaches 10.0% (again the second highest in the country following Mangystau Region with 10.7%). Available statistics further indicate that households with incomes below the subsistence minimum, including those below the food basket threshold, are predominantly composed of five or more household members. It should be noted that while the population with income below the subsistence minimum increased from 8.5% in 2024, there has been a decrease from levels observed between 2018-2023, when poverty indicators ranged from approximately 9.0% to 12.2% (similar patterns are observed for both urban and rural populations).

Targeted Social Assistance (TSA) in Kazakhstan represents a means-tested social support mechanism provided to households with per-capita income below the officially established poverty threshold. Eligibility for assistance applies to citizens of Kazakhstan, refugees, stateless persons permanently residing in the country, and ethnic returnees whose average per-capita household income falls below the poverty line. The mechanism is intended to support vulnerable low-income households through direct financial assistance and is commonly used as one of the indicators of household economic vulnerability within social assessments and livelihood restoration planning[22].

Available regional statistics for 2025 indicate substantial dependence on State social support mechanisms within Turkistan Region and comparatively elevated levels of economic vulnerability among rural households. According to a UNICEF-supported assessment of the social protection system in Turkistan Region, approximately 94,750 persons in the region receive TSA, while the estimated poor

[22] https://www.gov.kz/situations/11/56?lang=ru

population is reported at approximately 245,600 persons. The report also confirms that Turkistan Region ranks first nationally in the number of TSA recipients.

Regional statistics additionally indicate a high number of households dependent on family- and child-related social support mechanisms. Approximately 119,550 large families receive monthly State allowances within Turkistan Region, representing the highest number nationally due to large population. In addition, approximately 24,706 persons receive childcare allowance for children aged 1-1.5 years, while approximately 21,680 persons receive survivor's benefits.[23]

The reviewed community passports also identify substantial populations of pensioners, persons with disabilities, and multi-child households across the Project area. Higher concentrations of pensioners and persons with disabilities are reported in Yntymak, Kazybek bi, Maktaral okrug, and Atakent settlements.

The findings of the LARP socio-economic survey similarly indicate the presence of vulnerable households among the directly affected population. The eligibility criteria applied under the LARP, vulnerable households include low-income households, households with disabled members, large families with four or more children under 18 years old, elderly persons without family support, and woman-led households. Although no affected households were identified with incomes below the subsistence minimum during the survey, the SES identified 92 vulnerable households among affected households. This included 6 households with disabled members, 42 households with four or more children under 18 years old, 7 households composed of elderly persons without family support, and 37 woman-led households (a few households . A number of households met more than one vulnerability criterion; however, they were counted only once in the total number of vulnerable households to avoid double counting. As the SES relied primarily on self-reported information provided during interviews and did not include full documentary verification of vulnerability status, the eligibility and vulnerability status of PAPs will require further verification during LARP implementation. Further information regarding the identification and profile of vulnerable groups within the Project Area of Influence and among affected households is provided in Section 7.5.7.

Livelihood characteristics relevant to Project impacts. Agriculture and livestock production represent the dominant livelihood activities within the Project corridor. Land use and livelihood patterns vary across the affected districts, with greater reliance on pasture-based livestock activities in Saryagash and Keles districts and irrigated agriculture in Zhetysay and Maktaaral districts, where irrigated land is used predominantly for cotton cultivation. Findings from the LARP socio-economic survey indicate that 40 affected households reported ownership of livestock, including cattle, sheep, goats, horses. The survey also confirmed the importance of irrigated agriculture for affected households, particularly in Zhetysay and Maktaaral districts. During the census and socio-economic survey, 141 APs reported concerns regarding interruption of irrigation water supply and associated impacts on agricultural production. Similar concerns regarding irrigation infrastructure, irrigation water supply, and potential impacts on agricultural productivity were also raised during public consultations. Although parts of the Project corridor are located in proximity to the Shardara Reservoir, no fishing communities or households primarily dependent on fisheries were identified during the socio-economic survey or stakeholder engagement process.

Migration patterns. All Project-affected districts demonstrate negative migration balances, with outward migration particularly pronounced in Zhetysay and Saryagash districts. The combination of limited high-wage employment opportunities within Turkistan Region and higher wages in larger economic centers of Kazakhstan and abroad contributes to substantial out-migration of the working-age population from the corridor area. Migration is predominantly associated with employment-related mobility, including seasonal and longer-term labour migration to Astana, Almaty, Shymkent, the western oil-and-gas regions of Kazakhstan, and, to a lesser extent, abroad. Out-migration is

[23] https://www.unicef.org/kazakhstan/media/14291/file/02_SEP_Turkestan_RU_fin.pdf.pdf

reported to occur predominantly among working-age men engaged in construction, oil-and-gas, transport, trade, and service-sector employment, with remittances and other forms of financial support representing an important supplementary income source for some rural households. Labour migration patterns may also influence household composition and may contribute to increased economic and caregiving responsibilities among women, elderly household members, and extended families remaining in rural communities.

Findings from the LARP socio-economic survey indicate comparatively limited labour migration among directly affected households. Thirteen affected households reported having family members working outside Turkistan Region, representing approximately 5.2% of households with completed socio-economic surveys. All identified migrant household members were reported to be 7.5.7residing in other regions of Kazakhstan, predominantly in Astana. Although respondents did not provide detailed information regarding the amount or frequency of remittances, affected households indicated that migrant family members provide financial and other forms of support to the household, including support for household expenditures and repairs. While migration does not represent a dominant livelihood strategy among affected households, the findings indicate that remittances represent a supplementary source of income for some affected households within the Project area. This information has been considered in the assessment of household socio-economic conditions and vulnerability.

7.5.4 Land Use and Land Tenure

Land use along the corridor. Land use along the corridor varies systematically along the north-south transect:

- **Saryagash and northern Keles districts (approximately KM 0–60):** intensively managed cultivation comprising small-scale arable plots and a high density of polytunnels (often heated, supporting multi-season cropping). Crops include short-rotation vegetables and salad crops (leafy vegetables, cabbage, onions, cucumbers, tomatoes), melons and watermelons, and orchard crops (apple, almond, cherry, and other fruits). High summer temperatures combined with adequate irrigation enable more than one crop per season on the same land. Cereals and cotton are not significant in this section. Cultivated areas are typically fenced to prevent grazing damage by free-roaming animals.
- **Southern Keles, Shardara, and parts of the corridor outside the irrigated zone:** extensive open-steppe rangeland used for free-range grazing of sheep, cattle, and horses. The vegetation is grass-dominated and seasonal, with green coverage in spring and early summer and bare to brown coverage in late summer and autumn. These areas are unfenced; pastoral land use is the dominant productive activity.
- **Zhetysay and Maktaaral districts (approximately KM 80–115):** intensively cultivated irrigated agricultural land in the Mirzachoel (“Hungry Steppe”) cluster, dominated by cotton (approximately 33,700 ha planted in Maktaaral District alone in 2024 within a total of approximately 60,600 ha of cropland; collectively the cluster supports 80,000–85,000 ha of cotton annually, including in adjacent districts). Irrigation is supplied through a dense engineered network of canals connected to the Syr Darya / Shardara system. Field sizes are small, supporting a high rural population density.
- **Settlement and built-up land:** compact rural settlements (auls / villages) embedded within the agricultural matrix throughout, plus the urban centre of Saryagash City and the smaller secondary urban centres of Zhetisay, Myrzakent, Asykata, Atakent, and Shardara.
- **Reservoir and water-body land:** the Shardara Reservoir and its margin in Shardara District, including state-owned land within the reservoir inundation zone, supporting reedbeds, salt-tolerant scrub, and seasonally inundated wetlands.

Land tenure. Land tenure within the Project corridor comprises a combination of privately owned land and long-term leased State land, with agricultural land overwhelmingly held under lease

arrangements. Based on the LARP analysis, leased land accounts for 323 affected plots (approximately 87% of all affected plots) and approximately 398 ha of affected land (approximately 95.5% of the total affected area), while privately owned land represents only 49 affected plots with approximately 18.8 ha affected. Private land ownership is concentrated primarily within Saryagash and Maktaaral districts and is mainly associated with residential and commercial plots, whereas agricultural and agricultural production land is predominantly leased from the State under long-term lease agreements issued by the relevant District Akimats in accordance with the Land Code of the Republic of Kazakhstan.

The tenure structure of the southern Project corridor, particularly within Zhetysay and Maktaaral districts, reflects the legacy of large-scale Soviet-era irrigation and agricultural development within the Mirzachoel cotton-producing zone, including field configuration and agricultural land-use patterns historically associated with former State and collective farm systems (kolkhoz / sovkhoz). The predominance of leased irrigated agricultural land within these districts additionally reflects the continued importance of large-scale agricultural production, particularly cotton cultivation and irrigated crop farming, within the regional economy.

Agricultural inputs and practices. Discussions with local farmers documented in the original Project ESIA draft indicate that chemical-fertilizer use is variable and in some areas limited, with reliance on organic inputs and crop rotations. Agrochemical use (pesticides, herbicides) is more extensive in the cotton-producing southern districts. The legacy of decades of intensive cotton production, including potential residues of organochlorine and organophosphate pesticides in soils, is flagged in Section 7.3.2 (soils) and Section 7.3.7 (groundwater) as a baseline issue requiring site-specific verification.

Project-affected land. The total number of land plots affected by Project land acquisition has evolved as the railway alignment has been refined and cadastral verification has progressed during Project preparation and EPC-stage design development. Based on the latest available land acquisition analysis, the Project affects a total of 371 land plots covering approximately 10,900 ha, of which approximately 417 ha are directly affected by permanent acquisition (approximately 3.8% of the total plot area). The highest number of affected plots is located within Zhetysay district (176 plots), followed by Maktaaral (84 plots), Keles (68 plots), and Saryagash (43 plots).

The affected plots are associated with 340 households and 32 legal entities, corresponding to 309 unique households and 23 unique legal entities after removal of duplication linked to multiple plot ownership/use. Land acquisition impacts are overwhelmingly concentrated on leased agricultural land, which accounts for 323 plots (approximately 87% of all affected plots) and approximately 398 ha of affected land (approximately 95.5% of the total affected area). Privately owned land represents only 49 plots with approximately 18.8 ha affected. Private land ownership is concentrated primarily within Saryagash and Maktaaral districts, while all affected plots in Zhetysay district are held under lease arrangements.

The affected land is predominantly agricultural in character. Agricultural plots account for 303 affected plots, while agricultural production plots account for an additional 25 plots. Residential plots (28 plots) and commercial plots (15 plots) represent a comparatively limited share of total impacts and are primarily associated with privately owned land. The predominance of leased agricultural land reflects the strongly agriculture-oriented land use pattern of the Project corridor, particularly within Zhetysay and Maktaaral districts where irrigated cotton and crop production dominate local livelihoods.

Table 82: Summary of Project-Affected Land

Indicator	Value
Total affected land plots	371
Total area of affected plots	~10,900 ha

Indicator	Value
Permanently acquired area	~417 ha
Share of total plot area acquired	~3.8%
Affected households (gross)	339
Affected legal entities (gross)	32
Unique affected households	308
Unique affected legal entities	23
Agricultural leasehold plots	323 plots (~398 ha; ~95.5% of affected area)
Privately owned plots	48 plots (~18.6 ha)

Predominant land-use types traversed. The Project corridor traverses three principal land-use zones. The northern section (approximately KM 0–60) passes through intensively managed irrigated agricultural land in Saryagash and northern Keles districts, characterized by polytunnel horticulture, open-field vegetable cultivation, orchards, and mixed farming. The central section crosses predominantly open-steppe rangeland in southern Keles and Shardara districts, where land use is dominated by livestock grazing and relatively sparse settlement. The southern section (approximately KM 80–115) traverses the intensively irrigated Mirzachoel agricultural area within Zhetysay and Maktaaral districts, where cotton cultivation, wheat production and other irrigated crops dominate land use and local livelihoods.

The Project corridor predominantly affects long-term leased agricultural land used for pasture, irrigated cotton cultivation, wheat production, and other agricultural activities. The LARP identifies 323 leased agricultural plots, comprising 298 plots leased by 274 households and 25 plots leased by 18 legal entities. Based on the SES findings, 242 agricultural respondents identified agriculture as their principal livelihood source, comprising 229 households and 13 legal entities. The sensitivity of affected agricultural land therefore depends not only on the area acquired, but also on the function of the affected land within the wider agricultural holding. The LARP residual-land assessment identified 61 irrigated agricultural plots where the residual area is 3 ha or less and fragmentation may affect continued agricultural usability, including 21 plots where the residual irrigated area is 1 ha or less. Relevant factors include fragmentation, altered access, interruption of irrigation or drainage connections, and access for agricultural machinery. These issues are particularly relevant in Zhetysay and Maktaaral districts, where irrigated agriculture is predominant and the availability of alternative agricultural land is limited.

The full plot-by-plot inventory of affected land, assessment of residual land usability, entitlement matrix, and implementation arrangements for compensation and livelihood restoration are presented in the Project Land Acquisition and Resettlement Plan (LARP), prepared in parallel with this Supplementary ESIA. This section is limited to establishing the land-use and livelihood context relevant to the environmental and social impact assessment; land acquisition, compensation, and resettlement impacts are assessed in detail in the LARP.

7.5.5 Infrastructure and Public Services

Transport infrastructure. The principal existing transport infrastructure relevant to the corridor comprises (i) the existing rail network of the Republic of Kazakhstan, with which the new Project alignment connects at the northern terminus near Darbaza in Saryagash District (the Project itself

extends national rail connectivity to the southern districts); (ii) the M-32 republican-significance road and the regional road network connecting the corridor districts to Shymkent and to the wider national road network; (iii) the dense network of district and rural-access roads serving individual settlements and agricultural areas; and (iv) public-transport services (intercity and intra-district bus services) operating on the road network. Construction-related haulage uses both the M-32 corridor and the local road network, with corresponding implications for local road conditions and traffic management. The Saryagash road border crossing with the Republic of Uzbekistan is an existing significant cross-border transport node within the AOI.

Community passport data additionally indicate that road infrastructure quality also varies significantly between settlements. Some communities contain comparatively extensive asphalt road networks, while others remain dependent on gravel or earth roads and continue to experience infrastructure deficiencies affecting connectivity and access to services and markets. For example, Darbaza reports approximately 20 km of asphalt roads, 19 km of gravel roads, and 4 km of earth roads, while Tegisshil reports approximately 59 km of asphalt roads and 7.3 km of gravel roads.

Existing railway infrastructure within the Project corridor is currently limited primarily to Darbaza and Kazybek bi communities. Darbaza contains an operational railway station together with the “51 razezd” railway siding settlement, while Kazybek bi contains approximately 3 km of railway infrastructure within the okrug territory. Kurkeles is located approximately 1.7 km from the nearest railway station. Large portions of Zhetysay and Maktaaral districts currently lack direct rail access, and the absence of railway infrastructure in the southern segment represents one of the principal drivers for the proposed Project.

Transport and local access. The Project corridor is served by a combination of national and district roads, local rural roads, agricultural tracks and informal access routes connecting settlements with agricultural land, grazing areas, irrigation infrastructure and neighboring communities. In rural sections of the corridor, these local routes perform an important socioeconomic function beyond general transport, providing access to fields and pastures, schools, healthcare facilities, markets and other community services. Maintaining connectivity across the railway corridor is therefore particularly important for communities and land users whose daily activities require movement between settlements and agricultural areas.

Energy supply. Electricity supply to the corridor is provided through the national grid; transmission and distribution lines are present throughout the corridor (in some sections, multiple parallel high-voltage transmission lines, as noted in the landscape baseline in Section 7.7). The Shardara Hydroelectric Power Station (100 MW; see Section 7.3.6) is a regionally significant generation asset on the Syr Darya. Natural gas supply is available through pipeline connections to most settlements; the Trans-Asia Gas Pipeline / Central Asia–China and the Turkmenabat–Omsk pipeline pass through the wider region (the latter providing context for the Region's transit role; not directly impacted by the Project). Solid-fuel heating (coal, wood, agricultural residues) remains in use in rural households during winter, contributing to seasonal air-quality conditions documented in Section 7.3.4

Community passport data additionally indicate that all communities reporting electricity access demonstrate near-universal household electricity coverage. Natural gas coverage varies substantially between communities. Darbaza reports comparatively low natural gas coverage (approximately 40%) together with incomplete drinking water coverage, while Tegisshil and Atakent report full natural gas coverage.

Water supply and sanitation. Centralized piped water supply is available in Saryagash City, the smaller urban centers of the southern districts, and in the larger rural settlements. Smaller rural settlements rely on a combination of community boreholes, private wells, and small-scale local supply networks abstracting from the shallow Quaternary alluvial aquifer (Section 7.3.7). Centralized sewerage is limited to the larger urban centers; on-site sanitation (septic tanks, pit latrines) is the predominant

solution in rural areas, with associated implications for groundwater protection in the irrigated southern districts where the water table is shallow.

Community passport data indicate that deficiencies in drinking water systems and local utility infrastructure remain among the principal infrastructure concerns across several settlements, particularly within Maktaraal okrug, where repair of drinking water systems and local roads was repeatedly identified as a priority issue.

Telecommunications. Mobile telecommunications coverage is widely available throughout the corridor, including in rural settlements. Fixed-line telephone services and broadband internet are concentrated in urban centers and larger settlements. The availability of mobile communications supports the operation of the Project's grievance redress mechanism and the EPC contractor's worker- and community-engagement arrangements.

Education. Educational infrastructure includes pre-school facilities (kindergartens), general secondary schools, and vocational education facilities distributed across rural settlements and concentrated in larger settlements. Tertiary education facilities are concentrated in Shymkent and the Region's larger cities.

All surveyed communities within the Project Area contain schools and pre-school facilities, although the scale of educational infrastructure varies considerably between settlements. Kurkeles represents the largest educational center among the surveyed Saryagash communities, with 15 schools, while Darbaza and Tegisshil report five and four schools respectively. Within Keles district, Oshakty reports nine schools and Birlik (Keles) reports three schools. In the southern section of the corridor, Maktaraal okrug reports seven schools and one college, while Atakent reports six schools.

Community-level information additionally indicates that larger settlements within Zhetysay district support comparatively extensive educational infrastructure. Dildabekov reports five secondary schools serving approximately 3,051 pupils and employing approximately 400 teachers, while Kazybek bi reports six schools serving approximately 3,694 pupils and employing approximately 514 teachers. Yntymak reports six secondary schools with approximately 2,829 pupils.

Regional data from the UNICEF-supported socio-economic profile additionally indicate continuing education-sector challenges within Turkistan Region, including comparatively low pre-school attendance, the continued operation of several three-shift schools, and comparatively weak reading outcomes among children relative to national averages.

Healthcare facilities. Healthcare infrastructure follows the standard Kazakhstan rural healthcare hierarchy: feldsher-midwife posts (FAPs) in smaller rural settlements, providing primary care including basic obstetric services; rural medical outposts and physician's offices in larger villages; District-level hospitals and polyclinics in District administrative centers; and specialist regional facilities in the Region's cities. Emergency services (fire, ambulance, civil defense) are provided through standard national arrangements, with response times determined by distance to district centers.

Healthcare services within the Project corridor are organized through a network of rural hospitals, polyclinics, rural medical ambulatories (SVAs), FAPs, ambulatories, and medical posts. Kurkeles represents the largest healthcare center among the surveyed Saryagash communities, reporting one rural hospital, three ambulatories, and eight FAPs. Darbaza reports one hospital, two FAPs, and three medical posts, while Tegisshil reports one polyclinic, two FAPs, and two medical posts. Within Keles district, Oshakty reports three ambulatories and five FAPs, while Birlik (Keles) reports one rural hospital and two ambulatories serving a geographically dispersed rural population.

The southern Project corridor communities within Maktaaral and Zhetysay districts demonstrate comparatively stronger healthcare infrastructure associated with larger irrigated agricultural settlements. Maktaaral okrug reports one hospital, three SVAs, and ten FAPs, while Atakent reports one SVA and two FAPs. Community passport data additionally indicate that Maktaral okrug contains

one of the strongest healthcare facilities identified along the corridor, including a hospital with approximately 95 beds, 25 doctors, and 116 nurses.

Available regional data from the UNICEF-supported socio-economic profile of Turkistan Region additionally indicate broader healthcare-sector challenges affecting the Region, including comparatively low healthcare financing levels, shortages of rural healthcare personnel, and lower-than-average provision of pediatric beds.

Overall, access to infrastructure and public services varies considerably between settlements along the Project corridor. Larger settlements generally provide a broader range of education, healthcare and utility services, while smaller and more dispersed rural communities have greater dependence on local road connections and district centers for access to higher-level services. This variation is relevant to the sensitivity of communities to temporary disruption of access, traffic movements and pressure on local services during Project construction.

7.5.6 Community Health and Wellbeing

Health system context. Healthcare in the corridor districts is delivered through the public healthcare system of the Republic of Kazakhstan, administered by the Ministry of Health and the Akimat of Turkistan Region. Primary healthcare in rural areas is provided through the network of FAPs, supplemented by rural physician's offices and district hospitals. Specialist and inpatient care is provided at District and regional facilities, with referrals to Shymkent and Almaty for higher-acuity conditions. The Mandatory Social Health Insurance system (OSMS) of the Republic of Kazakhstan provides a financing framework for healthcare access.

Burden of disease. The principal causes of morbidity and mortality in Turkistan Region broadly mirror the national pattern of the Republic of Kazakhstan, with cardiovascular disease, cancers, and external causes (injuries) as the leading causes of mortality, and increasing prevalence of non-communicable disease risk factors (hypertension, diabetes, obesity, tobacco use). Communicable disease burden includes a regionally significant tuberculosis burden (a long-standing public-health priority in Kazakhstan), seasonal respiratory infections, and gastrointestinal infections associated with water-supply and sanitation conditions in some rural areas. Vaccine-preventable disease coverage is supported by the national immunization program. Maternal and child health indicators have improved over recent decades but rural–urban differentials persist.

Determinants of community wellbeing. Community wellbeing in the corridor is shaped by a combination of factors including: socio-economic conditions (Section 7.5.3), access to services (Section 7.5.5), housing conditions, environmental quality (notably air and water quality, Sections 7.3.4 and 7.3.6), exposure to natural hazards (Section 7.3.8), social cohesion within multi-ethnic settlements (Section 7.5.7), and access to recreational and cultural resources. Field observations and stakeholder consultations during site verification documented strong community ties within rural settlements, active local civic structures, and — in the southern districts — relatively high levels of household-level entrepreneurship in agricultural value chains. Public-safety perception in rural settlements is generally reported as positive; specific concerns identified during stakeholder engagement are documented in the project Stakeholder Engagement Plan and in the EPC contractor's grievance records.

Site security arrangements. During construction, site security for construction compounds, work areas, material storage areas and construction camps will be provided by the EPC Contractor and its subcontractors as part of standard site management arrangements. The primary functions of site security personnel will be to control access to construction areas, deter unauthorized entry, and protect personnel, equipment and materials. The potential community health and safety risks associated with interactions between security personnel and local communities, together with the applicable management measures and requirements for security personnel conduct, are assessed in Section 8 (Impact Assessment) and addressed through the Construction-phase ESMP.

Community health and wellbeing sensitivity varies along the Project corridor. Sensitive receptors include residential areas and individual dwellings close to the railway alignment and construction access routes; schools, healthcare facilities and other community infrastructure; agricultural workers and livestock users regularly moving across or alongside the corridor; and communities dependent on local roads and tracks for access to services and agricultural land. Children, older persons, persons with disabilities and other individuals with reduced mobility may be particularly sensitive to changes in access, traffic conditions and community safety.

7.5.7 Vulnerable Groups, Gender and Ethnic Composition

Vulnerable groups framework. Vulnerable groups in the AOI are identified consistent with the requirements of ADB Safeguard Policy Statement (SPS, 2009), IFC Performance Standard 1 (2012), and AIIB Environmental and Social Standard 1 (ESF, 2024). For the purposes of this Supplementary ESIA, vulnerable groups within the AOI are taken to comprise: women-headed households; the elderly, particularly those without adult children resident in the same household; persons with disabilities; low-income households (those reliant on Targeted Social Assistance, with incomes below the subsistence minimum, or otherwise meeting LARP-defined low-income criteria); severely affected households (defined for LARP purposes as those losing more than 10% of their agricultural land or facing relocation as a result of the project); ethnic minority households where multi-ethnic composition may give rise to differential risks of exclusion from project information or grievance mechanisms; seasonal labour migrants and their dependents; and groups dependent on natural resources (e.g. open-steppe pastoralists, fishers on the Shardara Reservoir, gatherers of reeds or other plant material).

As discussed above in section , Turkistan Region demonstrates comparatively elevated levels of economic and social vulnerability, particularly among rural households, large families, and households dependent on agriculture and social support mechanisms. Vulnerability within the directly affected population has been assessed through the census and socio-economic survey undertaken for the Project LARP. The LARP applies vulnerability criteria covering households below the applicable poverty threshold, large households with four or more children below 18 years, households containing persons with disabilities, women-led households, and elderly persons without family support. A total of 93 affected households were identified as vulnerable, without double counting households meeting more than one criterion. These comprise 42 large households with four or more children below 18 years, 37 households comprising elderly persons without family support, seven households with disabled members, and seven women-led households. No surveyed affected household was identified as having income below the subsistence minimum. Vulnerable households are eligible for additional assistance under the LARP in addition to applicable compensation and livelihood restoration measures.

Although no affected households were identified with incomes below the subsistence minimum during the survey, the findings confirm the presence of vulnerable groups within the directly affected population that may require additional support during LARP implementation.

The scale and severity of land acquisition impacts vary significantly between affected households and legal entities. Based on plot-level analysis, 213 affected plots (approximately 57.3%) involve acquisition of less than 10% of the total plot area, while 67 plots (18.0%) involve impacts between 10% and 20%. More substantial impacts include 63 plots (16.9%) affected in the range of 20-50%, 20 plots (5.4%) affected between 50% and 99%, and 9 plots subject to full acquisition.

The LARP assessment identified a total of 121 severely affected APs, including 117 households and 4 legal entities. The highest number of severely affected PAPs is located within Zhetysay and Maktaaral districts, where agricultural plots are generally smaller, more fragmented, and more intensively cultivated. Severe impacts were assessed not only on the basis of proportional land loss, but also considering livelihood dependence, residual land usability, irrigation access, fragmentation, and operational continuity of agricultural and commercial activities.

Gender baseline. Women in the corridor districts participate in agricultural production (notably in vegetable, fruit, and polytunnel cultivation in the northern districts, and in cotton-related labour in the southern districts), in household enterprises, and in formal employment in education, health, and services. Women additionally play a significant role in household management, childcare, family support, and community-related activities within rural communities. Female labour-force participation in the corridor is below the male rate, particularly in rural areas, with associated differential exposure to economic shocks. The pattern of male out-migration for seasonal and longer-term labour leaves a substantial number of de facto women-headed households during the migration season, with implications for women's roles in household decision-making, agricultural management, and community engagement.

Women in Turkistan Region generally have broad access to education, healthcare, and public services. According to the 2021 Population Census, educational attainment among women and men is broadly comparable. The proportion of women with higher education increased from 21.6% at the previous census to 27.3% in 2021, while the corresponding proportion for men increased from 17.8% to 27.9%. Women are actively represented in the education, healthcare, public administration, retail, and service sectors, while also contributing significantly to agricultural production and family-based economic activities within rural communities.

Traditional social norms remain influential within many rural communities of Turkistan Region, particularly in the southern districts. While women actively contribute to household livelihoods, participation in mixed-gender public meetings and formal community decision-making processes may be comparatively limited.

The LARP socio-economic survey provides Project-specific evidence regarding these gender roles within affected communities. Of 227 surveyed affected households, 41 (18.1%) were recorded as female-headed. For vulnerability purposes, the LARP applies the narrower concept of a women-led household, referring to households in which a woman is the principal household head and primary decision-maker responsible for management of the household and its livelihood; seven surveyed households met this criterion. Survey findings indicate that traditional household structures and gender roles remain influential within the Project area. Approximately 69.4% of respondents indicated that women are not always directly involved in community-level decision-making, while 30.1% considered that women have opportunities to participate. Approximately 92.7% indicated that women's participation in decision-making would generally occur together with husbands or other male family members.

These findings are consistent with experience during the May 2026 Project consultations, where women's participation in formal mixed-gender meetings was limited. Additional informal outreach was therefore undertaken by the female E&S specialist to provide Project information and obtain the views of women who did not attend the formal meetings. The findings indicate the need for differentiated engagement approaches, including opportunities for individual or separate engagement where appropriate, to ensure that women and vulnerable households have effective access to Project information, livelihood restoration measures, and the grievance mechanism. The LARP provides for individual meetings, home visits, and other appropriate consultation methods where required to facilitate participation.

No specific concerns relating to gender-based violence were raised during stakeholder engagement activities or the LARP socio-economic survey. This does not, however, preclude the need to consider gender-related risks associated with Project implementation, including those associated with workforce influx and worker-community interactions, as part of the impact assessment and associated management measures.

Further gender-disaggregated information on the directly land-acquisition-affected population, together with gender-related provisions for compensation, livelihood restoration, consultation, and grievance management, is presented in the Project LARP.

Education, literacy and access to services. Kazakhstan records near-universal adult literacy (above 99% for both women and men), and gender parity in school enrolment is broadly achieved at primary and secondary level nationally and in Turkistan Region; women are well represented in tertiary education. Within the corridor districts, however, women's translation of educational attainment into formal employment is constrained by the predominantly agricultural economy, limited non-farm opportunities, and care responsibilities. Access to health and social services is formally universal — including maternal and reproductive health services and the mandatory social health insurance system — but rural women in the southern districts can face practical access constraints arising from distance to facilities, transport availability, and household time burdens. These services and any construction-phase pressures on them are considered further under community health and wellbeing (Section 7.5.6) and community health and safety (Section 8).

Social norms and participation in public forums. Traditional household structures and gender roles remain influential in the corridor communities, particularly in the southern, more conservative and more ethnically Uzbek districts. Women's direct participation in community-level and public decision-making forums is reported by a majority of survey respondents as comparatively limited, with men more frequently representing the household in public settings. This has direct implications for stakeholder engagement: reliance on open public meetings alone risks under-representing women's views, and the Stakeholder Engagement Plan accordingly provides for women-only or small-group consultation formats, female engagement staff, and recording of participation on a sex-disaggregated basis. Women nonetheless participated actively in the census and socio-economic survey, including as household heads and respondents.

Gender-based violence and harassment (GBV/GBVH). Comprehensive district-level GBV prevalence data are not publicly available; nationally, survey evidence indicates that a material proportion of women have experienced intimate-partner or other gender-based violence, and under-reporting is widely recognized, reflecting social stigma and limited confidence in reporting channels. Kazakhstan has strengthened its legal framework, including 2024 reforms criminalizing domestic violence. Further gender-disaggregated data on the directly affected population, and the gender-related components of livelihood restoration, are set out in the parallel LARP, which complements — rather than substitutes for — the gender baseline presented here.

Ethnic composition. The multi-ethnic composition of Turkistan Region and of the corridor districts (described in Section 7.5.2) gives rise to a number of considerations relevant to project-level stakeholder engagement, information disclosure, and grievance management. The largest ethnic minority in the Region is ethnic Uzbek (approximately 17% regionally; substantially higher in some southern districts and along the international border with Uzbekistan), with smaller communities of ethnic Russians, Tajiks, Azerbaijanis, Turks, Tatars, Uighurs, Kyrgyz, Kurds, and other groups across more than 40 nationalities. The principal language of business and administration is Kazakh; Russian is a widely used second language; Uzbek and other languages are used within community settings. Project information disclosure and grievance materials are accordingly to be made available in Kazakh and Russian as a minimum, with consideration of additional languages for specific community engagement activities.

Beyond language, the social structure of the corridor communities carries several implications for how engagement, decision-making, public participation and grievance handling are conducted. Community life is organized around dispersed rural settlements with active local civic structures, and public administration is accessed primarily through the district Akimat and rural-okrug administration; formal engagement and grievance pathways therefore need to work alongside, rather than bypass, these recognized local authorities and respected community figures (including village elders), who in practice mediate much local dispute resolution. Decision-making at household and community level tends to follow traditional patterns in which men more often represent the household in public forums, particularly in some rural communities. Reliance on open public meetings alone therefore risks under-representing the views of women, younger people and some minority members; the Stakeholder

Engagement Plan accordingly provides for a mix of formats (public meetings, small-group and women-only sessions, and individual household engagement), engagement timed around the agricultural calendar and male out-migration season, and the use of female and Uzbek- and Russian-speaking engagement staff. For grievance handling, the same considerations mean that confidential and multiple intake channels are required so that complainants — particularly women and members of minority or vulnerable households — are not obliged to raise sensitive matters in public or solely through male intermediaries; the project GRM (Section 9) provides anonymous and confidential routes alongside the Akimat-level committees. No Indigenous Peoples meeting the applicable lender criteria have been identified within the Project area.

While the broader Project Area of Influence demonstrates considerable ethnic diversity, the LARP census and socio-economic survey indicate that the directly affected population is ethnically highly homogeneous. All surveyed affected persons except one household identified as ethnically Kazakh, with one respondent identifying as Azeri. No respondents reported disadvantage or marginalization associated with their ethnic background, and no distinct ethnic minority community was identified within the directly affected population. No Indigenous Peoples meeting the applicable lender criteria have been identified within the Project area.

According to information provided by the Akimat of Turkistan Region (2020), ethnic groups within the Region are generally integrated within the wider population and are reported to have access to land and natural resources, healthcare, education, essential services, and social security. Notwithstanding this broader regional context, Project-level stakeholder engagement takes account of language, gender, vulnerability, and locally relevant cultural and participation patterns.

Indigenous Peoples. Indigenous Peoples (per ADB SPS 2009 Indigenous Peoples Safeguard Requirements / IFC Performance Standard 7 / AIIB ESS3) are **not** triggered for this Project. The original Project ESIA draft confirmed the absence of Indigenous Peoples within the AOI; this position is re-confirmed in the present Supplementary ESIA on the basis of: (i) the demographic composition of the corridor districts, in which the largest groups (Kazakhs, Uzbeks, Russians) are recognized national or regional ethnic groups rather than Indigenous Peoples in the sense defined by the lender safeguards; (ii) the absence of any group within the AOI that meets the IFC PS7 / ADB SPS Appendix 3 / AIIB ESS3 trigger criteria of distinct collective attachment to ancestral territories, customary cultural / economic / social / political institutions distinct from those of the dominant society, an indigenous language, and self-identification as a distinct cultural group; and (iii) the absence of Indigenous Peoples within the wider Turkistan Region as recognized in national legislation. The Indigenous Peoples Safeguard / Performance Standard accordingly does not apply to the Project, and a separate Indigenous Peoples Plan is not required.

7.6 Cultural Heritage Baseline

Regional cultural heritage context. The Republic of Kazakhstan possesses a rich and continuous cultural heritage extending over approximately 23,000 years (original Project ESIA draft), spanning Palaeolithic, Bronze Age, and Iron Age archaeology; the historical period of the Turkic Khaganates; the Silk Road urban centers (most prominently the historic city of Turkistan, which is the regional administrative center); the medieval and early-modern periods of nomadic Kazakh statehood; the Russian Imperial and Soviet periods; and the modern era of the independent Republic. Within the wider Project area, the principal historical and cultural overlay is that of nomadic Turkic peoples and (in the southern, more sedentary irrigated zone) Persian-speaking sedentary agricultural traditions, supplemented by the Soviet-era development of the Mirzachoel cotton-producing region and its associated infrastructure and settlements.

Legal and regulatory framework. Cultural heritage protection in the Republic of Kazakhstan is governed principally by the Law of the Republic of Kazakhstan on the Protection and Use of Objects of Historical and Cultural Heritage (in force, with successor and amending instruments to the original

1992 Law No. 1488-XII and the subsequent 2019 / 2020 reforms). The Land Code of the Republic of Kazakhstan (Article 127, 20 June 2003 No. 442-II) establishes the principle that construction works without prior archaeological examination represent a regulated risk and require coordination with the authorized cultural heritage body. The applicable lender safeguards are the IFC Performance Standard 8 (Cultural Heritage, 2012), the ADB Safeguard Policy Statement (2009) cultural heritage provisions, and the AIIB Environmental and Social Standard 1 (Cultural Heritage, ESF 2024). The detailed national and lender frameworks for cultural heritage are summarized in Section 3 (legal and policy framework).

Project-specific archaeological investigations. Historical-cultural and archaeological investigations have been undertaken at successive stages of Project design. At feasibility stage, a historical-cultural examination was undertaken by Archaeological Expertise LLP under Agreement No. AR-10-22/5 dated 18 October 2022, with the resulting conclusion No. AR-10/324-22 dated 28 October 2022 covering the proposed railway alignment between km 0 and km 110. The examination identified nine historical and cultural heritage sites, comprising four settlement sites (Elubay, Beskempyr, Akata and Kurykkeles) and five funerary sites (Juantobe, Oymaut, Zhantoksai 1, Zhantoksai 2 and the Perdekhan Ata mound). The feasibility-stage alignment intersected a number of these sites or their protection zones or passed in their immediate vicinity.

Six of the nine feasibility-stage receptors were intersected by the proposed alignment or their protection zones. The alignment passed approximately 10 m from the protection zone of Kurykkeles settlement, approximately 30 m from the protection zone of the Zhantoksai 2 burial ground, and approximately 10 m from the Perdekhan Ata mound. The feasibility-stage assessment therefore identified a high degree of spatial interaction between the proposed railway and known archaeological resources.

The 2022 assessment required a 40 m protection zone around identified monuments, within which new construction was prohibited. Where avoidance could not be achieved, archaeological investigation and excavation were required in accordance with national heritage procedures. The assessment also required repeat historical-cultural examination where subsequent changes were made to the boundaries or alignment of the surveyed Project land. A chance-find procedure was specified requiring works to stop and the relevant authorities to be notified if archaeological remains, artifacts, bones, ancient structures, or other evidence of material culture were encountered during design, survey, earthworks, or construction.

Subsequent archaeological assessment. Further historical-cultural assessment was undertaken as the Project design developed. The historical-cultural expert assessment included as Appendix 7 of the national OVOS identifies eight archaeological sites or site groups, designated **Birlik 1 to Birlik 8**, comprising burial grounds, groups of burial mounds, and individual burial mounds. The assessment provides geographical coordinates for individual archaeological features, their distance and direction from the railway axis, photographic records, and mapped protection zones. In total, 33 individual burial mounds are recorded across the eight Birlik sites or site groups. The identified receptors and their relationship to the surveyed railway alignment are summarized in Table 83 below.

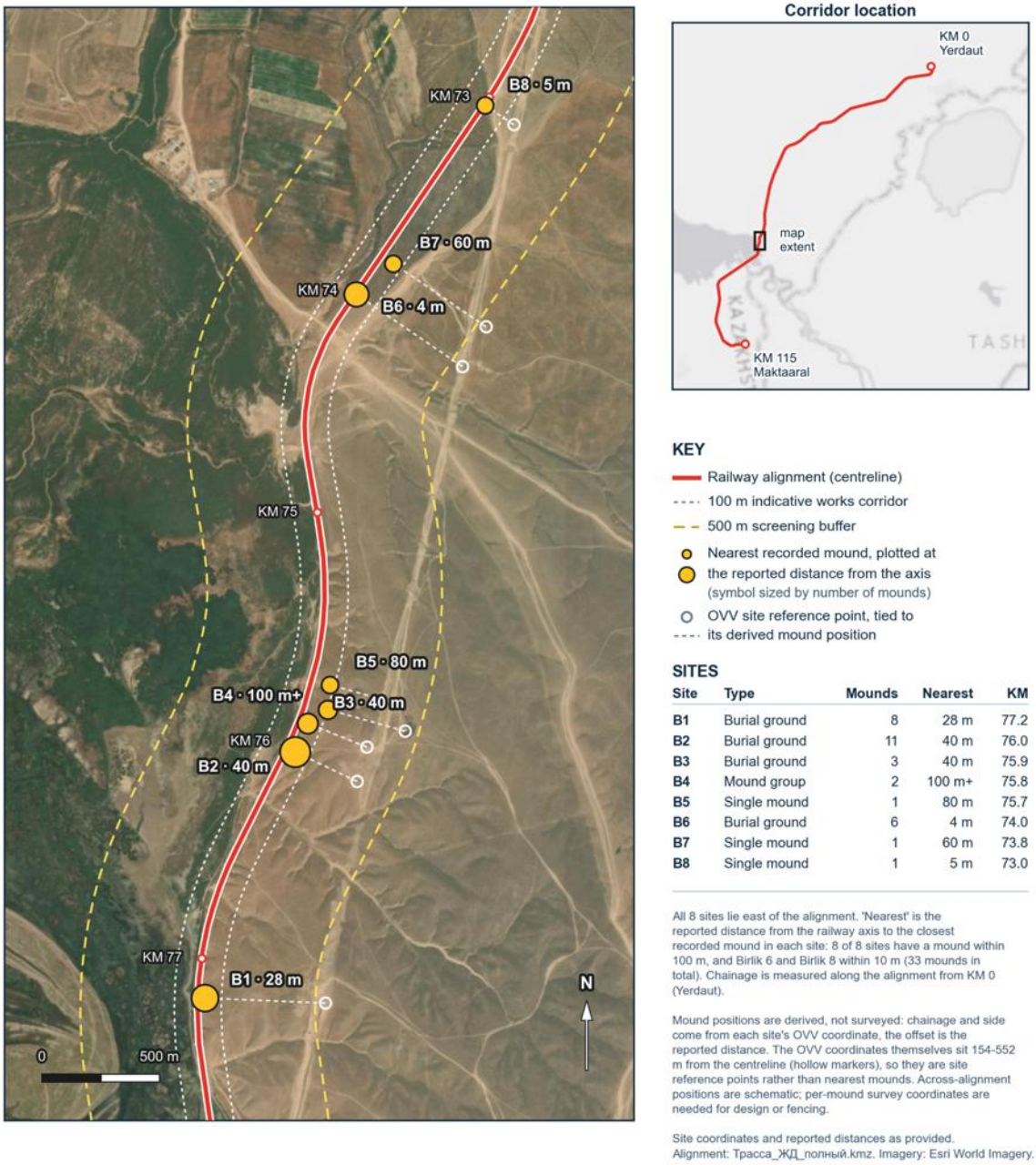
Table 83: Archaeological Sites

Site	Archaeological character	No. of recorded mounds	Closest recorded distance from railway axis	Baseline observation
Birlik 1	Burial ground	8	**28 m**	Multiple mounds occur at varying distances from the alignment; the closest recorded mound is approximately 28 m from the railway axis.

Site	Archaeological character	No. of recorded mounds	Closest recorded distance from railway axis	Baseline observation
Birlik 2	Burial ground	11	**40 m**	Largest mound group identified in the later assessment; several mounds occur within approximately 40–80 m of the railway axis.
Birlik 3	Burial ground	3	**40 m**	Three-mound funerary complex; the closest recorded mound is approximately 40 m from the railway axis.
Birlik 4	Group of burial mounds	2	**100 m**	Two-mound group located approximately 100 m or more from the railway axis.
Birlik 5	Individual burial mound	1	**80 m**	Single archaeological receptor approximately 80 m from the railway axis.
Birlik 6	Burial ground	6	**4 m**	Burial-ground complex containing the closest recorded mound to the railway axis; other mounds occur at varying distances from the alignment.
Birlik 7	Individual burial mound	1	**60 m**	Single mound approximately 60 m from the railway axis.
Birlik 8	Individual burial mound	1	**5 m**	Individual burial mound located approximately 5 m from the railway axis.
Total	—	**33**	**4 m minimum**	Eight archaeological sites/site groups.

The later assessment therefore identifies 33 individual burial mounds distributed across eight archaeological sites or site groups. Their proximity to the railway varies considerably. The closest recorded receptor is a mound within the Birlik 6 burial ground, approximately 4 m from the railway axis, while the Birlik 8 mound is approximately 5 m from the axis. Other relatively close receptors include Birlik 1, where the closest recorded mound is approximately 28 m from the axis, and Birlik 2 and Birlik 3, where the closest recorded mounds are approximately 40 m from the axis. The assessment categorizes individual mounds according to their distance from the railway axis, including receptors within 0–40 m, 40–80 m, 80–120 m, and more than 120 m. The individual coordinates of the recorded mounds have been used to map their spatial distribution relative to the Project alignment, as shown in Figure 46.

Figure 47: Location of Archaeological Sites Identified by the Subsequent Historical-Cultural Assessment



Source: Historical-Cultural Expert Assessment, Appendix 7 of the national OVOS; site locations reproduced from WGS84 coordinates presented in the assessment.

Site-specific heritage protection plans have been prepared for the identified archaeological receptors. These establish a monument protection zone, a development regulation zone, and a protected natural landscape zone around the archaeological features, together with restrictions applicable to activities within these zones. The close proximity of several archaeological receptors to the railway is particularly important: individual mounds associated with Birlik 6 and Birlik 8 are recorded approximately 4 m and 5 m, respectively, from the railway axis, while additional receptors occur within 40 m. The historical-cultural assessment therefore establishes specific protection and archaeological management requirements for receptors potentially affected by the developed railway alignment.

The relationship between the final detailed alignment and construction footprint and the known archaeological sites and their applicable protection zones remains an important Project interface. The historical-cultural assessment establishes measures for protection and archaeological management of identified sites, including restrictions within protection zones and archaeological investigation where avoidance cannot be achieved. Where subsequent alignment changes extend into areas not covered by the existing archaeological investigations, further historical-cultural examination is required in accordance with national requirements. Detailed requirements for protection of known sites, archaeological investigation and monitoring, chance finds, and construction-phase cultural heritage management are addressed in the impact assessment and ESMP.

Tangible cultural heritage other than archaeological sites. In addition to the archaeological sites described above, other tangible features of cultural and community importance occur throughout the Project corridor. These include mosques and other places of worship within settlements, and established cemeteries and burial grounds associated with corridor communities. Older settlements also contain Soviet-era civic, agricultural, and infrastructure features that contribute to the more recent historical character of the landscape, particularly within the intensively irrigated southern districts of Zhetysay and Maktaaral. The Mirzachoel irrigation system, associated pumping infrastructure, and planned agricultural settlements are prominent elements of this twentieth-century landscape. These features are described here as part of the cultural-historical character of the corridor and are not, unless separately designated or identified through Project investigations, assumed to constitute protected cultural heritage under national legislation. No known mosque, cemetery, or other non-archaeological cultural heritage site has been identified as requiring physical displacement as a result of the Project.

Intangible cultural heritage. The Project corridor forms part of the wider cultural landscape of southern Kazakhstan, within which living cultural practices include Kazakh language and oral and musical traditions, religious and community celebrations, hospitality practices, and traditional knowledge associated with agriculture and livestock husbandry. These traditions occur throughout the five Project-affected districts, although their expression reflects the different livelihood and cultural landscapes along the corridor. In Saryagash and Keles districts, mixed agricultural and livestock-based livelihoods contribute to continuing knowledge and practices associated with animal husbandry, grazing, seasonal livestock movement, and rural land use. Similar pastoral traditions remain relevant in Shardara District, alongside agricultural and fishing-related practices associated with the Shardara Reservoir and surrounding irrigated areas. In the southern Zhetysay and Maktaaral districts, traditional and contemporary livelihood knowledge is more strongly associated with intensive irrigated agriculture, including cotton and other crop production, irrigation management, and the agricultural practices that have developed within the Mirzachoel irrigated landscape.

The ethnic composition described in Section 7.5 is also reflected in the cultural traditions and languages of corridor communities. Kazakh cultural and linguistic traditions predominate throughout the Project area, while Uzbek cultural and linguistic traditions are more prominent within communities in the southern districts and close to the Uzbekistan border. Religious observance, family and community celebrations, hospitality, and locally established forms of community interaction remain important aspects of social life across the corridor.

No specific intangible cultural heritage practice, tradition, knowledge system, or place of cultural significance has been identified through the Project studies or stakeholder engagement as being uniquely dependent upon land directly affected by the Project or as likely to be lost as a result of Project development. The Project is therefore not presently assessed as resulting in the loss of identified intangible cultural heritage. Nevertheless, traditional patterns of agricultural and pastoral land use and community access are relevant to the assessment of agricultural severance, livestock movement, access, and community connectivity elsewhere in this ESIA. Culturally appropriate engagement arrangements, including consideration of language, gender, and local community structures, are addressed through the Stakeholder Engagement Plan.

7.7 Landscape and Visual Amenity

Landscape character classification. The landscape along the Project corridor can be classified into three principal character types, consistent with the classification used in the original Project ESIA draft and confirmed by site verification:

- **Open-steppe landscape:** predominant in the central and parts of the northern sections of the corridor (Saryagash District steppe areas, parts of Keles, and the open ground of Shardara District). Character: open, unfenced, undulating ground with grass-dominated vegetation maintained as a short sward through extensive grazing. Strong seasonal variation: green coverage in spring and early summer (with limited bare areas), turning to a predominantly brown colour in summer and autumn under high temperatures and limited rainfall.
- **Arable / irrigated agricultural landscape:** predominant in the southern districts (Zhetysay and Maktaaral) and locally in northern Saryagash and Keles districts. Character: small fields under intensive irrigated cultivation, with a dense engineered network of supply and drainage canals, polytunnels (heated, often visually prominent in the landscape), orchards, and cotton fields with associated agricultural infrastructure. Visual character is highly engineered and seasonally variable with the cropping cycle.
- **Urban / settlement landscape:** comprising Saryagash City (the principal urban centre in the corridor), the smaller secondary urban centres (Zhetisay City, Myrzakent, Atakent, Asykata, Shardara), and the compact rural settlements (auls / villages). Character: low- to medium-rise built form, predominantly residential, with a network of local streets and service infrastructure, surrounded by agricultural land.

A fourth character type, *reservoir-margin landscape*, is locally significant at the Shardara Reservoir margin in Shardara District, characterized by extensive reedbeds, salt-tolerant scrub, seasonally inundated flats, and the engineered shoreline of the reservoir itself; this landscape type is associated with the principal biodiversity values of the corridor (Section 7.4) and provides a visually distinctive feature within the otherwise open-steppe character of the central section.

The landscape character described above is illustrated by the site photographs presented throughout the baseline sections of this ESIA, including representative views of the open steppe, irrigated agricultural areas, settlement interfaces and the Shardara Reservoir margin.

Existing detractors from landscape naturalness. The landscape along much of the corridor, and particularly in the south-western sections, is already affected by a number of man-made features that detract from naturalness:

- the existing road network, including the M-32 and regional roads, district roads, rural-access tracks, and (more recently) project-related construction-haul tracks;
- electricity transmission lines and pylons, including, in some sections, multiple high-voltage lines running broadly parallel to one another and to the alignment, with their associated steel-lattice pylons forming prominent vertical features in the otherwise low-relief landscape;
- the existing rail network at the northern end of the corridor and other rail infrastructure;
- agricultural infrastructure, including the dense canal network, pump stations, polytunnels, agro-industrial buildings (sunflower-oil refinery, mill, storage facilities, greenhouses, cattle farms) particularly concentrated near the planned Maktaaral Station; and
- the active construction works of the Project itself — embankment formation, track-laying, bridge approaches, station works, borrow pits, batching plants — which form a prominent feature of the contemporary landscape across active work fronts at the time of preparation of this Supplementary ESIA.

Visual amenity and viewpoints. The Project corridor does not pass through a nationally or internationally designated landscape, and no formally designated scenic viewpoints or landscape-based tourist attractions have been identified within the Project Area of Influence. The visual

landscape is predominantly rural and is already influenced to varying degrees by agricultural development, roads, electricity infrastructure, irrigation infrastructure, settlements and, at the northern end of the corridor, existing railway infrastructure.

Visual sensitivity nevertheless varies materially along the alignment. Within the open-steppe sections of Saryagash, Keles and Shardara districts, the low relief and limited screening vegetation create long and open views across the landscape. Railway embankments, bridges, overhead infrastructure and moving trains may consequently be visible over comparatively long distances, although the existing landscape is generally of low to moderate visual sensitivity and already contains linear infrastructure and other anthropogenic features.

Within the intensively cultivated landscapes of Zhetysay and Maktaaral districts, the visual environment is more strongly modified by irrigated agriculture, canals, roads, polytunnels, agricultural buildings, settlements and other infrastructure. Views are generally experienced by residents, agricultural workers and road users rather than from designated recreational or scenic viewpoints. The capacity of this landscape to accommodate additional infrastructure is therefore generally greater than in the more open and less developed sections of the corridor.

The Shardara Reservoir margin represents the most distinctive landscape and visual receptor along the Project corridor. The combination of open water, reedbeds, seasonally inundated flats and open horizons contrasts with both the surrounding steppe and the intensively modified agricultural landscapes farther south. The reservoir margin is also used locally for fishing, recreation and informal access, increasing the importance of visual amenity to people using this area. The railway embankment and associated structures are already prominent locally where construction has progressed along the reservoir margin.

Settlement receptors are also locally important where the railway approaches or passes close to existing communities. The principal visual receptors comprise residents with views toward the railway, people working on agricultural land adjacent to the alignment, users of local roads and crossings, and recreational users of the Shardara Reservoir margin. Visual sensitivity is highest where residential receptors have relatively open and direct views of the railway and where the alignment introduces substantial new structures into otherwise open landscapes.

Overall, the Project corridor is not considered to comprise a landscape of high regional or national scenic value, and much of the alignment passes through modified agricultural or infrastructure-influenced landscapes with a comparatively high capacity to accommodate change. Landscape and visual sensitivity is therefore generally Low to Medium. Locally higher sensitivity occurs at the Shardara Reservoir margin and at residential receptors with open, short-distance views of the railway, which are carried forward as the principal landscape and visual receptors in the impact assessment.

8. Impact Assessment and Mitigation and Management Measures

8.1 Preamble

This chapter presents the results of the impact assessment for the Project. It identifies the predicted effects on the receiving environment, evaluates their significance both before and after mitigation, and sets out the mitigation and management measures that will be applied. The assessment follows the methodology described in Section 5 and addresses each of the three Project stages — Design and

Project Land Take, Construction, and Operations and Maintenance. The chapter is organized into four parts, which are intended to be read in sequence:

Part 1 — Valued Environmental Receptors (Section 8.2). The assessment is structured around a defined set of Valued Environmental Receptors (VERs), which are the physical, biological, social and cultural features of the receiving environment on which Project effects are predicted to act. Each VER has been ascribed a value or sensitivity rating derived from its importance at the local, regional, national or international scale. The VERs and their ratings provide the reference framework against which the magnitude of each predicted impact is judged in order to determine significance.

Part 2 — Summary of Impacts by Project Stage (Section 8.3). This part presents the impact assessment results in tabular form. A separate table is provided for each Project stage. Each table sets out, for every identified impact: a unique Impact ID, a summary description, the magnitude scoring against the criteria defined in Section 5, the VER affected and its value, the significance before mitigation, the committed mitigation measures, and the significance after mitigation. The tables are the authoritative record of the assessment outcomes and are the primary reference for tracking mitigation commitments through the EPC, construction and operational phases.

Part 3 — Topic-Based Narrative (Section 8.4). The tables in Part 2 necessarily condense the assessment into a standard scoring format. Part 3 provides the supporting site-specific narrative organized by environmental and social topic. It explains the basis for the scoring, sets out the technical reasoning behind significance judgements, and describes site-specific issues that warrant fuller discussion than the tables allow — for example the impacts within the Shardara Reservoir IBA/KBA, the assessment of construction dust under IAQM guidance, and the management of impacts on Critical Habitat. Where further assessment is required to close out residual uncertainty before or during the EPC phase, this is identified within the relevant topic.

Part 4 — Residual Significant Effects (Section 8.4.7). The final part consolidates the residual significant effects, that is, those impacts that remain after the full implementation of the committed mitigation. It identifies where residual impacts are unavoidable in the context of a linear infrastructure project of this nature and scale, and flags those residual impacts that will require offset or compensatory measures to meet the requirements of the lenders' safeguards and Good International Industry Practice.

Taken together, the four parts of this chapter provide both the comprehensive record of the impact assessment and the basis for the mitigation, monitoring and management commitments carried forward into the Environmental and Social Management Plan (ESMP) and the supporting management plans referenced in Section 10.

8.2 Valued Environmental Receptors

The impact assessment is structured around a defined set of Valued Environmental and Social Receptors (VERs), representing the physical, biological, social, socio-economic and cultural features, resources, individuals, groups and systems that may experience change as a result of the Project. The VERs have been identified principally from the baseline conditions presented in Chapter 7, supplemented by stakeholder engagement, specialist studies and modelling, the ESCA, the national environmental assessment documentation, including the OVOS, and observations made during preparation of this Supplementary ESIA.

Table 84 presents the VERs used in the assessment and groups them by receptor type to provide a clear link between the baseline and the impact assessment. Each VER is assigned a unique reference number that is carried through the impact assessment tables in Section 8.3 and the residual-effects assessment, allowing individual impacts and significance ratings to be traced back to the receptor affected. The indicative value/baseline sensitivity shown in Table 84 provides the starting point for the assessment; in accordance with the methodology in Section 5, the sensitivity applied to a specific

impact may vary where the receptor's susceptibility to that particular type of change differs materially from its general baseline sensitivity.

Standards, regulatory limits, guideline values and impact mechanisms are not treated as VERs. They are used, where relevant, as criteria for evaluating the magnitude or acceptability of change affecting the receptor.

Table 84: Valued Environmental Receptors

VER No.	Valued Environmental or Social Receptor	Indicative Value / Baseline Sensitivity	Comments on VER
Land, Agriculture and Livelihoods			
1	Agricultural production systems	Regional / Moderate	Agriculture is a predominant livelihood and land-use system throughout the corridor, including livestock production, mixed agriculture and intensive irrigated cropping.
2	Productive agricultural land	Regional / Moderate	Includes pasture, irrigated cropland, cotton, wheat, horticultural land and other productive agricultural areas affected by permanent or temporary Project land take.
3	Agricultural access and land connectivity	Regional / Moderate	Access between holdings, fields, irrigation infrastructure, roads and settlements is important to continued agricultural use. Railway severance may increase travel distances or restrict access.
4	Irrigation and drainage infrastructure	Regional / Moderate	Irrigation canals, drainage channels and associated infrastructure are fundamental to agricultural production, particularly in Zhetysay and Maktaaral. Community consultations identified continuity of irrigation as a material concern.
5	Intensive agricultural production infrastructure, including polytunnels and covered cultivation	Regional / Moderate	Intensive horticultural systems may be sensitive to dust, access interruption and physical disturbance.
16	Existing land uses adjacent to the alignment	Regional / Moderate	Includes agricultural, residential, commercial and other established land uses potentially affected by Project construction and operation.
24	Agricultural livelihoods and income	Regional / Moderate	Agricultural income is a principal livelihood source among affected households and businesses and is dependent on continued productive use and accessibility of land.
25	Businesses and business livelihoods along the corridor	Local / Moderate	Includes formal and household businesses potentially affected by access restrictions, displacement or changes in local economic activity.
71	Agricultural land users, livestock owners and grazing users	Regional / Moderate	Land users and livestock owners may be affected by construction disturbance, railway severance, access restrictions and changes to livestock movement between settlements and grazing areas.
89	Small residual and fragmented irrigated agricultural holdings	Regional / High	The LARP identifies irrigated plots where residual land size, fragmentation, altered access, irrigation connectivity and

VER No.	Valued Environmental or Social Receptor	Indicative Value / Baseline Sensitivity	Comments on VER
			machinery access may materially affect continued agricultural usability.
Physical Environment and Natural Resources			
7	Ambient air quality at communities along existing roads and access routes	Local / Moderate	Residential and community receptors may experience construction dust and vehicle emissions along existing access and haul routes.
8	Ambient air quality at communities adjacent to the new alignment	Local / Moderate	Includes residents, schools, workplaces and other sensitive human receptors potentially exposed to Project-related dust and emissions.
13	Hydrological regime of the Syr Darya and Shardara Reservoir	Regional / High	Major regional water system important for water supply, irrigation, ecology and reservoir functioning.
17	Geological and aggregate resources	Regional / Moderate	Includes gravel, soil and other materials obtained from borrow pits and quarries for Project construction.
18	Regional construction material resources	Regional / Moderate	Aggregate, sand, concrete and other material resources used by the Project; principally relevant to resource efficiency and sourcing.
28	Groundwater resources and hydrogeological regime	Regional / High	Includes groundwater flow, groundwater availability and the potential interaction of the railway embankment and excavations with shallow groundwater.
29	Soil resources	Regional / Moderate	Includes soil structure, productive capability, erosion susceptibility and chemical condition.
31	Land affected by existing contamination	Local / Moderate	Existing contaminated or potentially contaminated land may create risks where disturbed during construction.
42	Local waste-management capacity	Regional / Moderate	Existing disposal and recycling capacity may be affected by Project-generated construction and operational waste streams.
43	Other watercourses, canals, drains and ditches	Regional / Moderate	Includes natural and artificial water features susceptible to pollution, sedimentation, obstruction or physical disturbance.
44	Surface-water quality of the Syr Darya, Shardara Reservoir and other watercourses	Regional / High	Relevant to construction runoff, accidental releases, wastewater and operational pollution pathways.
45	Irrigation-water availability and channel flows	Regional / High	Agricultural livelihoods depend on timely and reliable irrigation supply, particularly during the cropping period.
85	Global and regional climate	International / High	Receptor for Project greenhouse-gas emissions and associated contribution to climate change.
86	Project infrastructure exposed to physical climate hazards	National / High	Embankments, bridges, drainage structures, stations and related infrastructure are exposed to extreme heat, flood, drought, wind and other climate hazards over the Project design life.

VER No.	Valued Environmental or Social Receptor	Indicative Value / Baseline Sensitivity	Comments on VER
Biodiversity and Ecosystem Services			
33	Shardara Important Bird and Biodiversity Area / Key Biodiversity Area	International / Extreme	Internationally recognized biodiversity area and principal biodiversity receptor along the alignment.
34	Critical Habitat biodiversity values	International / Extreme	Includes habitats, species and ecological functions triggering Critical Habitat under the applicable lender standards.
37	Overwintering waterbird assemblage	International / Extreme	Internationally important wintering/congregatory bird assemblage associated principally with Shardara Reservoir.
38	Breeding bird assemblage	National / High	Breeding colonies and associated habitat identified through Project surveys within and around the reservoir.
46	Dalmatian Pelican	International / Extreme	IBA qualifying species and Critical Habitat biodiversity value.
47	Ecosystem services provided by the Shardara Reservoir and surrounding landscape	Regional / High	Includes ecological, water-resource, livelihood and community-use functions supported by the reservoir system.
51	Threatened fish species identified within the Project AoI	National / High	Includes fish species of conservation concern potentially affected through aquatic habitat, water-quality or hydrological pathways.
63	Natural wetland habitat	National / High	Natural Habitat associated with the reservoir and associated wetland systems.
64	Migratory bird assemblage	International / Extreme	Internationally important assemblage using the Central Asian and associated migratory flyways.
65	Reedbed, floodplain grassland, scrub and other Natural Habitat associated with Shardara Reservoir	National / High	Includes Natural Habitat affected by permanent and temporary Project footprint and disturbance.
74	Raptors and vultures of conservation significance	International / Extreme	Includes globally threatened species such as Steppe Eagle and other raptors identified through Project studies.
75	Other bird species of conservation significance	National / High	Includes nationally and internationally significant bird species not separately identified as individual VERs.
76	IUCN- and Kazakhstan Red Data Book-listed flora	National / High	Flora of conservation significance identified as relevant to the Project AoI.
77	IUCN-listed mammals	National / High	Includes Marbled Polecat and Goitered Gazelle and associated suitable habitats.
78	IUCN-listed reptiles	National / High	Includes Central Asian Tortoise and associated suitable habitat.

VER No.	Valued Environmental or Social Receptor	Indicative Value / Baseline Sensitivity	Comments on VER
79	IUCN-listed fish	International / Extreme	Includes the Syr-Darya Shovelnose Sturgeon and other threatened aquatic species identified by the biodiversity assessment.
80	IUCN-listed invertebrates	National / High	Includes Odonata and other invertebrates of conservation significance identified within the assessment area.
81	Pygmy Cormorant	International / Extreme	IBA qualifying species and Critical Habitat biodiversity value.
83	Other threatened bird species	International / Extreme	Includes globally threatened species such as White-headed Duck where relevant to the Project AoI.
Community, Health and Socio-economic Receptors			
11	Residents of communities adjacent to the new railway	Local / High	Includes settlements where the alignment approaches or passes close to residential areas and where residents may experience noise, vibration, air-quality, severance or community-safety effects.
12	Residents along construction access and haul routes	Local / High	Potentially exposed to construction traffic, dust, noise, road-safety risks and temporary access disturbance.
20	Noise-sensitive human receptors	Local / High	Includes residential and other sensitive receptors identified through the noise and vibration assessment and modelling.
22	Road users, pedestrians and other users of existing transport routes	Local / High	Includes drivers, pedestrians, cyclists and other users potentially exposed to construction traffic and railway-crossing risks.
23	Local communities within the Project Area of Influence	Local / High	Broader community receptor relevant to community health and safety, access, amenity, emergency response and social effects.
26	National and regional economy	National / High	Principal receptor for beneficial effects associated with transport capacity, trade, employment and regional economic development.
27	Local workforce and employment market	Local / Moderate	Relevant to Project employment, local procurement, skills development and potential labor-market effects.
90 – NEW	Vulnerable and disadvantaged households and individuals	Local / High	Includes low-income households, persons with disabilities, elderly persons, female-headed households and other groups with reduced capacity to avoid or recover from adverse Project effects.
91 – NEW	Community infrastructure and public services	Local / High	Includes roads, utilities, healthcare, education and other facilities or services potentially affected by construction access, disruption or increased demand.
92 – NEW	Women, girls and other persons potentially exposed to SEA/SH or GBVH risks	Local / High	Relevant where workforce influx, worker-community interaction or workplace conditions create credible GBVH pathways.
Labor and Worker Safety			

VER No.	Valued Environmental or Social Receptor	Indicative Value / Baseline Sensitivity	Comments on VER
21	Construction workforce	National / High	Workers are directly exposed to occupational safety, health, labor and accommodation risks, including potentially fatal construction hazards.
84	Operational and maintenance workforce	National / High	Railway operations and maintenance expose workers to live railway, electrical, maintenance, emergency-response and other occupational hazards.
Cultural Heritage			
9	Known archaeological sites and associated protection zones	National / High	Includes the feasibility-stage archaeological sites and the Birlik archaeological sites/site groups identified through subsequent historical-cultural assessment, including receptors in very close proximity to the railway alignment.
10	Previously unidentified archaeological resources / chance finds	National / High	Archaeological value is unknown prior to discovery; High is adopted on a precautionary basis, with actual value to be determined following discovery and specialist assessment.
93 – NEW	Cemeteries, religious structures and other tangible cultural heritage	Local / High	Includes community cemeteries, mosques, places of worship and other tangible features of cultural or community significance identified within the corridor.
Landscape and Visual Receptors			
14	Landscape character and public views	Regional / Moderate	Broad corridor landscape and visual receptor, including views experienced by residents, land users and travelers.
15	Open-steppe landscape	Regional / Moderate	Open, low-relief landscape with long views and relatively limited screening, particularly in Saryagash, Keles and Shardara.
94 – NEW	Shardara Reservoir landscape and visual setting	Regional / High	Most distinctive landscape receptor within the corridor; includes open-water, reedbed and reservoir-margin views and recreational use.
95 – NEW	Residential visual receptors with open views toward the railway	Local / High	Residents with short-distance and relatively unobstructed views of the embankment, bridges, railway infrastructure and passing trains.
Structures and Other Physical Human Receptors			
72	Buildings and structures sensitive to vibration	Local / High	Residential and other structures close to construction and operational railway activities, including receptors identified by vibration screening.
88	Residents near the auxiliary 10 kV OHL and associated electrical infrastructure	Local / Moderate	Human receptor for potential electromagnetic-field exposure; applicable standards are assessment criteria rather than VERs.

The value/sensitivity ratings presented above represent the indicative baseline value and susceptibility of each VER and provide the starting point for the impact assessment. In accordance with the methodology in Section 5, receptor sensitivity is impact-specific and may therefore be adjusted in the assessment of an individual impact where the susceptibility of the receptor to that particular type of change differs materially from the indicative rating presented above. Any such

adjustment is identified and justified in the relevant impact assessment. Standards, regulatory limits and guideline values are not treated as VERs; they are used, where applicable, as criteria against which the magnitude or acceptability of predicted change is evaluated.

8.3 Summary of Impacts by Project Stage

Impacts and Mitigation for Design

Table 85 presents the results of the IA for the design stage and land take requirements of the project. Unsurprisingly, these impacts are focused on the issues of loss of land to agriculture as the project passes mainly through productive agricultural land, and the issues of displacement of people and communities. It addresses impacts that flow from the geometry and engineering form of the alignment fixed at the design stage (severance, embankment hydrology, landscape change, protected-area conflict); Table 86 separately addresses the impacts of the act of taking land itself — physical and economic displacement and permanent habitat loss within the acquired footprint. The distinction mirrors the Design/Land Take split adopted in the narrative at Sections 8.4.1 and 8.4.2.

Impacts and Mitigation for Land take

Table 86 presents the results of the IA for Land take Issues. Utilizing the Hierarchy of Mitigation, the design has sought to minimize land take and the direct effects of the project on settlements and urban areas. However, land take for the project will inevitably lead to loss of residential, commercial and agricultural land, severance and fragmentation of farm units as well as the need to resettle affected people within the project Right of Way and a significant area of land taken from the Sadara Reservoir IBA.

The offsetting or compensation for this significant residual impact will be managed through a Land Acquisition and Resettlement Plan (including livelihood restoration plan) in conformance with the requirements of ADB SPS (2009).

Impacts and Mitigation for Construction Phase

Table 87 shows the predicted impacts and risks for the project during the construction phase. Mitigation is set out based on generic impacts for projects of this type and in this receiving environment.

. Where construction activities have already been undertaken, retrospective compliance and implementation are addressed through the parallel ESCA and its Corrective Action Plan. The mitigation identified in this ESIA applies prospectively to the remaining construction activities and, where relevant, to corrective measures that remain technically and operationally practicable.

Impacts and Mitigation for Operations and Maintenance Phase

Table 88 provides a summary of the predicted impacts for the Operations and Maintenance Phase. The committed mitigation measures are set out and these provide a minimum basis of design plus the design requirements set out in Section 8.4.1 (design) . A key for the abbreviations used in these table is provided below.

Key for Tables

Impact Magnitude Headings Im = Impact, C = Class, S = Score. Impact Aspects S = Size, E = Extent, D = Duration, F = Frequency, P = Probability, Rev = Reversibility. For Size - Hi = High, Med = Medium, Lo = Low, Neg = Negligible. For Extent – Vl = Very Local, L = Local, Reg = Regional, Nat = National, Int = International. For Duration – Tr = Transient, St = Short Term, Med = Medium, LT = Long term, Per = Permanent. For Frequency - One = One-off, Ra = Rare. Inf = Infrequent, Fre = Frequent, Con = Continuous. For Probability – Cer = Certain, Hi = High, lo = Low. For Reversibility

Text in Impact Magnitude shown in Red is the calculated Magnitude of the Impact. NS = Non-significant.

Vista
Environment

Vista Environment

Table 85: Impact, Mitigation and Significance for Design

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
AF001	3	Agricultural access and land connectivity	Permanent severance or diversion of agricultural and livestock movement routes by the railway embankment, potentially increasing journey distances and costs and restricting access between holdings, pasture, settlements and water resources.	Moderate	Medium	Low
AF002	4	Irrigation and drainage infrastructure	Permanent interruption, constriction or alteration of irrigation and drainage infrastructure where the railway crosses the managed agricultural network, potentially affecting irrigation supply, drainage and continued agricultural use of residual land.	Moderate	Medium	Low
AF007	28	Groundwater resources and hydrogeological regime	Potential alteration of shallow groundwater movement by the railway embankment, with localised risk of waterlogging or drying of adjacent soils where shallow groundwater flow is intercepted.	Moderate	Medium	Low
AR001	9	Known archaeological sites and associated protection zones	Potential direct physical impact on known archaeological sites and burial mounds where the final construction footprint or associated works interact with archaeological sites or applicable protection zones; complete receptor-by-receptor verification is unavailable for all completed sections.	Moderate	Medium	Medium
AR002	9	Known archaeological sites and associated protection zones	Change to the setting of burial mounds and other known archaeological receptors where the permanent railway is constructed in close proximity to them.	Moderate	Medium	Low
HG001	13	Hydrological regime of the Syr Darya and Shardara Reservoir	Alteration or obstruction of surface-water flow by the permanent embankment, with potential upstream ponding or flooding and downstream erosion or scour where cross-drainage is inadequate.	Moderate	Medium	Low
LV001	14	Landscape character and public views	Permanent change in landscape character arising from the railway embankment, bridges, stations, sidings and associated infrastructure across open steppe, agricultural and reservoir-margin landscapes.	Moderate	Medium	Medium

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
LV002	14	Landscape character and public views	Permanent change in visual amenity for residents, agricultural users, travellers and reservoir users as a result of views of the embankment, bridges, stations and other railway infrastructure.	Moderate	Medium	Medium
PG001	33	Shardara IBA/KBA	Permanent interaction of the selected alignment with the internationally recognised Shardara IBA/KBA and associated Critical Habitat, including permanent habitat loss and fragmentation within the designated area.	Major	High	High
TE064	77	IUCN-listed mammals	Fragmentation of terrestrial mammal habitat and restriction of movement caused by the permanent railway as a new linear barrier.	Minor	Medium	NS
TE079	78	IUCN-listed reptiles	Fragmentation of reptile habitat and restriction of movement caused by the permanent railway embankment and associated infrastructure.	Moderate	Medium	Low
CS007	23	Local communities within the Project Area of Influence	Community-safety risk established through permanent design, including inadequate provision or protection of at-grade crossings and inadequate measures to prevent unauthorized pedestrian, vehicle or livestock access to the live railway.	Moderate	High	Medium

Table 86: Impact, Mitigation and Significance for Land take

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
AF004	16	Existing land uses adjacent to the alignment	Permanent and temporary loss of residential, commercial and productive agricultural land required for the Project footprint, Right of Way and temporary construction facilities.	Moderate	Medium	Medium
SE001	24	Agricultural livelihoods and income	Loss or interruption of income and livelihood activities arising from acquisition of productive land and assets, temporary occupation, residual-plot fragmentation and altered access.	Moderate	Medium	Low
TE001	33	Shardara IBA/KBA	Permanent loss of approximately 150 ha of habitat within the Shardara IBA/KBA beneath the permanent Project footprint.	Moderate	High	High
TE006	46	Dalmatian Pelican	Permanent loss of approximately 150 ha of habitat within the IBA/KBA used by Dalmatian Pelican.	Moderate	High	High
TE018	64	Migratory bird assemblage	Permanent loss of approximately 150 ha of habitat within the IBA/KBA used by the migratory bird assemblage.	Moderate	High	High

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
TE024	83	Other threatened bird species	Permanent loss of approximately 150 ha of wetland habitat potentially used by other threatened bird species.	Moderate	High	Medium
TE028	37	Overwintering waterbird assemblage	Permanent loss of approximately 150 ha of habitat within the IBA/KBA used by the wintering bird assemblage.	Moderate	High	Medium
TE032	38	Breeding bird assemblage	Permanent loss of approximately 150 ha of wetland and foreshore habitat used by breeding birds.	Moderate	High	Medium
TE036	75	Other bird species of conservation significance	Permanent habitat loss within the IBA/KBA affecting other bird species of conservation significance.	Moderate	High	Medium
TE040	83	Other threatened bird species	Permanent habitat loss within the IBA/KBA affecting Lesser White-fronted Goose and other relevant threatened bird receptors.	Moderate	High	Medium
TE058	65	Reedbed, floodplain grassland, scrub and other Natural Habitat associated with Shardara Reservoir	Permanent loss of Natural Habitat within the approximately 150 ha IBA/KBA footprint.	Moderate	High	Medium
TE069	76	IUCN- and Kazakhstan Red Data Book-listed flora	Permanent loss of suitable terrestrial habitat within the permanent railway footprint that may support flora of conservation significance.	Moderate	High	Low
TE078	78	IUCN-listed reptiles	Permanent loss of suitable steppe/semi-desert pasture and scrub habitat within the permanent railway footprint.	Moderate	High	Low

Table 87: Impact, Mitigation and Significance for Construction

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
AF003	4	Irrigation and drainage infrastructure	Risk of contamination of irrigation channels and adjacent agricultural land from fuels, oils, chemicals and construction plant or machinery.	Minor	Low	NS
AF005	5	Intensive agricultural production infrastructure, including polytunnels and covered cultivation	Soiling of crops, polytunnels and other intensive agricultural infrastructure by fugitive construction dust.	Minor	Low	NS

Vista Environment

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
AQ001	8	Ambient air quality at communities adjacent to the new alignment	Dust and gaseous emissions associated with concrete batching and related construction activities.	Negligible	NS	NS
AQ002	8	Ambient air quality at communities adjacent to the new alignment	Emissions from diesel-powered mobile construction plant and machinery with potential effects on local ambient air quality.	Minor	Medium	Low
AQ003	8	Ambient air quality at communities adjacent to the new alignment	Fugitive dust from earthworks, material stockpiles and vehicle movements on paved and unpaved roads.	Minor	Medium	Low
AQ004	8	Ambient air quality at communities adjacent to the new alignment	Criteria-pollutant emissions from stationary construction equipment including generators and other combustion sources.	Minor	NS	NS
AR003	10	Previously unidentified archaeological resources / chance finds	Potential discovery and disturbance of previously unidentified archaeological material during excavation and earthworks.	Moderate	Medium	Low
CS001	23	Local communities within the Project Area of Influence	Injury or other community-safety incidents caused by public encroachment into active work fronts, storage areas or construction compounds.	Minor	Medium	Low
CS002	12	Residents along construction access and haul routes	Increased road-traffic accident risk to communities arising from Project construction vehicles and material haulage.	Moderate	Medium	Low
CS003	23	Local communities within the Project Area of Influence	Community consequences of construction emergencies, including fires, major spills and Project-related transport incidents requiring effective emergency response.	Moderate	Medium	Low
MR001	18	Regional construction material resources	Project demand for aggregate, gravel, soil and other construction materials potentially placing pressure on existing local supply capacity or inducing additional extraction and transport impacts.	Minor	Low	NS
NO002	20	Noise-sensitive human receptors	Construction noise from earthworks, piling, plant, batching and construction traffic causing nuisance, amenity effects and potential sleep disturbance.	Minor	Medium	Low*
NO004	72	Buildings and structures sensitive to vibration	Structural or cosmetic damage risk from high-vibration construction activities including compaction, piling and ballast tamping.	Minor	Medium	Low

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
NO006	20	Noise-sensitive human receptors	Perceptible construction ground-borne vibration causing annoyance and potential sleep disturbance at receptors close to earthworks, piling and heavy plant.	Moderate	Medium	Low
SG001	29	Soil resources	Compaction, mixing and deterioration of soil physical, chemical and biological structure during construction and temporary land use.	Minor	Low	Low
SG002	43	Other watercourses, canals, drains and ditches	Diffuse and point-source pollution of watercourses and drainage features from spills, sediment and runoff from construction areas.	Minor	Low	NS
SG003	31	Land affected by existing contamination	Mobilisation of pre-existing soil or groundwater contamination during excavation and the associated requirement for appropriate handling and disposal.	Minor	Low	NS
TE002	33	Shardara IBA/KBA	Temporary loss of at least approximately 20 ha of wetland habitat for construction compounds, spoil storage and working areas.	Moderate	High	Medium
TE003	33	Shardara IBA/KBA	Construction disturbance from noise, light, vehicle movements and human activity affecting birds and other wildlife within and adjacent to the IBA/KBA.	Moderate	High	Medium
TE004	33	Shardara IBA/KBA	Pollution of water, soil and habitat within the IBA/KBA from sediment, fuel, chemicals and other construction-related releases.	Minor	Medium	NS
TE005	33	Shardara IBA/KBA	Temporary hydrological fragmentation caused by embankment construction, potentially affecting approximately 500 ha of reservoir habitat and approximately 3.25 million m^3 of active water storage west of the embankment.	Moderate	High	Medium
TE007	46	Dalmatian Pelican	Construction disturbance to Dalmatian Pelican through noise, lighting, machinery and human activity.	Minor	Medium	Low
TE008	46	Dalmatian Pelican	Temporary hydrological fragmentation affecting habitat used by Dalmatian Pelican.	Minor	Medium	Medium
TE009	46	Dalmatian Pelican	Risk of direct injury or mortality during site clearance and construction.	Minor	Medium	Low
TE010	74	Raptors and vultures of conservation significance	Construction disturbance to raptors and vultures from noise, lighting, machinery and human activity.	Minor	Medium	Low
TE011	74	Raptors and vultures of conservation significance	Risk of direct injury or mortality to raptors and vultures during construction and site clearance.	Minor	Medium	Low
TE012	37	Overwintering waterbird assemblage	Construction disturbance to wintering waterbirds through noise, lighting, plant movements and human activity.	Moderate	High	Low

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
TE016	64	Migratory bird assemblage	Construction disturbance to migratory birds using the reservoir and associated wetland habitats.	Minor	Medium	Low
TE017	64	Migratory bird assemblage	Temporary hydrological fragmentation and altered shallow-water habitat during embankment construction.	Minor	Medium	Low
TE019	64	Migratory bird assemblage	Risk of direct injury or mortality to migratory birds during site clearance and construction.	Minor	Medium	Low
TE021	74	Raptors and vultures of conservation significance	Risk of direct injury or mortality during site clearance and construction.	Minor	Medium	Low
TE022	83	Other threatened bird species	Construction disturbance to other threatened bird species.	Minor	Medium	Low
TE023	83	Other threatened bird species	Temporary hydrological fragmentation affecting habitats used by other threatened bird species.	Minor	Medium	Low
TE025	83	Other threatened bird species	Risk of direct injury or mortality during site clearance and construction.	Minor	Medium	Low
TE026	37	Overwintering waterbird assemblage	Construction disturbance to wintering birds.	Moderate	High	Low
TE027	37	Overwintering waterbird assemblage	Temporary hydrological fragmentation affecting wintering-bird habitat.	Moderate	High	Low
TE029	37	Overwintering waterbird assemblage	Risk of direct injury or mortality to wintering birds during site clearance.	Minor	Medium	Low
TE030	38	Breeding bird assemblage	Disturbance to breeding birds from construction noise, lighting and human activity.	Minor	Medium	Low
TE031	38	Breeding bird assemblage	Temporary hydrological fragmentation affecting breeding-bird habitat.	Minor	Medium	Low
TE033	38	Breeding bird assemblage	Risk of direct injury or mortality to breeding birds during site clearance.	Minor	Medium	Low
TE035	75	Other bird species of conservation significance	Temporary hydrological fragmentation affecting other bird species.	Minor	Medium	Low
TE037	75	Other bird species of conservation significance	Risk of direct injury or mortality during site clearance.	Minor	Medium	Low
TE039	83	Other threatened bird species	Temporary hydrological fragmentation affecting Lesser White-fronted Goose and other relevant bird receptors.	Minor	Medium	Low
TE041	75	Other bird species of conservation significance	Risk of direct injury or mortality during site clearance.	Minor	Medium	Low

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
TE042	75	Other bird species of conservation significance	Construction disturbance from noise, lighting and human activity.	Minor	Medium	Low
TE043	75	Other bird species of conservation significance	Risk of direct injury or mortality during site clearance.	Minor	Medium	Low
TE050	47	Ecosystem services provided by Shardara Reservoir	Temporary reduction of approximately 3.25 million m^3 of active reservoir storage west of the embankment during construction.	Moderate	High	Low
TE051	47	Ecosystem services provided by Shardara Reservoir	Temporary effects on fish populations and fishery-related ecosystem services associated with construction, sedimentation and temporary changes in reservoir conditions.	Minor	Medium	Low
TE052	79	IUCN-listed fish	Disturbance to threatened fish from bridge and in-channel construction,			

Table 88: Impact, Mitigation and Significance for Operations and Maintenance

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
AF006	71	Agricultural land users, livestock owners and grazing users	Risk of injury or death to domesticated livestock entering the operational railway corridor.	Moderate	Medium	Low
AF007	2	Productive agricultural land	Operational drainage effects from culverts and railway drainage structures, including downstream erosion and upstream ponding or flooding where structures are blocked, inadequately maintained or hydraulically deficient.	Moderate	Medium	Low
CS004	23	Local communities within the Project Area of Influence	Injury or fatality to members of the public through trespass or unauthorized access to operational railway infrastructure.	Moderate	Medium	Low
CS005	22	Road users, pedestrians and other users of existing transport routes	Road-user, pedestrian, agricultural-vehicle and livestock collision risk at public and farm crossings.	Moderate	Medium	Low
NO001	20	Noise-sensitive human receptors	Operational railway noise from train pass-bys, station activity, horn use, locomotive idling and shunting affecting residents and	Moderate	Medium	Medium

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
			other sensitive receptors, including sleep disturbance and loss of amenity.			
NO003	20	Noise-sensitive human receptors	Human exposure to operational ground-borne vibration from passing freight and passenger trains, particularly at Maktaaral and Ushagash.	Moderate	Medium	Low
TE081	33	Shardara IBA/KBA	Operational pollution of water and soil from locomotive fuel, cargo spills and railway drainage within the IBA/KBA.	Moderate	Medium	Low
TE082	46	Dalmatian Pelican	Operational disturbance from train movements, idling, horn use, lighting and associated activity.	Low	Low	Low
TE083	46	Dalmatian Pelican	Mortality or injury through collision with railway electrical infrastructure.	High	High	Potentially High / BAP dependent
TE084	37	Overwintering waterbird assemblage	Operational disturbance from train movements, locomotive noise, horn use and lighting.	Low	Low	Low
TE085	37	Overwintering waterbird assemblage	Mortality or injury through collision with railway electrical infrastructure.	High	High	Low / BAP dependent
TE086	64	Migratory bird assemblage	Mortality or injury through collision with railway electrical infrastructure.	High	High	Low / BAP dependent
TE087	74	Raptors and vultures of conservation significance	Operational disturbance associated with train movements and railway activity.	Low	Low	Low
TE088	74	Raptors and vultures of conservation significance	Mortality or injury through collision with or electrocution by railway electrical infrastructure.	High	High	Low
TE089	83	Other threatened bird species	Operational disturbance associated with train movements and railway activity.	Low	Low	Low
TE090	83	Other threatened bird species	Mortality or injury through collision with or electrocution by railway electrical infrastructure.	Moderate	High	Low
TE091	37	Overwintering waterbird assemblage	Operational disturbance from train and locomotive activity.	Low	Low	Low
TE092	37	Overwintering waterbird assemblage	Mortality or injury through collision with railway electrical infrastructure.	High	High	Low
TE093	38	Breeding bird assemblage	Operational disturbance from train movements, noise and lighting.	Low	Low	Low
TE094	38	Breeding bird assemblage	Mortality or injury through collision with railway electrical infrastructure.	Moderate–High	High	Low

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
TE095	74	Raptors and vultures of conservation significance	Operational disturbance from trains and associated railway activity.	Low	Low	Low
TE096	74	Raptors and vultures of conservation significance	Mortality or injury through collision with or electrocution by railway electrical infrastructure.	High	High	Low
TE097	75	Other bird species of conservation significance	Operational disturbance from trains and associated railway activity.	Low	Low	Low
TE098	75	Other bird species of conservation significance	Mortality or injury through collision with railway electrical infrastructure.	Moderate	High	Low
TE099	75	Other bird species of conservation significance	Operational disturbance from train movements, horn use, lighting and associated activity.	Negligible	NS	NS
TE108	47	Ecosystem services provided by Shardara Reservoir	Pollution of reservoir ecosystem services from operational fuel or cargo spills.	Minor	Medium	Low
TE109	79	IUCN-listed fish	Operational water pollution from locomotive fuel, cargo or other railway-related spills.	Minor	Medium	Low
TE112	80	IUCN-listed invertebrates	Operational water pollution affecting invertebrate receptors.	Minor	Medium	Low
TE113	77	IUCN-listed mammals	Mortality or injury to mammals through collision with operating trains.	Moderate	Medium	Low
TE115	63	Natural wetland habitat	Pollution of wetland habitat from locomotive fuel, cargo spills or railway drainage.	Minor	Medium	Low
TE116	76	IUCN- and Kazakhstan Red Data Book-listed flora	Soil pollution affecting flora of conservation significance as a result of operational spills.	Minor	Medium	Low
TE121	78	IUCN-listed reptiles	Mortality or injury to reptiles through collision with operating trains.	Moderate	Medium	Low
TE122	75	Other bird species of conservation significance	Operational disturbance from train and locomotive noise along the railway corridor.	Negligible	NS	NS
TE123	82	Invasive species	Introduction or spread of invasive alien species during operation through rolling stock, maintenance activity and disturbed trackside ground.	Minor	Low	NS
WH007	84	Operational and maintenance workforce	Serious injury or fatality during inspection and maintenance of track and railway infrastructure, including work on or adjacent to live railway operations.	Moderate	High	Low

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
WH008	84	Operational and maintenance workforce	Electrical shock, burns, arc flash or fatal electrocution during maintenance of 10 kV distribution and associated electrical systems.	Moderate	Medium	Low
WH009	84	Operational and maintenance workforce	Serious injury or fatality to railway workers and emergency responders during derailments, collisions, fires, dangerous-goods incidents and other railway emergencies.	Moderate	Medium	Low
GHG002	85	Global and regional climate	Operational Scope 1 emissions from diesel traction and Scope 2 emissions from electricity use. Annual tCO_2e estimate to be updated following recalculation using the OVOS operating basis.	Moderate	Medium	Medium
EMF001	88	Residents near the auxiliary 10 kV OHL and associated electrical infrastructure	Community exposure to electromagnetic fields from 10 kV auxiliary overhead lines and transformer installations.	Negligible	Low	Low
CC001	86	Project infrastructure exposed to physical climate hazards	Long-term physical climate risks including river flood, rainfall-induced slope instability and increasing temperature/track-buckling risk over the Project design life.	High	High	Moderate
HG002	43	Other watercourses, canals, drains and ditches	Operational hydraulic effects associated with culverts, including increased downstream flow velocity and erosion, upstream ponding and loss of hydraulic capacity if inspection and cleaning are inadequate.	Moderate	Medium	Low
HC001	23	Local communities within the Project Area of Influence	Low-probability/high-consequence hazardous-cargo accident involving derailment, collision or other railway emergency, with potential consequences for communities, the Syr Darya/Shardara IBA/KBA, water resources and agricultural infrastructure.	Major	Medium	Medium
WM004	28	Groundwater resources and hydrogeological regime	Hazardous and biosecurity-related waste generated at the Maktaaral disinfection complex, including disinfectant residues, contaminated wash-water, PPE and biological materials, with potential soil and groundwater contamination if poorly managed.	Minor	Medium	Low
WR001	96 – new	Regional water resources and existing potable-water supply users	Operational water demand at Maktaaral Station and the biosecurity/disinfection facilities, with potential effects on existing potable-water users if the existing network lacks sufficient sustainable capacity.	Minor	Medium	Low

Impact ID	VER No.	VER affected	Summary Description	Impact Magnitude	Sig. before mitigation	Sig. after mitigation
CS008	23	Local communities within the Project Area of Influence	Community health and safety risk associated with accidental chemical release and biosecurity-related incidents at the Maktaaral disinfection complex.	Minor	Medium	Low
WM005	28	Groundwater resources and hydrogeological regime	Hazardous and non-hazardous waste generated by locomotive and wagon servicing at Yerdaut, with potential soil and groundwater contamination if storage, transport or disposal is inadequate.	Minor	Medium	Low
SG004	28	Groundwater resources and hydrogeological regime	Fuel-storage, unloading and locomotive-refuelling spill risk at Yerdaut, including potential contamination of soil, shallow groundwater and drainage infrastructure.	Minor	Medium	Low
WH011	84	Operational and maintenance workforce	OHS risks to the Yerdaut locomotive-maintenance workforce, including interaction with rolling stock, lifting, fuel handling, work at height, confined spaces, hot work and electrical servicing.	Moderate	Medium	Low
WR002	96 – new	Regional water resources and existing potable-water supply users	Operational water demand at Yerdaut Station and servicing facilities, with potential effects on existing water users where network capacity or headroom is inadequate.	Minor	Medium	Low
AF008	4	Irrigation and drainage infrastructure	Operational severance or degradation of irrigation-network performance where individual crossings do not maintain adequate hydraulic function, including blockage, sedimentation, erosion and altered flow.	Minor	Medium	Low
WH012	84	Operational and maintenance workforce	Health, safety and welfare risks associated with Project-provided operational worker accommodation, locomotive crew-rest facilities and related welfare infrastructure.	Minor	Medium	Low
SG005	43	Other watercourses, canals, drains and ditches	Operational diffuse water and soil pollution from minor spills and discharges associated with routine railway operation outside the IBA/KBA.	Minor	Medium	Low
LV001	14	Landscape character and public views	Permanent operational presence of the railway, embankment, bridges, stations, sidings and associated infrastructure causing long-term change in landscape character.	Major	Medium	Medium
LV002	14	Landscape character and public views	Long-term change in views experienced by residents, land users, travellers and recreational users as a result of permanent railway infrastructure and operations.	Moderate	Medium	Medium

8.4 Topic Based Narrative by Design Stage

This section provides the supporting site-specific narrative for the impacts summarized in the four tables in Section 8.3. It is organized into four subsections corresponding to the Project stages of Design, Land Take, Construction, and Operations and Maintenance. Within each subsection, the narrative is grouped by environmental and social topic, covering only those topics for which impacts have been identified at that stage.

The purpose of the narrative is to set out the site-specific context, technical reasoning and design response that sit behind the significance scores recorded in the tables. It is not intended to repeat the scoring or the listing of mitigation measures, which remain the authoritative record in Section 8.3, but to explain why each significant impact has been judged as it has, including the characteristics of the affected VER and the nature, scale and duration of the predicted change, to describe the receiving environment and receptors in sufficient detail to support the conclusions, and to identify where further assessment or design development is required at the EPC stage or during construction. Where relevant, the assessment distinguishes between measures already incorporated into or implemented as part of the Project and additional mitigation identified through this Supplementary ESIA, taking account of the current stage of Project design and construction. The supporting VER sensitivity assessments and detailed impact-magnitude scoring are provided in Annex G.

8.4.1 Design

Design-stage impacts arise from the principal engineering decisions taken before construction begins — the horizontal and vertical alignment of the track, the location of the Right of Way, the position of crossing structures and stations, and the engineering form of the line (predominantly embankment). These decisions establish the permanent geometry of the Project and therefore lock in a set of impacts for which the principal opportunities for avoidance occur at design stage and which may subsequently be reduced, but generally cannot be fully avoided, through construction or operational mitigation**.** The Design subsection focuses on those impacts; impacts arising from the act of taking land are addressed under Land Take (Section 8.4.2), and impacts from the physical works themselves under Construction (Section 8.4.3).

8.4.1.1. Post-construction-start context

Construction commenced in 2024 prior to the effectiveness of this Supplementary ESIA and its ESMP, with approximately 100 km of alignment levelled and approximately 4 km of track laid at the date of this Supplementary ESIA. The horizontal and vertical alignment, the location of the Right of Way, the position of crossing structures and stations, and the engineering form of the line have substantially been determined and, in many locations, implemented. The Design subsection accordingly distinguishes between (a) realized design decisions that have shaped the as-designed Project and which are described here as design outcomes; and (b) genuinely forward-looking EPC-stage and pre-construction items that remain to be delivered, which are described as commitments with binding effect under the EPC Contract and the ESMP. The Design and Pre-Construction Phase ESMP operates as a verification framework requiring the EPC Contractor to confirm that the as-built design reflects the mitigation commitments set out in this Supplementary ESIA, to identify and report any departures, and to identify any unanticipated impacts; the verification framework is exercised under the IESC and ESCA Corrective Action Plan transition framework documented in Section 10 of this Supplementary ESIA.

8.4.1.2. Mitigation hierarchy outcomes

The developed Project design incorporates a number of outcomes that reduce impacts relative to an unmitigated design:

(i) localized alignment adjustment associated with the avoidance of a known archaeological feature during earlier design development, together with site-specific protection arrangements for archaeological receptors identified by subsequent investigations;

(ii) inclusion of culverts, agricultural and livestock passages, road crossings and bridge structures that provide cross-corridor connectivity, while recognizing that the adequacy and location of this provision for particular communities and agricultural users requires site-specific verification, and

(iii) use of a comparatively constrained formation across the Shardara Reservoir IBA/KBA, limiting the permanent Project footprint within the designated area to approximately 150 ha.

These outcomes are realized in the as-designed Project. Despite these measures, a number of significant residual impacts at the design stage remain, the most material is the impact on the Shardara Reservoir IBA/KBA and Critical Habitat (PG001), for which the selected alignment results in unavoidable habitat loss within the designated area and which is therefore carried forward to the Biodiversity Action Plan and applicable compensation/offset framework discussed under Construction.

8.4.1.3. Agriculture

Agricultural land use and sensitivity vary along the Project alignment. In Saryagash and Keles districts, affected agricultural land is predominantly non-irrigated land and pasture, with more limited areas of cultivated land, including rainfed wheat. In Zhetysay and Maktaaral districts, agriculture is substantially more dependent on irrigation, with affected land in Zhetysay principally used for irrigated wheat and cotton production and affected land in Maktaaral predominantly used for irrigated cotton production. Consequently, the principal Project-related risks to agricultural functionality also vary spatially: livestock and agricultural access/severance are of particular importance in pasture-dominated areas, while irrigation continuity, plot fragmentation, agricultural machinery access and drainage are particularly important in the irrigated agricultural areas of Zhetysay and Maktaaral. This spatial distinction is consistent with the national OVOS, which identifies extensive networks of supply and distribution canals, drainage collectors and discharge channels within the irrigated sections of the alignment, with particularly developed irrigation systems identified on the second to fourth Project sections

The LARP further shows that the sensitivity of affected agricultural land depends not only on the area acquired but also on the functionality of the residual holding, including its size and configuration, continued access, irrigation and drainage connectivity, and agricultural machinery access. The LARP identifies 61 fragmented irrigated plots with residual areas of 3 ha or less, including 21 plots with residual areas of 1 ha or less. These findings demonstrate that Project effects on agriculture can extend beyond the land physically occupied by the railway where severance or disruption of agricultural infrastructure affects the continued usability or productivity of residual land.

AF001 – Severance of agricultural land and livestock access

Source and pathway. The railway, constructed predominantly on embankment, creates a permanent linear barrier through agricultural land. The alignment can separate agricultural holdings from associated farmsteads, neighboring parcels, grazing areas, water points and existing agricultural and livestock movement routes. Where an existing formal or informal route is severed or substantially diverted, farmers may experience increased journey distances, time and operating costs when moving between fields, while livestock owners may experience restricted or more circuitous access between settlements, grazing areas and water resources.

Embedded Design Mitigation. The Project design incorporates dedicated livestock and agricultural passages together with larger box culverts capable of supporting livestock movement. The location and dimensions of livestock crossings have been informed by consultation with affected communities and local authorities (2026) concerning established livestock routes and access to pasture. This includes 4 × 2.5 m livestock passages at KM 22.9 and KM 42.8, together with a livestock passage at

KM 55.1 recorded in the design register as 4 × 2.5 m, for which the final effective clear height and practical suitability remain subject to as-built verification. Across the approximately 115 km alignment, the structures inventory identifies extensive provision for cross-corridor movement. The practical adequacy of this provision depends not only on the number and spacing of structures, but also on their location and usability relative to established agricultural and livestock movement patterns.

VER and sensitivity. The principal receptors are agricultural land users, livestock owners and agricultural holdings dependent upon continued cross-corridor access. Agriculture represents an important livelihood source within the Project corridor, although susceptibility varies according to agricultural activity, availability of alternative access and the functionality of residual holdings. Agricultural access and livestock movement are therefore assessed as a **Moderate-sensitivity VER**.

Impact. The permanent railway will alter some existing agricultural and livestock movement routes. Without adequate crossing provision, this could increase travel distances and costs, constrain movement of agricultural machinery and livestock and, in individual cases, affect the continued practical or economic use of residual agricultural land.

Consultation with affected communities has informed the location and dimensions of livestock crossings and, at specific locations, resulted in modifications to the crossing design. At Shyrildak/Zhabaitobe in Keles District, an on-site consultation was held on 6 March 2026 with approximately 50 local residents, together with representatives of the Keles District and Birtilek rural Akimats, KTZ and the Project designer. Residents explained that approximately 800–1,000 cattle and 4,000 smaller livestock were kept or grazed on the opposite side of the railway from the settlements and that the established livestock route crossed the alignment around KM 22.9. They indicated that approximately 600–800 animals could use the route at one time and raised concerns that the proposed smaller crossing would be inadequate, requesting a passage approximately 4 m wide. The issue was subsequently raised formally by the Birtilek rural Akimat and the resulting design provides a 4 × 2.5 m livestock passage at KM 22.9.

A further on-site consultation was held on 6 March 2026 in the Birtilek area around KM 55.0–55.1, also involving approximately 50 residents together with representatives of the local authorities, KTZ and Project representatives. Residents identified the route around KM 55.0 as the principal means by which livestock access pasture on the opposite side of the railway and reported approximately 800–1,000 cattle using the surrounding grazing area. Particular concern was raised that a 2 × 2 m crossing would be too small for practical livestock movement, and residents requested a larger passage. The subsequent design register records a 4 × 2.5 m livestock passage at KM 55.1. However, the signed consultation minutes of 6 March 2026 record that technical constraints at this location may limit the effective clear height to approximately 2 m while providing approximately 4 m usable width. The final as-built dimensions, approaches and practical suitability of the structure for the livestock movements identified during consultation shall therefore be verified before operation.

Livestock access was also discussed in the Sattarov/Oshakty area. Earlier consultation and correspondence with local residents and authorities identified the need to maintain safe access between settlements and pasture on opposite sides of the railway, with residents specifically raising concerns about the safety of driving livestock across the railway itself. During the subsequent ESIA consultation at Oshakty on 20 May 2026, residents again raised the number, dimensions and practical usability of crossings, explaining that smaller drainage structures could be too narrow, long and dark for cattle and that common crossing routes were used by livestock from several settlements several times each day. The final Project design includes a 4 × 2.5 m livestock passage at KM 42.8.

Subsequent Akimat correspondence and formal KTZ responses confirm that a request for an additional crossing around KM44.8 was not accepted on design grounds, with the KM42.8 crossing identified as the alternative crossing point. The practical accessibility and adequacy of this arrangement will therefore form part of the pre-operation as-built access verification.

Taken together, these consultations demonstrate that livestock severance is a **location-specific impact**, dependent on the relationship between the railway alignment, settlements, established livestock routes and access to pasture. They also demonstrate that consultation has been used to identify locally important routes and to inform the dimensions and location of crossing structures. While the crossing network incorporated into the Project substantially reduces the overall barrier effect, localized impacts may occur where established routes are severed and available crossings result in a material diversion or restriction of access. On this basis, the impact is assessed as **Moderate magnitude and Medium adverse significance**.

Mitigation and design response. For sections already constructed, the adequacy of the as-built crossing provision shall be verified against actual agricultural and livestock access requirements, taking account of crossing dimensions, approach conditions, accessibility, practical usability, location relative to established movement routes and the resulting diversion distance. Particular attention shall be given to locations where affected communities have raised specific access concerns and to longer-spaced reaches where the availability of suitable alternative crossings may result in material diversions.

Where verification identifies a material connectivity deficiency, KTZ and the EPC Contractor shall consult with affected users and implement technically and operationally practicable corrective measures. These may include improving access to an existing crossing, adapting a suitable existing structure or, where necessary and technically feasible, providing additional crossing provision. This verification and any required corrective measures shall be completed before the start of operations.

Residual impact. Subject to completion of the verification and implementation of practicable corrective measures where material deficiencies are identified, the extensive embedded crossing provision is expected to maintain reasonable agricultural and livestock connectivity across the alignment. Some localized increases in journey distance may remain. The residual impact is assessed as Minor magnitude and Low adverse significance.

AF002 – Loss of agricultural infrastructure connectivity

Source and pathway. The railway crosses an extensively modified agricultural irrigation and drainage network, particularly within the intensive irrigated agricultural areas of Zhetysay and Maktaaral. The national OVOS confirms that the alignment crosses irrigated areas containing numerous supply and distribution canals, drainage collectors and discharge channels, with particularly developed irrigation systems identified on the second, third and fourth Project sections.

The permanent railway embankment and associated structures could interrupt, constrict or otherwise alter these systems. Loss or reduction of irrigation supply could reduce agricultural productivity or render residual agricultural plots unsuitable for their existing use, while obstruction of drainage could contribute to waterlogging or deterioration of agricultural land. The potential impact is therefore not limited to the physical railway footprint.

The LARP confirms the importance of this pathway to residual-land viability and requires consideration of irrigation, drainage and access alongside residual plot size and configuration. It also provides for restoration or reconstruction of irrigation canals, pipelines, drainage systems and water access points affected by Project activities.

Embedded design mitigation. The as-designed Project provides structures intended to maintain drainage patterns and irrigation connectivity through the railway embankment. The hydraulic and agricultural functionality of affected irrigation canals, pipelines, drainage collectors and associated infrastructure is intended to be maintained through the permanent design.

VER and sensitivity. The principal receptors are irrigation and drainage infrastructure, productive irrigated agricultural land and agricultural users dependent upon continued functionality of these systems. Sensitivity is particularly high within Zhetysay and Maktaaral because agricultural production

is dependent upon managed irrigation and functioning drainage and disruption of individual elements of the network can affect land beyond the immediate Project footprint. The VER is assessed as **Moderate sensitivity.** Although agricultural production in Zhetysay and Maktaaral is dependent on managed irrigation and drainage, affected infrastructure is generally capable of being restored, reconstructed or otherwise reinstated where Project-related disruption occurs.

Impact. Permanent interruption, inadequate hydraulic capacity or inappropriate modification of an irrigation or drainage feature could reduce irrigation availability, impair agricultural drainage and affect the continued agricultural use of residual land. Given the density of the irrigation and drainage network and agricultural dependence upon it in the southern corridor, the impact is assessed as **Moderate magnitude and Medium adverse significance**.

Construction experience also demonstrates that this pathway is real rather than solely predictive. LARP consultations have reported damage to irrigation infrastructure, associated loss of agricultural productivity and inability to cultivate affected land at some locations. Such cases require verification and corrective action where attributable to the Project.

Mitigation and design response. For remaining construction areas, affected infrastructure shall be verified and condition-recorded before works at the relevant location. Where temporary interruption is unavoidable, temporary arrangements shall be provided where reasonably practicable and permanent functionality restored promptly.

For sections already constructed, KTZ shall complete as-built verification of relevant irrigation and drainage crossing structures and undertake consultation with users at locations where irrigation-related concerns were raised. The verification shall determine whether construction has resulted in physical damage to irrigation or drainage infrastructure and whether any associated crop, production, income or other economic losses have occurred. The fact that concerns were raised does not in itself establish that an impact or economic loss occurred.

The findings shall be documented in an Irrigation Verification Report. Where Project-related physical damage or deficiencies, or crop, production, income or other economic losses are verified, KTZ shall prepare a Corrective Action Plan identifying the required physical corrective or reinstatement works, compensation and/or livelihood-restoration measures, responsibilities, budget and implementation schedule. Physical corrective and reinstatement works shall be implemented through the ESMP, while compensation and livelihood-restoration measures shall be implemented in accordance with the applicable provisions of the LARP. Verification of the functionality of affected irrigation and drainage infrastructure, and completion of any material physical corrective works, shall be completed before the start of operations.

Residual impact. With embedded continuity structures, verification of as-built functionality and implementation of corrective works where deficiencies are identified, widespread permanent loss of agricultural productivity due to severance of irrigation or drainage infrastructure is not expected. Remaining effects are expected to be localized and remediable. Subject to completion of these measures before start of operations, the residual impact is assessed as **Minor magnitude and Low adverse significance.**

AF007 – Embankment effects on shallow groundwater and agricultural drainage

Source and pathway. The predominantly embanked railway has the potential to alter shallow subsurface water movement where the alignment crosses the groundwater gradient or occurs in areas of shallow groundwater. Where the formation or associated structures impede lateral groundwater movement, groundwater levels could rise on the up-gradient side of the railway, potentially contributing to waterlogging and secondary salinization of adjacent agricultural land; conversely, altered movement could locally reduce soil moisture on the down-gradient side.

This pathway is particularly relevant within low-lying irrigated agricultural areas where agricultural productivity depends upon the combined functioning of irrigation, drainage and shallow groundwater systems. The national OVOS identifies flooding, waterlogging, secondary salinization and drying among the forms of land degradation that require prevention, although it does not specifically assess whether the Project embankment could cause such effects through impedance of shallow groundwater movement.

VER and sensitivity. The principal receptors are the shallow groundwater/hydrogeological regime, productive agricultural soils and agricultural land susceptible to changes in groundwater and drainage conditions. Sensitivity is greatest in intensively irrigated areas where persistent waterlogging or salinization could materially affect crop productivity. The VER is assessed as **moderate sensitivity**.

Impact. Available geological, hydrogeological and agricultural information is sufficient to identify the potential impact pathway and the areas in which the risk is most relevant; however, site-specific verification is required to determine whether the permanent embankment materially impedes shallow groundwater or agricultural drainage at individual locations. The available OVOS documentation does not provide a corridor-wide quantitative assessment demonstrating that this effect has been eliminated.

The potential effect is expected to be geographically localized and is amenable to engineering correction through drainage measures where identified. Nevertheless, because the railway formation is permanent and site-specific verification remains outstanding, the impact is assessed on a precautionary basis as **Moderate magnitude (although scored minor) and Medium adverse significance**.

Mitigation and outstanding action. Locations potentially susceptible to groundwater impedance shall be identified using available geotechnical and hydrogeological information, irrigation and drainage mapping, field inspection, stakeholder information and evidence of existing or emerging waterlogging. At these locations, targeted assessment shall determine whether the railway materially affects shallow groundwater movement or agricultural drainage and whether existing culverts, drains and other hydraulic structures provide adequate connectivity.

Where a material Project-induced effect is confirmed, technically appropriate corrective drainage or other engineering measures shall be designed and implemented. Any verified livelihood effects resulting from loss of agricultural productivity shall be addressed in accordance with the LARP.

The targeted assessment should be completed before start of operations. Where the assessment identifies locations at which the actual response of shallow groundwater to the permanent railway embankment cannot be reliably determined before operation, monitoring should continue through the first year of operation, with corrective measures implemented where a material Project-induced effect is demonstrated.

Residual impact. Pending completion of the targeted assessment and confirmation of the effectiveness of any required corrective measures, the residual impact is conservatively retained as **Moderate magnitude and Medium adverse significance**. The significance may subsequently be reviewed where assessment and monitoring demonstrate that material Project-induced effects are absent or have been effectively mitigated.

8.4.1.4. Archaeology

The Project corridor is archaeologically sensitive, with known archaeological resources identified through successive historical-cultural investigations, as described in Section 7.7. The feasibility-stage assessment identified nine historical and cultural heritage sites, comprising settlement and funerary sites, while the subsequent historical-cultural assessment included in Appendix 7 of the national OVOS identifies 33 individual burial mounds distributed across eight archaeological sites or site groups (Birlik 1–8). Several of the later receptors are located in close proximity to the developed railway alignment,

including individual mounds associated with Birlik 6 and Birlik 8 recorded approximately 4 m and 5 m respectively from the railway axis. The historical-cultural assessment defines preliminary protection-zone arrangements around the identified archaeological features, comprising monument protection zones, development regulation zones and protected natural landscape zones, which are to be taken into account in detailed Project design.

The archaeological investigations and associated protection requirements represent an important constraint on the detailed Project design and construction footprint. Available ESCA information indicates that archaeological constraints informed aspects of the design, including localized realignment to avoid at least one identified archaeological feature. However, the documentation available for preparation of this Supplementary ESIA does not provide a complete receptor-by-receptor record demonstrating the final treatment of every identified archaeological site and associated protection zone. Given the advanced stage of construction, complete retrospective reconstruction of this information may not be practicable. The assessment therefore adopts a precautionary approach and does not assume that avoidance of all known archaeological receptors and applicable protection zones has been demonstrated.

AR001 – Direct impact on known archaeological resources

Source and pathway. The principal impact pathway is the spatial relationship between the permanent railway alignment and known archaeological sites and their applicable protection zones. Direct intersection by the railway formation or associated infrastructure could result in physical disturbance or loss of archaeological material, while works within applicable protection or development-control zones could affect the integrity of known receptors.

The feasibility-stage historical-cultural assessment identified substantial interaction between the original alignment and known archaeological resources. Six of the nine receptors identified at that stage were intersected by the proposed alignment or their protection zones. The assessment identified a 40 m protection zone around recorded monuments, within which new construction was prohibited, and required archaeological investigation and excavation where avoidance could not be achieved. KTZ_DM 260926(1)

Subsequent historical-cultural assessment undertaken as the Project design developed identified the Birlik 1–8 sites, comprising 33 individual burial mounds, and established site-specific heritage protection arrangements. Several archaeological features are located very close to the railway axis, including mounds at Birlik 6 and Birlik 8 recorded approximately 4 m and 5 m respectively from the axis, while the closest recorded mound at Birlik 1 is approximately 28 m from the axis. These distances place the receptors within the range requiring particular consideration under the heritage protection requirements identified through the Project's historical-cultural assessments. The absence of direct intersection with the recorded centre or footprint of a mound cannot therefore, by itself, be taken as demonstrating compliance with the applicable site-specific heritage protection requirements. KTZ_DM 260926(1)

VER and sensitivity. Known archaeological sites are finite and non-renewable cultural heritage resources. Physical loss or substantial disturbance is irreversible, and the identified receptors are subject to specific protection requirements under national cultural heritage procedures. Known archaeological resources are therefore assessed as a **High-sensitivity VER**.

Impact. Direct physical disturbance of a known archaeological receptor could result in permanent and irreversible loss of archaeological fabric and associated historical, scientific and cultural information. Although such effects would generally be spatially localised, their irreversible nature results in an assessed **Moderate magnitude**. Given the High sensitivity of the receptors, the potential direct impact on known archaeological resources is assessed as **High adverse significance before mitigation**.

Historical-cultural investigations and site-specific protection planning were undertaken during Project development, and archaeological constraints informed aspects of the Project design, including

localised alignment adjustment to avoid an identified archaeological feature. Given the proximity of several known receptors to the railway alignment, specific protection and management measures are required for remaining works and Project close-out.

Mitigation and design response. The mitigation hierarchy for known archaeological resources is avoidance of identified monuments and their applicable protection areas wherever practicable. Where avoidance cannot be achieved, archaeological investigation, excavation, recording, protection or other treatment shall be undertaken in accordance with national cultural heritage requirements and subject to the requirements and approval of the competent cultural heritage authority.

For all remaining works, known archaeological sites and their applicable monument-protection, development-regulation and protected-natural-landscape zones shall be treated as Project constraints and incorporated into the Cultural Heritage Management Plan (CHMP), construction drawings and contractor constraint mapping. Potentially damaging works shall not proceed within or immediately adjacent to a known archaeological receptor or applicable protection area unless avoidance has been demonstrated or the required archaeological investigation, treatment and competent-authority approval has been completed. Appropriate demarcation, access restrictions, contractor controls and archaeological supervision shall be applied where relevant.

For sections where construction has already occurred, KTZ shall review relevant archaeological, design, construction and competent-authority records and record the status of known archaeological receptors in the Project cultural heritage register. The review shall prioritize receptors in closest proximity to the railway alignment, including Birlik 6 and Birlik 8, and shall be completed before commencement of operations. Any outstanding action required by the competent cultural heritage authority shall be implemented.

Where physical disturbance of a known archaeological receptor is identified, it shall be recorded as a realized impact. Any subsequent archaeological investigation, recording or other action required by the competent authority shall be implemented to address outstanding cultural heritage requirements and support the protection and management of remaining archaeological resources.

The Project Chance Find Procedure shall apply to all remaining ground-disturbing works. In the event of a suspected archaeological or cultural heritage find, work in the immediate area shall stop, the find shall be protected from further disturbance, and the competent cultural heritage authority and appropriately qualified archaeological personnel shall be notified in accordance with the procedure. Works shall recommence only following the required assessment and authorization.

Residual impact. Implementation of the CHMP, protection of known archaeological receptors and their applicable protection areas, competent-authority oversight of any unavoidable archaeological treatment, and implementation of the Chance Find Procedure will substantially reduce the potential for further impacts. For completed sections, the cultural heritage register and close-out review will provide the mechanism for identifying and addressing any outstanding heritage requirements.

With these measures in place, the residual magnitude is assessed as **Minor**. Given the High sensitivity and non-renewable nature of the archaeological receptors, the residual impact for AR001 is assessed as **Medium adverse significance**.

8.4.1.5. Hydrology

The Project crosses a range of natural and engineered surface-water features, including the Syr Darya River, the Shardara Reservoir margin and floodplain, the Keles and Kurukkeles rivers, ephemeral drainage channels in the northern part of the corridor, and an extensive network of irrigation and drainage channels farther south. The Syr Darya is crossed by the approximately 500 m Project bridge, while smaller watercourses, ephemeral channels and irrigation/drainage features are crossed by bridges, culverts and other drainage structures.

The Project is constructed predominantly on embankment. While elevation of the railway formation provides resilience against inundation of the railway itself, the embankment also forms a permanent linear barrier across existing surface-water pathways. The principal design-stage hydrological impact therefore concerns whether sufficient hydraulic connectivity has been maintained through the permanent railway formation to avoid materially altering existing drainage patterns or increasing flood risk.

HG001 – Alteration of surface-water flow and increased flood risk

Source and pathway. The permanent railway embankment intersects natural watercourses, ephemeral drainage lines, irrigation and drainage networks and the wider Syr Darya/Shardara hydrological system. Where hydraulic openings are absent, inadequately located or insufficiently sized, the embankment could restrict cross-corridor flow, resulting in upstream ponding or increased flood extent. Concentration of flows through inadequately configured structures could also increase local flow velocities and associated erosion or scour.

The nature and scale of this pathway vary substantially along the alignment. In the northern Saryagash and Keles sections, numerous small ephemeral channels convey runoff principally during snowmelt and intense rainfall events. In the southern Zhetysay and Maktaaral sections, drainage is increasingly controlled by the engineered irrigation and drainage network. The most significant natural hydrological interface occurs at the Syr Darya and Shardara Reservoir, where the railway crosses a much larger and more complex river/floodplain/reservoir system.

The national OVOS similarly identifies the Syr Darya floodplain and the dense irrigation and drainage network of the southern corridor as important features crossed by the alignment, and records shallow groundwater and weak water-saturated ground in parts of the irrigated and floodplain sections. In these areas, the design incorporates free-draining formation materials and geosynthetic reinforcement to improve formation stability and drainage.

VER and sensitivity. The principal VER comprises the surface-water resources and drainage systems crossed or potentially influenced by the Project, including local drainage lines and watercourses and the wider Syr Darya/Shardara hydrological system. Sensitivity varies spatially, with the Syr Darya/Shardara system having greater regional importance for water regulation, irrigation and internationally important wetland habitats than the smaller ephemeral drainage features crossed elsewhere along the alignment. Taking account of this variation across the Project corridor, surface-water resources and drainage systems are assessed overall as a Moderate-sensitivity VER, while the greater sensitivity of the Syr Darya/Shardara interface is taken into account in the location-specific assessment and mitigation requirements.

Embedded Mitigation. The Project design incorporates substantial cross-drainage provision. Culverts and smaller bridge structures are used to maintain drainage across the alignment, while the Syr Darya is crossed by the approximately 500 m main bridge. Within the wider Shardara Reservoir crossing, the design also provides four additional bridge structures intended to maintain hydrological connectivity through the railway embankment. The Design ESMP requires these additional openings to be confirmed in the as-built design and the total hydraulic opening across the reservoir crossing to be verified against the design intent.

Permanent developed areas at the Project stations also incorporate dedicated stormwater-management systems, including drainage channels, stormwater inlets, closed drainage networks, pumping and treatment infrastructure and storage/evaporation ponds. These provide embedded design control of runoff from developed surfaces and reduce the potential for localized increases in runoff or ponding associated with the station footprints.

Impact. In the absence of adequate cross-drainage, the permanent railway embankment could obstruct or redistribute surface-water flow, resulting in localized ponding, increased flood levels or extent, erosion and scour. At smaller ephemeral drainage lines, effects would generally be spatially

localized. The potential consequence is greater at the Syr Darya/Shardara crossing because of the scale and complexity of the hydrological system and the environmental and agricultural receptors dependent upon it.

Hydraulic connectivity is, however, an integral component of the developed Project design. Culverts and bridge openings have been incorporated at drainage and watercourse crossings, including the main Syr Darya bridge and additional openings through the Shardara section. The impact is therefore not assessed on the basis of an impermeable railway embankment. Taking account of the scale of the Project, the sensitivity of the receiving hydrological environment and the hydraulic provision incorporated into the design, the impact is assessed as **Moderate magnitude and Medium adverse significance**.

A remaining design consideration concerns the adequacy of hydraulic capacity under future climate conditions. The Project Climate Resilience Assessment identifies the Syr Darya bridge, track embankments and drainage infrastructure as climate-sensitive assets. While the assessment does not predict a uniform increase in flood exposure across the corridor, it identifies uncertainty in future peak-flow conditions over the Project design life. The relevant hydrological pathways vary spatially: smaller ephemeral catchments may respond to changes in intense rainfall and snowmelt, while flood conditions at the Syr Darya crossing are influenced by upstream catchment conditions, snowmelt, reservoir regulation and regional water-management arrangements. The requirement is therefore to verify the hydraulic capacity of material structures against appropriate future climate-adjusted design flows rather than assuming a uniform rainfall – runoff response across the alignment.

Additional Mitigation. The final as-built Project shall maintain hydraulic connectivity at natural watercourses and material drainage pathways crossed by the railway and shall avoid unacceptable increases in upstream flood levels, downstream erosion or scour.

For the Shardara Reservoir/Syr Darya section, the main Syr Darya bridge and the four additional bridge structures intended to maintain cross-embankment hydrological connectivity shall be confirmed against the final/as-built design. The total effective hydraulic opening shall be verified as being consistent with the design intent.

The hydraulic capacity of material culverts, bridges and drainage structures shall also be verified against the applicable design flows, including an appropriate climate-change allowance. The Project Climate Resilience Assessment recommends review of culvert and drainage capacity against projected climate conditions and ensuring that embankment and bridge protection measures adequately account for flood and scour risk.

Where verification identifies inadequate hydraulic capacity or unacceptable hydraulic effects, appropriate design modifications shall be implemented. Depending on the nature and location of the deficiency, these may include increased or additional culvert capacity, relief structures, modification of inlet or outlet arrangements, additional hydraulic openings, or enhanced erosion and scour protection.

For sections already constructed, verification shall be undertaken against the as-built hydraulic configuration**,** rather than solely against the original design drawings, so that any material departures affecting hydraulic capacity or connectivity are identified.

The as-built hydraulic and climate-resilience verification, together with identification of any required corrective design measures, should be completed before start of operations**.** Any material corrective works necessary to provide adequate hydraulic connectivity or address unacceptable flood or scour risk should similarly be completed before the affected infrastructure is brought into operation.

Residual impact. The substantial hydraulic provision incorporated into the Project design means that widespread obstruction of existing surface-water flow is not expected. The principal remaining

uncertainty concerns confirmation of the as-built hydraulic configuration and the adequacy of individual structures under future climate-adjusted flood conditions.

Subject to completion of the hydraulic verification and implementation of any required corrective measures before start of operations**,** the residual impact is assessed as **Minor magnitude and Low adverse significance**.

8.4.1.6. Landscape and Visual

The Project passes through a predominantly low-relief landscape characterized by long horizons and extensive views. As described in Section 7.7, the alignment crosses open steppe landscapes in the northern and central sections, intensively modified irrigated agricultural landscapes in the south, settlement landscapes around the principal towns and villages, and the locally distinctive reservoir-margin landscape associated with the Shardara Reservoir.

The existing landscape is not pristine. Roads, transmission lines and pylons, existing railway infrastructure, irrigation networks, agricultural buildings and other infrastructure already introduce linear, vertical and industrial elements, particularly in the more developed southern sections. Nevertheless, the permanent railway introduces a new continuous linear feature comprising the raised embankment, track infrastructure, bridges, stations and associated structures. The design-stage assessment therefore considers separately the resulting change in landscape character and the change in views experienced by people within the Project area.

LV001 – Change in landscape character

Source and pathway. The principal sources of landscape change are the permanent railway embankment, bridges and bridge approaches, stations, sidings and associated railway infrastructure. These introduce a new continuous engineered feature through the existing landscape, with the degree of physical contrast varying according to the scale and form of the infrastructure and the character of the landscape crossed.

VER and sensitivity. Landscape sensitivity varies along the corridor. Intensively cultivated and settlement landscapes in Zhetysay and Maktaaral are assessed as **Low to Medium sensitivity** because they are already substantially modified and contain roads, irrigation infrastructure, utilities, agricultural buildings and other engineered features. Open steppe landscapes in Saryagash, Keles and Shardara districts are assessed as **Medium sensitivity** because of their openness, long horizons and relatively limited built development in some sections. The Shardara reservoir-margin landscape is assessed as **High sensitivity** because of its locally distinctive combination of open water, reedbeds, seasonally inundated flats and open steppe and its association with the internationally important biodiversity values of the reservoir.

For the purposes of the corridor-wide assessment, the landscape VER is assessed as **Medium sensitivity**, while recognizing the higher sensitivity of the Shardara Reservoir section.

Impact. The permanent railway results in a direct and long-term change to landscape character. The effect is less pronounced in the intensively modified agricultural and settlement landscapes of Zhetysay and Maktaaral, where the railway is experienced alongside existing infrastructure. In the open steppe and reservoir-margin sections, the contrast is greater and the embankment and major structures are more prominent within otherwise long and relatively uninterrupted horizons.

The alignment and vertical geometry are now substantially fixed, and much of the embankment formation has already been constructed or levelled. The principal landscape change is therefore largely a realized design outcome rather than an impact that can now be avoided through further alignment optimization.

Taking account of the permanent and continuous nature of the change, its spatial extent and the sensitivity of the landscapes crossed, the impact is assessed as **Moderate magnitude and Medium adverse significance**.

Mitigation and design response. The principal opportunities to avoid or minimize landscape effects arise through the permanent form and siting of Project infrastructure. For the alignment, embankment and major structures, these design decisions are now substantially realized.

Where detailed design of permanent facilities remains capable of refinement, architectural finishes and materials should use visually recessive and context-appropriate treatments where practicable. Where landscape planting forms part of the permanent design of stations, sidings, bridge approaches or other ancillary facilities, locally appropriate species should be used and planting targeted to locations where it assists integration of permanent structures into the surrounding landscape. Continuous planting along the open railway alignment is not proposed because it could itself emphasize the railway as an artificial linear feature.

Remaining architectural and permanent landscape-design requirements should be finalized before completion of the relevant permanent facilities**.**

Residual impact. The permanent railway will remain a prominent linear feature, particularly across the open steppe and Shardara Reservoir sections. Design treatment of concentrated permanent facilities can reduce their local prominence but cannot remove the fundamental landscape change.

The residual impact is assessed as **Moderate magnitude and Medium adverse significance**.

LV002 – Change in visual amenity

Source and pathway. The permanent embankment, bridges, stations and associated infrastructure will be visible from locations within the surrounding landscape. Visual exposure is influenced by receptor distance and orientation, infrastructure elevation, intervening vegetation and development, and local topography.

VER and sensitivity. Visual receptors comprise residents of settlements and individual properties with views towards the railway, people working on agricultural land close to the alignment, users of roads and other transport corridors, and recreational users of the Shardara Reservoir margin.

Residents with sustained views from their homes are assessed as **High sensitivity**. Recreational users of the Shardara Reservoir margin are also relatively sensitive because appreciation of the surrounding landscape forms part of their experience. Agricultural workers and travelers are generally of **Low to Medium sensitivity**, as their views are more intermittent or incidental. For the corridor-wide assessment, visual receptors are assessed as **Medium sensitivity**, recognizing that individual residential and recreational receptors may have higher sensitivity.

Impact. Visual effects are greatest where sensitive receptors are located close to elevated embankments, bridges, stations or other prominent structures and where there is little intervening screening. Effects generally reduce with distance and are less pronounced where the railway is experienced in the context of existing transport, utility, settlement or agricultural infrastructure.

Visual effects principally concern changes to the everyday visual environment of local communities and other users of the landscape rather than effects on designated scenic viewpoints. The Shardara Reservoir margin represents a locally more sensitive visual environment because of its recreational use, open character and the limited screening available across the reservoir-margin landscape.

As the principal alignment, embankment and major structures are now substantially fixed, these visual effects are largely realized design outcomes**.** Taking account of the permanence and extent of the change and the sensitivity of affected receptors, the impact is assessed as **Moderate magnitude and Medium adverse significance**.

Mitigation and design response. For permanent facilities where detailed design remains capable of refinement, layout, scale, materials and finishes should avoid unnecessary visual prominence and use context-appropriate treatments where practicable.

Permanent external lighting should be limited to that required for safe railway operation and facility security and designed to minimize unnecessary light spill towards nearby residential receptors and sensitive environmental areas. At the Shardara Reservoir crossing and other biodiversity-sensitive locations, permanent lighting should also be coordinated with applicable biodiversity requirements.

Where landscape planting forms part of the permanent design, targeted screening may be appropriate around stations and ancillary facilities where it would provide effective screening for nearby residential receptors. Continuous screen planting along the open alignment is not proposed.

Remaining architectural, permanent-lighting and landscape-design requirements should be finalized before completion of the relevant permanent facilities.

Residual impact. Some permanent change in views will remain because the principal railway infrastructure cannot practicably be screened across the open landscape. The residual impact is therefore assessed as **Moderate magnitude and Medium adverse significance**.

8.4.1.7. Shardara Reservoir IBA/KBA and Critical Habitat

The single most material design-stage impact is the conflict between the alignment and the Shardara Reservoir Important Bird Area / Key Biodiversity Area (PG001).

PG001 – Effects on the Shardara Reservoir IBA/KBA and Critical Habitat

Source and pathway. The alignment crosses the eastern margins of the Shardara Reservoir Important Bird Area / Key Biodiversity Area for approximately 16 km and required the construction of a raised embankment across the Syr Darya wetland habitats and associated open water. The permanent footprint of the railway within the IBA/KBA is approximately 150 ha, representing approximately 0.15% of the total IBA/KBA area.

VER and sensitivity. The IBA/KBA is internationally recognized and supports habitats and species that meet the Critical Habitat thresholds defined under the applicable lender safeguards, as described in Section 7. Critical Habitat is triggered for the Syr-Darya Shovelnose Sturgeon under precautionary application, the Dalmatian Pelican on the basis of 3.9–4.4% of the global flyway population at the EAAA, and the Pygmy Cormorant on the basis of the Azattyk colony discovered in June 2025. The receptor is therefore assessed as **extreme sensitivity**.

Impact. The permanent alignment results in direct interaction with the IBA/KBA and associated Critical Habitat. The principal design-stage effect arises from the location and permanent footprint of the railway within the internationally recognized area, including the barrier and fragmentation effect created by the embankment across wetland habitats and open water.

Avoidance of the IBA/KBA at design stage was not feasible within the wider strategic and engineering constraints of the route. The alignment is constrained by the need to connect existing rail infrastructure, by topography, and by the requirement to provide a single continuous crossing of the Syr Darya. Given the permanent footprint and fragmentation of habitat within the internationally recognized IBA/KBA and Critical Habitat, the spatial extent of the affected area and the long-term nature of the change, the impact is assessed as Major magnitude. In combination with the Extreme sensitivity of the receptor, the impact is assessed as High adverse significance.

Embedded Mitigation. The Project has applied the mitigation hierarchy in its remaining forms by: (i) narrowing the formation across the IBA/KBA to constrain the permanent footprint to approximately 150 ha, representing approximately 0.15% of the total IBA/KBA area; and (ii) incorporating four additional bridge structures within the reservoir crossing to maintain hydrological connectivity and reduce the fragmentation effect of the embankment. These outcomes are realized in the as-designed

Project, with the as-built footprint and bridge structure provision verifiable under the Independent Environmental and Social Consultant (IESC) framework.

Residual impact. Despite these measures, the residual significance at design stage is assessed as **High**.

The management of this residual impact through offset and compensation actions is described in detail under Construction (Section 8.4.3) in the biodiversity narrative and is structured around the Preliminary Biodiversity Action Plan, committed within 6 months of EPC contract award per Section 10 update) and the full Biodiversity Action Plan (committed within 18 months of F-BAP completion). The achievement of No Net Loss for the IBA/KBA, and Net Gain for the Critical Habitat triggers, is conditional on the full implementation of the BAP and the three-milestone third-party Net Gain verification framework committed in Section 10 of this Supplementary ESIA.

8.4.1.8. Biodiversity — Habitat Fragmentation

Two design-stage biodiversity impacts arise from the linear character of the alignment outside the Shardara Reservoir IBA/KBA: fragmentation of mammal habitat (TE064) and fragmentation of reptile habitat (TE079) in the steppe and semi-desert sections north of the reservoir.

Source and pathway. The permanent railway embankment creates a linear feature through terrestrial habitat that may restrict movement of fauna across the alignment and reduce habitat connectivity.

VER and sensitivity. The receptors of concern are goitered gazelle and marbled polecat for TE064, both IUCN Vulnerable, and Central Asian tortoise for TE079, also IUCN Vulnerable. The receptor sensitivities are as defined in the VER register in Section 8.2.

Impact. The potential effect is fragmentation of terrestrial habitat and restriction of movement across the permanent railway alignment. The detailed assessment of these receptors, including the basis for the magnitude and significance ratings, is provided in the biodiversity narrative under Construction in Section 8.4.3.

Mitigation and design response. Permanent cross-corridor structures incorporated into the Project design provide opportunities for fauna movement across the alignment and reduce the barrier effect of the railway. Species-specific connectivity measures and their effectiveness are addressed in the detailed biodiversity assessment in Section 8.4.3.

Residual impact. The residual significance remains as presented in Table 85: **Not Significant for TE064** and **Low for TE079**.

8.4.1.9. Community Safety

CS007 – Community safety design risk

Source and pathway. The permanent railway creates interfaces between the operational alignment and existing community movement routes. The principal design-stage pathways are the provision and configuration of at-grade level crossings and the potential for unauthorized pedestrian or livestock access to the railway where adequate fencing and authorized crossing provision are not incorporated into the permanent design. The Project includes 13 proposed at-grade level crossings, ranging from agricultural access tracks to crossings of the local road network in the southern section of the alignment.

VER and sensitivity. The VER comprises local residents and other users of roads, paths and agricultural access routes intersected by or adjacent to the railway, including pedestrians, road users and livestock owners. Receptor sensitivity is as defined in the VER register as **High**.

Impact. In the absence of appropriate design controls, interaction between the public and a live railway could result in serious injury or fatality through trespass, unauthorized crossing or collisions at at-grade crossings. The design-stage assessment records this risk because the effectiveness of the

operational controls assessed under CS004 and CS005 depends upon the crossing, fencing and access-control provisions established through the permanent design.

Given the potentially severe consequence of an unmanaged public/rail interface, the pre-mitigation significance is assessed as **High**.

Embedded Design Mitigation and Verification. The permanent design response comprises provision of perimeter fencing along the Right of Way, safe authorized crossing points, warning signage and defined standards for public road level crossings. Public road level crossings are to be fully automated with barriers and audible and visual warning systems and designed to applicable national and international standards, including appropriate sight-line clearance and approach geometry.

At agricultural crossings, provision is also made for users to contact the signalman where long loads or slow-moving livestock require additional crossing time.

The as-built crossing arrangements, fencing and associated safety infrastructure should be verified **before start of operations**. Operational inspection, maintenance, community awareness and enforcement measures are addressed under CS004 and CS005 in Section 8.4.4.

Residual impact. With the committed crossing standards, fencing and access-control measures incorporated into the permanent design, the residual design-stage significance is assessed as **Medium**. The operational risks are assessed separately under CS004 and CS005, where implementation and maintenance of the completed safety infrastructure reduce the residual significance to **Low**.

8.4.2 Land Take

As defined in this ESIA, the Land Take stage addresses impacts arising from the permanent acquisition and occupation of land required for the railway Right of Way and associated permanent infrastructure, together with temporary occupation of land for construction compounds, spoil storage, borrow pits, access and working areas. These impacts are distinct from those addressed under Design, which arise from the geometry and engineering form of the alignment, and those addressed under Construction, which arise from the physical works themselves.

The Land Take assessment therefore addresses the loss of residential, commercial and productive agricultural land; the associated physical and economic displacement and livelihood consequences for affected landowners and land users; and permanent loss of natural habitat within the acquired Project footprint, including within the Shardara Reservoir IBA/KBA.

Post-construction-start context. Land acquisition commenced in 2024 and was still ongoing during preparation of the LARP. The permanent land requirement is now substantially determined by the Project alignment and associated permanent infrastructure. Land acquisition is being implemented through a government-led process coordinated by the affected Akimats, with KTZ providing coordination and financing. The Land Acquisition and Resettlement Plan (LARP), prepared in parallel with this Supplementary ESIA, provides the authoritative framework for eligibility, compensation, physical displacement, livelihood restoration and monitoring.

The narrative below assesses the environmental and social consequences of the land-take footprint. For acquisition and displacement that have already occurred, compliance with applicable lender requirements and any necessary retrospective corrective measures are addressed through implementation and monitoring of the LARP and the parallel ESCA/IESC framework.

AF004 - Residential, Commercial and Productive Agricultural Land

Source and pathway. Permanent acquisition of land for the railway Right of Way and associated infrastructure removes land and assets from their existing residential, commercial or agricultural use. Temporary occupation of land for construction facilities similarly removes affected areas from their existing use for the duration of occupation.

VER and sensitivity. The affected receptors comprise residential, commercial and productive agricultural land and the households, land users and legal entities dependent upon these assets. The Project corridor is predominantly agricultural: the LARP identifies approximately 303 agricultural plots and 25 agricultural-production plots, while residential and commercial plots represent a substantially smaller proportion of the affected land inventory. Agricultural and agricultural-production plots are predominantly leasehold, whereas residential and commercial plots are more commonly privately owned.

Sensitivity varies according to the nature and degree of loss. Productive agricultural land is particularly important to households and businesses dependent upon agricultural production, while residential and commercial land may be highly sensitive where acquisition requires relocation or materially affects the viability of remaining property. These differences are addressed in detail through the LARP entitlement and livelihood-restoration framework.

Impact. Based on the current LARP inventory, approximately 417 ha is affected from land holdings totaling approximately 10,900 ha, representing approximately 3.8% of the total area of the affected plots. The revised inventory identifies approximately 371 affected plots, associated, after removal of duplication, with 308 households and 23 legal entities. These figures remain subject to final verification because design and land-survey work associated with the Maktaaral irrigation-canal reconstruction/diversion may identify additional affected plots or persons.

The effects are not evenly distributed. The majority of affected plots experience economic displacement associated with loss of agricultural land, while physical displacement is concentrated primarily around the more developed station areas. The LARP identifies 138 unique severely affected APs, comprising 132 households and six legal entities, based on loss of at least 10% of productive land or income-generating assets and/or physical displacement. The LARP identifies 14 households and one legal entity as relocation cases.

The permanent loss of acquired land is irreversible at the affected location. Taking account of the overall extent of acquisition, the predominance of partial agricultural land loss, the smaller number of physically displaced receptors and the significance of the affected assets to their users, the impact is assessed as **Moderate magnitude** and **Medium adverse significance**.

Mitigation and management response. Available information indicates that efforts were made during Project development to minimize impacts on residential areas and land requirements where practicable. The LARP records that most of the alignment traverses agricultural and sparsely populated land and that the Maktaaral station alignment was shifted southwards to reduce impacts on residential and commercial plots containing structures. KTZ also reports optimization of station layouts and other permanent facilities to reduce land requirements where technically feasible.

Where permanent land acquisition cannot be avoided, the principal management measures are those established through the LARP, including compensation at replacement cost, relocation assistance where applicable, livelihood-restoration measures and additional provisions for severely affected and vulnerable households.

The LARP currently identifies 93 vulnerable households, subject to further verification during implementation, and provides specific assistance measures for vulnerable and severely affected households.

Temporary land occupation should be minimized and, where it results in involuntary land-use impacts, treated in accordance with the applicable LARP entitlements. Physical reinstatement of temporarily disturbed land is addressed through the construction-phase soil and reinstatement measures in Section 8.4.3 rather than duplicated here.

For ongoing or future acquisition, works affecting the relevant land should proceed only following implementation of the applicable compensation, assistance, livelihood-restoration and corrective

measures required under the approved LARP. The LARP itself establishes this sequencing requirement for outstanding acquisition cases.

Residual impact. Compensation and livelihood restoration can address the economic and social consequences of land acquisition but cannot reverse the permanent physical loss of land within the railway footprint. Accordingly, the residual impact on residential, commercial and productive agricultural land remains **Medium adverse significance**, consistent with Table 86.

SE001 - Loss of Income and Livelihoods

Source and pathway. Land acquisition and temporary land occupation may reduce or interrupt income and livelihood activities where affected households, land users or businesses depend on agricultural land, commercial premises or other productive assets. The principal pathways are: (i) permanent loss of agricultural or commercial land and associated productive assets; (ii) temporary interruption of agricultural or commercial activities; and (iii) increased travel time, operating costs or reduced efficiency where residual land is fragmented or access is altered by the Project. The latter pathway is also related to the design-stage agricultural severance impact AF001 in Section 8.4.1.

VER and sensitivity. The affected receptors are households, land users and businesses whose income or livelihoods depend on land, agricultural production, livestock, commercial activity or other affected productive assets. Sensitivity varies according to the degree of livelihood dependence, scale of loss, viability of residual land and availability of alternative income sources. Particular sensitivity applies to severely affected households, vulnerable households and households retaining small or fragmented agricultural plots.

The LARP identifies 138 unique severely affected APs, comprising 132 households and six legal entities, based on loss of at least 10% of productive land or income-generating assets and/or physical displacement. It also identifies 93 vulnerable households, subject to verification during implementation.

Impact. For most affected households, land acquisition involves partial rather than complete loss of productive assets and the majority are expected to retain viable agricultural, livestock or business activities.

However, a subset of households may experience material reductions in productive land, residual plot fragmentation, constraints on irrigation or access, or other effects that reduce agricultural productivity or household income. The LARP identifies 61 irrigated agricultural plots requiring implementation-stage confirmation of residual usability, access and irrigation functionality, including 21 plots with residual areas of 1 ha or less. These cases, together with severely affected households, require priority consideration through livelihood-restoration planning. The impact is therefore assessed as **Moderate magnitude and Medium adverse significance**.

Mitigation and management response. The principal mitigation mechanism is the LARP. Compensation at replacement cost addresses the value of acquired assets, while livelihood restoration addresses the consequences of acquisition for income generation and livelihood viability. The LARP includes transitional support, agricultural and livestock livelihood restoration, business-restoration assistance, support for vulnerable and severely affected households, and access to training, employment and procurement opportunities.

The livelihood-restoration program is targeted according to the nature and severity of impact. Priority households, including severely affected households and those retaining very small residual agricultural holdings, are to receive more intensive support. Individual livelihood-restoration planning is proposed for the highest-risk households, with monitoring for at least two years following completion of land acquisition and additional measures where Project-related constraints continue to prevent restoration.

For land acquisition already undertaken, compensation and livelihood-restoration status shall be verified through LARP implementation, including identification and correction of any outstanding compensation, entitlement or livelihood-restoration gaps. For ongoing and future acquisition, compensation, assistance and applicable livelihood-restoration measures are to be implemented before the affected land is handed over for construction.

Implementation effectiveness will be subject to independent monitoring, including verification of compensation and assistance, consultation with affected and vulnerable households and assessment of whether agricultural production, business activities, employment and income sources have been restored.

Residual impact. Unlike the permanent physical loss of land assessed under AF004, the principal effect assessed under SE001 is the consequence of land acquisition for household or business income and livelihood viability. Replacement-cost compensation, targeted livelihood restoration and continued monitoring therefore provide a mechanism to restore affected income sources and productive capacity.

Subject to full implementation of the LARP and achievement of livelihood-restoration outcomes, the residual impact is assessed as **Low adverse significance**.

The Project nevertheless remains Category A for involuntary resettlement because that classification reflects the overall scale and nature of Project land acquisition and displacement. It does not mean that every individual livelihood impact must remain High or Medium after effective compensation and livelihood restoration. The residual Low rating for SE001 therefore reflects the anticipated condition of affected households following implementation of the LARP, rather than a reduction in the overall resettlement classification.

TE001 - Permanent Habitat Loss — Shardara Reservoir IBA/KBA

Source and pathway. The largest single land take impact on the natural environment is the permanent loss of approximately 150 ha of habitat under the embankment footprint within the Shardara Reservoir IBA/KBA. This area represents approximately 0.15% of the total IBA/KBA area of 96,000 ha, but is concentrated in habitats of high ecological value, including approximately 130 ha of braided channels and floodplain grassland and approximately 20 ha of Tugai scrub, reedbed marshland and open mud.

VER and sensitivity. These habitats individually and collectively underpin the ecological function of the site and the reasons for which it was internationally recognized. The affected receptors comprise the Shardara IBA/KBA itself (TE001), the Dalmatian Pelican (TE006), the migratory bird assemblage (TE018), other IUCN-threatened bird species (TE024), the wintering bird assemblage (TE028), the breeding bird assemblage (TE032), other bird species (TE036), the Lesser White-fronted Goose (TE040), and the Natural Habitat of the wetland complex (TE058). Receptor sensitivities are as defined in the VER register in Section 8.2.

Impact. Permanent habitat loss within the embankment footprint is irreversible and is the cause of a suite of significant impacts on the receptors for which the IBA/KBA is designated. The detailed assessment of each of these receptors and the basis for the significance scoring is provided in the Biodiversity narrative under Construction (Section 8.4.3).

It is not duplicated in this Land Take subsection because the underlying impact is common across all nine table entries: in each case, permanent habitat loss within the Project footprint is the impact being assessed.

Mitigation and management response. The design-stage narrowing of the formation and strict footprint controls reduce but cannot eliminate the permanent habitat loss. The detailed technical reasoning behind the mitigation and offset response is provided in the Biodiversity narrative under

Construction (Section 8.4.3), with the residual impact addressed through the Biodiversity Action Plan and the offset framework described in the Biodiversity narrative and in Section 9.

Residual impact. The residual significance of the permanent habitat loss within the IBA/KBA is **High** for the receptors of international importance (TE001, TE006, TE018) and **Medium** for the receptors of national importance or lower-magnitude exposure (TE024, TE028, TE032, TE036, TE040, TE058) prior to offset action.

Achievement of No Net Loss (NNL) for the IBA/KBA, and Net Gain (NG) for the Critical Habitat triggers, is conditional on the full implementation of the BAP, including the offset actions identified in the Preliminary BAP at Annex B.

Permanent Habitat Loss — Terrestrial Sections

Source and pathway. Outside the IBA/KBA, the permanent footprint of the embankment along the terrestrial sections of the alignment will result in the loss of steppe, semi-desert and loess slope habitat. The land-take dimension is the irreversibility of the loss: areas that are stripped and built over within the permanent Right of Way cannot subsequently be returned to their pre-Project condition.

VER and sensitivity. The affected receptors comprise IUCN and Kazakh Red List flora (TE069) and IUCN Red Listed reptiles, principally the Central Asian Tortoise and European Glass Lizard (TE078). Receptor sensitivities are as defined in the VER register in Section 8.2.

Impact. Permanent occupation of the Right of Way results in irreversible loss of suitable habitat for these receptors. The detailed assessment of the flora and reptile receptors, including the basis for the significance scoring, is provided in the Biodiversity narrative under Construction (Section 8.4.3).

Mitigation and management response. The design response combines the minimization of the permanent footprint, the reinstatement of temporary works areas with steppe and semi-desert communities using locally-sourced native seed, and the creation of areas within the temporary works zone that are left uncompacted to facilitate burrow creation and recolonization by ground-dwelling reptiles and invertebrates. Pre-clearance surveys, translocation of priority species, and the post-construction surveillance regime described under Construction provide the operational basis for these commitments.

Residual impact. With the full implementation of these measures, the residual significance is reduced to **Low** for both flora and reptiles. As with the IBA/KBA impacts, the achievement of the lenders' biodiversity outcomes is conditional on the implementation of the Biodiversity Action Plan.

8.4.3 Construction

Construction is the stage at which the temporary and short-to-medium-term impacts of the Project are concentrated. It encompasses the full program of works required to build the line, including site clearance, earthworks, embankment formation, bridge construction across the Syr Darya and the four additional reservoir crossings, station works at Maktaaral and Erdaulet, installation of track and overhead line equipment, ancillary works at sidings and passing loops, and the establishment and operation of construction compounds, worker accommodation, borrow pits and spoil storage areas. Construction will take place over an estimated three construction seasons and will be carried out in stages along the alignment, so that impacts on any one location are themselves staged in time.

The construction stage produces the largest number of identified impacts in the assessment (68 entries in Table 87), reflecting both the scale of the works and the diversity of receptors along the 114.8 km alignment. The majority of construction impacts are temporary in duration and reversible once the relevant activity is complete and reinstatement is finished; the principal exceptions are the permanent loss of biodiversity within the embankment footprint (addressed under Land Take in Section 8.4.2 and under Biodiversity below) and the unforeseen mobilization of pre-existing soil or groundwater contamination.

Construction commenced in 2024 before completion of this Supplementary ESIA and the lender-aligned ESMP. The assessment therefore distinguishes, where relevant, between impacts from works already undertaken and impacts associated with remaining construction. For completed or ongoing works, the assessment does not assume that mitigation subsequently identified through this Supplementary ESIA was in place; construction-to-date compliance and any required corrective actions are addressed through the parallel ESCA and its Corrective Action Plan. For remaining works, the mitigation and management measures identified below apply prospectively through the construction-phase ESMP.

The committed mitigation measures in the construction summary table are drawn from Good International Industry Practice for projects of this type and scale. Mitigation will be operationalized through the Contractor's Construction Environmental and Social Management Plan (CESMP) and its supporting topic-specific plans (Air Quality Management Plan, Construction Waste Management Plan, Pollution Prevention Plan, Traffic Management Plan, Workforce Management Plan, Biodiversity Management Plan, and others as identified). Given that construction is already under way, these plans are to be prepared or, where construction-to-date has proceeded without them, updated by the EPC contractor for the remaining works and reviewed and approved by KTZ and the lenders' Independent Environmental and Social Consultant prior to mobilization. Implementation will be subject to the construction oversight regime described in Section 10.

8.4.3.1. Agriculture

Three construction-stage impacts on agriculture are identified, all of which arise from the proximity of construction activities to actively managed productive land along the alignment.

AF003 – Contamination of irrigation channels and agricultural land

Source and pathway. The first (AF003) is the risk of contamination of irrigation channels and adjacent fields from the loss of containment of fuels, oils and chemicals stored or used on site, and from leaks or spills from construction plant and machinery. Sources of risk include refueling operations, the maintenance of plant in the field, hydraulic line failures on heavy equipment, the storage of bulk fuels at site compounds, and the transport of fuels to forward operating locations. Where contamination reaches an irrigation channel, the consequences extend beyond the point of release because the channel network distributes water across multiple agricultural holdings.

VER and sensitivity. The principal receptors are actively managed agricultural land and the irrigation network supporting agricultural production along the alignment. Sensitivity is greatest in the intensively irrigated agricultural areas of Zhetysay and Maktaaral, where agricultural production is dependent on continued access to irrigation water. Receptor sensitivity is as defined as **Moderate**.

Impact. A significant spill or loss of containment entering an irrigation channel could affect irrigation-water quality and contaminate agricultural soils or crops downstream of the point of release. The potential extent of the impact is therefore greater than a comparable terrestrial spill because contaminants entering the irrigation network may be transported beyond the immediate construction footprint. The impact is assessed as **Minor magnitude and Low significance**.

Mitigation and management response. The mitigation response is the Contractor's Pollution Prevention Plan, including bunded fuel and chemical storage, dedicated refueling areas located away from watercourses, spill response equipment at each work front, and routine inspection and maintenance of plant.

Residual impact. With implementation of these measures, there will be **No Significant** residual impact.

AF005 – Soiling of crops and greenhouse surfaces from fugitive dust

Source and pathway. The second (AF005) is the soiling of crops and greenhouse surfaces from fugitive dust emissions during construction.

VER and sensitivity. The receptor of particular concern is the area of intensive polytunnel and polythene-covered horticulture in the southern part of the alignment, where dust deposition on the plastic cover material reduces light transmission and crop growth, and where soft fruit crops cannot be washed before market. Receptor sensitivity is as defined as **Moderate**.

Impact. Fugitive dust generated by earthworks, construction traffic and other construction activities may deposit on crops and greenhouse surfaces, potentially affecting crop productivity or marketability. The technical assessment of construction dust risk is set out under Air Quality below. The national OVOS independently identifies construction dust as a material construction issue and requires regular dust suppression during earthworks and on construction roads. The impact is assessed as **Minor magnitude and Low significance**.

Mitigation and management response. The mitigation response is set out under Air Quality below and implemented through the Air Quality Management Plan. Soft-fruit producers in the affected polytunnel area will be specifically identified in the stakeholder engagement program and a complaints monitoring mechanism established for the duration of construction.

Residual impact. The residual significance for agricultural receptors will be not significant provided the Air Quality Management Plan is fully implemented.

AF002 – Interruption or modification of irrigation infrastructure

Source and pathway. Construction activities may affect existing irrigation canals, pipelines, drainage systems and associated infrastructure. Works at canal crossings, embankment construction, and the relocation or reconstruction of irrigation infrastructure may temporarily interrupt water supply, alter flows, damage infrastructure or restrict access for operation and maintenance.

VER and sensitivity. The receptors are agricultural land users dependent on irrigation water, particularly in Zhetysay and Maktaaral, where irrigated agriculture is an important land use.

The LARP demonstrates the importance of maintaining irrigation supply to affected land users. During the census and socio-economic survey, APs using 141 agricultural plots raised concerns regarding potential disruption of irrigation systems and access to irrigation water. These comprised 128 plots in Zhetysay District and 13 plots in Maktaaral District, all of which are leased and used for agricultural purposes. Irrigation-related concerns were also raised during the May 2026 public consultations, including in relation to specific irrigation infrastructure affected by the works.

The 141 plots represent locations where APs expressed concern regarding potential irrigation disruption; they do not represent 141 confirmed cases of interruption or damage. Nevertheless, the number of affected land users raising this issue and their dependence on irrigation demonstrate the sensitivity of agricultural production to disruption of water supply.

Subsequent information provided by KTZ demonstrates that irrigation and drainage crossings were systematically considered during Project design. The design register dated 6 April 2026 identifies 79 structures serving irrigation ditches, canals and drainage channels within the first construction phase. The register demonstrates design provision but does not, by itself, confirm that every structure has been constructed and is functioning as intended; this remains subject to as-built and commissioning verification.

VER sensitivity is assessed as **Moderate**.

Impact. Construction could interrupt irrigation water supplies where works affect canals, pipelines or other irrigation infrastructure. The consequences would depend on the timing and duration of the interruption and whether an alternative supply was available. An interruption during an important stage of the growing season could reduce crop production and result in associated economic losses.

Construction commenced in 2024, before lender-aligned due diligence was undertaken. Specific irrigation infrastructure has subsequently required modification or restoration as part of the works.

Project records document completed corrective works at KM25.9, where a water-conveyance pipe supplying agricultural fields was restored and the associated access road was levelled to reinstate access for irrigation operation and maintenance equipment. Completion was reported by the works contractor on 9 September 2026.

During the May 2026 consultation at Berlik, participants raised concerns regarding a damaged LOTOK irrigation channel located at Ushagash, approximately 12 km from Berlik. KTZ subsequently clarified that the irrigation issue referred to at Berlik and the Ushagash LOTOK channel are the same asset and do not represent separate irrigation impacts. KTZ has further confirmed that restoration of the Ushagash channel is underway: the principal foundation works have been completed and installation of the channel remains outstanding.

At Atakent, relocation of the existing LOTOK irrigation channel associated with the Maktaaral Station works has commenced. KTZ reports that the works are ongoing, with approximately 300 m of excavation remaining. The associated land-acquisition process has also commenced and the relevant regional resolution is pending.

These specific construction-related cases are distinct from the 141 agricultural plots identified through the LARP census, which, as noted above, record concerns regarding **potential irrigation disruption** rather than confirmed cases of interruption, damage or livelihood loss.

KTZ has confirmed that no formal written irrigation-related complaints have been received. This does not alter the concerns recorded through the LARP census and May 2026 consultation process, but confirms that these have not resulted in formal written irrigation grievances to date.

The remaining requirements are therefore to complete restoration of the Ushagash channel and relocation of the Atakent channel; maintain irrigation continuity during remaining works; verify the as-built functionality of relevant irrigation and drainage structures through inspection and commissioning; and rectify any Project-related deficiency identified through commissioning or supervision.

Without mitigation, interruption or impairment of irrigation supply during the cropping season could affect crop production and associated agricultural income. Given the **Moderate sensitivity** of affected agricultural land users, the potential impact is assessed as **Moderate adverse** prior to mitigation. The available information does not indicate widespread realized irrigation disruption, with the 141 agricultural plots representing concerns regarding potential interruption rather than confirmed cases of irrigation loss or damage.

With implementation of the Irrigation Network Management Plan, maintenance of irrigation continuity during remaining works, completion of the identified restoration and relocation works, and verification and rectification of relevant irrigation and drainage infrastructure before handover, the residual impact is assessed as **Low adverse**.

Mitigation and management response. For remaining works, continuity of irrigation supply shall be managed through the Irrigation Network Management Plan and Community Liaison Officer. Where works require temporary interruption of an active canal, interruptions shall be scheduled outside the May–September cropping season wherever technically achievable; affected water users and the territorial body of the Ministry of Water Resources and Irrigation shall receive a minimum of 14 days' written notice; temporary bypass arrangements shall be provided where interruption during the cropping season is unavoidable; and no interruption shall exceed 72 hours without a documented alternative supply arrangement.

For completed and substantially completed sections, relevant irrigation and drainage crossing structures shall be verified through as-built records, inspection and appropriate

commissioning/functionality checks. Any Project-related obstruction, damage, inadequate reinstatement or impaired functionality identified through construction supervision, commissioning, consultation or the GRM shall be rectified by the responsible contractor. Access required for operation and maintenance of irrigation infrastructure shall also be reinstated where affected.

Reported crop, production, income or other economic losses shall be investigated on an asset- and claimant-specific basis. Where Project-related loss is substantiated, compensation and livelihood-restoration measures shall be applied in accordance with the applicable provisions of the LARP.

Ushagash LOTOK restoration. The ongoing restoration of the LOTOK irrigation channel at Ushagash shall be completed. Following installation of the channel, its functionality and the availability of access required for operation and maintenance shall be verified. Any Project-related deficiency identified during completion or commissioning shall be rectified.

Atakent LOTOK relocation. The ongoing relocation of the LOTOK irrigation channel associated with the Maktaaral Station works shall be completed while maintaining irrigation functionality during the remaining works. The associated land-acquisition process shall be completed in accordance with the LARP and applicable national requirements. Following completion, the functionality of the relocated channel and the availability of access required for operation and maintenance shall be verified.

Residual impact. With implementation of the Irrigation Network Management Plan, maintenance of irrigation continuity during remaining works, completion of the Ushagash restoration and Atakent relocation, reinstatement of affected infrastructure, and verification of the functionality of relevant irrigation and drainage structures before handover, the likelihood and duration of Project-related interruption of irrigation supply will be substantially reduced. Any Project-related deficiencies identified through completion or commissioning shall be rectified, and any substantiated Project-related economic losses shall be addressed in accordance with the LARP. The residual significance of AF002 is therefore assessed as **Low adverse**.

8.4.3.2. Air Quality

Construction activities along the alignment present a high likelihood of fugitive dust emissions and a lower but non-trivial risk of gaseous emissions from mobile and stationary fossil-fuel equipment. The technical screening, sensitivity analysis and risk assessment of construction dust have been undertaken following the methodology of the UK Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction (2024).

The screening identifies human receptors within 250 m of the works, notably at the new station at Erdaulet and the modernized station at Maktaaral, together with isolated properties along the alignment, and the ecological receptor of the Shardara Reservoir IBA/KBA, where dust deposition could affect vegetation and water quality. The assessment of dust emission magnitude concludes that earthworks are Large, reflecting the Project's 114.8 km length and approximately 12.3 million m^3 of material to be used; trackout is Large; construction activities are Medium; and demolition activities are Small. The combined IAQM assessment identifies an overall High Risk before mitigation, particularly for earthworks and trackout at the two station locations. This IAQM risk classification determines the level of dust-control measures required and should not be confused with the impact-significance ratings derived under the Section 5 methodology.

The national EIA and associated permissible-emissions assessment provide additional quantitative information on atmospheric emissions. They include an inventory of stationary and mobile emission sources and atmospheric dispersion modelling for construction and operation using the Kazakhstan regulatory modelling framework. The modelling assesses compliance against maximum short-term ambient-air concentration criteria applicable to residential areas and includes calculation grids and residential-area boundaries. The national assessment concludes that calculated Project-related concentrations comply with the applicable national ambient-air criteria at the assessed receptor and

sanitary-protection-zone boundaries and provides construction-period dispersion outputs and contour maps in its supporting appendices.

The national modelling is useful supporting evidence but does not replace this Supplementary ESIA assessment. In particular, the dispersion calculations reviewed frequently record that background concentration was not specified, meaning that the calculations principally demonstrate the incremental contribution from Project emission sources rather than total ambient concentrations comprising existing background plus the Project contribution. Short-term prior-Project monitoring is reported in the existing baseline, but the sampling locations, duration and analytical documentation are not sufficient to constitute a comprehensive lender-aligned ambient air-quality baseline. The assessment therefore combines the available baseline information, the national dispersion modelling and the receptor-based construction-dust assessment.

AQ001 – Dust and gaseous emissions from concrete batching

Source and pathway. Concrete batching can generate particulate emissions through handling and transfer of cement, aggregates and other dry materials, together with gaseous emissions from associated plant and vehicle movements. Emissions may disperse beyond the batching-plant boundary and affect nearby receptors where adequate separation or dust controls are not maintained.

VER and sensitivity. The principal VER is air quality along the new alignment and at sensitive receptors potentially exposed to batching activities. Residential areas, schools, hospitals and nurseries represent the principal human receptors. Air quality along the new alignment is identified as a **moderate sensitivity** VER, while individual sensitive community receptors are afforded greater protection through the receptor-offset requirements incorporated into the ESMP.

Impact. Batching emissions are localized and occur for the duration of operation of the relevant construction facility. Given the limited spatial extent of the pathway and the requirement for separation from sensitive receptors, the impact is assessed as Negligible magnitude and Not Significant, consistent with Table 87.

Mitigation and management response. No batching plant will be located within 500 m of sensitive receptors, including residential areas, schools, hospitals and nurseries. Batching-plant dust will be controlled through bag filters or equivalent control systems, with plant locations verified against receptor offsets and air-quality monitoring undertaken at the nearest sensitive receptors where appropriate.

For remaining construction, these controls will be incorporated into the Contractor's Air Quality Management Plan and verified before operation of any new or relocated batching facility.

Residual impact. With the committed controls, the residual impact remains Not Significant.

AQ002 – Emissions from mobile fossil-fuel construction equipment

Source and pathway. Construction plant, heavy machinery and vehicles generate combustion emissions, principally NO_x, particulate matter, CO, SO_2 and hydrocarbons. These emissions are dispersed to ambient air and may temporarily affect receptors close to active work fronts, haul routes and construction compounds.

VER and sensitivity. The assessment is made with reference to applicable national and Project ambient air-quality standards, which are treated as a **moderate sensitivity** VER within the VER register because they protect human health at the national level. Local residents close to active construction areas are the principal human receptors.

Impact. Emissions from individual items of mobile plant are temporary and spatially dispersed along the construction corridor. The national OVOS similarly inventories and assesses emissions from both mobile and stationary sources during construction against applicable national ambient-air criteria. Given the temporary nature of emissions, the movement of plant between work fronts and the limited

duration of exposure at individual receptors, the impact is assessed as **Minor magnitude and low adverse significance**.

Mitigation and management response. A no-idling policy will be enforced; construction operations will be planned to avoid unnecessary equipment use; low-emission engines compliant with applicable standards will be used where practicable; and plant and vehicles will be routinely maintained. Equipment producing visible excessive exhaust emissions will be removed from service until repaired. These measures are consistent with the national emissions-management framework and will be implemented through the Air Quality Management Plan for the remaining works.

Residual impact. With implementation of these controls, the residual significance is assessed as **Low**.

AQ003 – Fugitive dust from earthworks, stockpiles and vehicle movements

Source and pathway. Fugitive dust is generated by earthworks, excavation and placement of fill, handling and storage of excavated materials, vehicle movement over paved and unpaved surfaces, trackout of soil onto public roads and wind erosion of exposed surfaces and stockpiles. Dust may be transported to nearby residential, agricultural and ecological receptors.

VER and sensitivity. The principal human VER comprises local residents, identified as a **moderate-sensitivity** receptor in the VER register. The most concentrated sensitive receptors occur around Erdaulet and Maktaaral, with additional isolated properties along the alignment. Agricultural crops and polytunnel horticulture are considered separately under AF005, while the Shardara Reservoir IBA/KBA represents a sensitive ecological receptor for dust deposition.

Impact. The scale of the earthworks and the dry, windy conditions characteristic of the Project corridor mean that construction has substantial potential to generate fugitive dust in the absence of control. The IAQM assessment classifies earthworks and trackout as Large dust-emission-magnitude activities and identifies the Project as High Risk for construction dust before mitigation. As noted above, this is an IAQM dust-management classification rather than the Section 5 significance rating.

At individual community receptors, effects are expected to be temporary and associated with the period during which active earthworks, haulage or material handling occur in the vicinity. Taking account of the duration, reversibility and spatially localized nature of exposure, the Section 5 assessment is **Minor magnitude and low adverse significance**. The national EIA independently identifies dust from earthworks as a material construction issue and specifically requires regular dust suppression during earthworks during the construction period.

Mitigation and management response. The Contractor's Air Quality Management Plan will incorporate the full suite of IAQM measures appropriate to the High Risk classification, including damping down of haul roads and exposed surfaces; sheeting or covering of stockpiles and loaded vehicles; wheel washing at site exits; speed limits of 15–25 km/h on unpaved roads; minimization of material drop heights; phased earthworks; and stabilization of long-term stockpiles.

Visual inspections will be undertaken at active work fronts and haul routes, supported by PM10 monitoring at representative sensitive receptors. Particular attention will be given to Erdaulet and Maktaaral and to locations where construction occurs close to residential, intensive agricultural or ecologically sensitive receptors.

Where monitoring, visual inspection or community complaints indicate that controls are insufficient, additional damping, reduced vehicle speeds, temporary suspension or relocation of dust-generating activities, or other appropriate corrective measures will be applied.

Residual impact. Complete elimination of dust during major earthworks is not practicable, particularly during high-wind and dry-weather conditions. However, with full implementation of the Air Quality Management Plan and adaptive control of dust-generating activities, the residual significance is assessed as **Low**.

AQ004 – Emissions from stationary construction equipment

Source and pathway. Stationary combustion equipment, principally temporary generators and other diesel-powered plant, emits NO_x, SO_2, CO, particulate matter and VOCs to ambient air during construction.

VER and sensitivity. As for AQ002, the relevant VER comprises applicable national and Project ambient air-quality standards and nearby human receptors. VER sensitivity is **Moderate**.

Impact. Stationary construction sources are limited in number and operate locally at compounds and work fronts. Their contribution to ambient concentrations is therefore expected to be localized and temporary. The national OVOS inventory and dispersion assessment provides further evidence that calculated emissions from identified Project sources remain within the applicable national receptor-boundary air-quality criteria, although the limitations relating to background concentrations described above remain applicable. The impact is assessed as **Minor magnitude and Low**.

Mitigation and management response. Mains electricity will be used in preference to diesel generation where available. Generators will be appropriately sized and maintained in accordance with manufacturer specifications. Equipment emitting persistent visible black smoke will be shut down and maintained before being returned to service.

Residual impact. With these controls, the residual impact remains **Not Significant**.

Construction-to-date and monitoring

Construction commenced before completion of this Supplementary ESIA and the lender-aligned Air Quality Management Plan. The assessment therefore does not assume retrospectively that the full IAQM control package described above was implemented throughout works completed to date. No evidence reviewed indicates a material construction-related deterioration in ambient air quality requiring a retrospective change to the significance conclusions; however, the absence of a comprehensive pre-construction ambient monitoring dataset limits quantitative retrospective verification.

For the remaining works, the Air Quality Management Plan will therefore provide the principal control framework, supported by monitoring at representative sensitive receptors and the Project GRM. The national environmental protection measures plan (which forms part of the national EIA process) additionally provides for instrumental air-quality measurements at four points around the applicable sanitary-protection-zone boundary, providing a further compliance-verification mechanism.

8.4.3.3. Archaeology

The construction-stage archaeological risk is the encountering of previously unknown buried artifacts during ground disturbance (AR003). The Turkestan Region has a documented archaeological record extending back several millennia, and ground-disturbing activities along an alignment of this length cannot reliably avoid all such material on the basis of desk-based and surface survey alone.

AR003 – Chance finds during ground-disturbing works

Source and pathway. Construction activities involving excavation, stripping, foundation works, earthworks and other ground disturbance have the potential to encounter previously unknown archaeological material that was not identified through desk-based assessment or surface survey.

VER and sensitivity. The receptor comprises previously unknown archaeological artefacts, features or deposits that may occur below ground along the Project alignment. Because the nature, extent and significance of any such material cannot be known before discovery, the receptor is assessed on a precautionary basis as **High** in accordance with the VER register.

Impact. If previously unknown archaeological material is encountered during ground-disturbing works and is not recognized or appropriately managed, construction could result in its damage, disturbance

or irreversible loss before its significance can be established. The potential consequence is therefore material notwithstanding the uncertainty regarding the likelihood and location of a find. The impact is assessed as **Moderate magnitude and high adverse significance**.

Mitigation and management response. A draft Archaeological Chance Finds Protocol has been prepared for the Project and will be finalized and implemented through the Construction ESMP for all remaining ground-disturbing works.

The Protocol will define the categories of material to be reported, the procedure for immediately stopping work in the vicinity of a potential find, the chain of notification to the Contractor's environmental manager, the KTZ Project team and the relevant national cultural heritage authorities, and the procedure for recording, assessment, recovery or in-situ preservation before works are permitted to resume.

All personnel involved in ground-disturbing activities will be trained in the Protocol as part of induction, with refresher training at appropriate intervals. The Construction ESMP requires immediate cessation of works on discovery, notification to KTZ within 24 hours, maintenance of a chance-finds register and appropriate incident records.

Where ground-disturbing works are undertaken in the vicinity of known archaeological sites, the Chance Finds Protocol will operate together with the site-specific archaeological protection requirements identified through the historical-cultural assessment. That assessment establishes protection zones and archaeological-management requirements for known sites, including restrictions on works within applicable protection areas.

For sections already constructed, the Project should confirm through IESC review whether any archaeological finds were encountered during works to date and, if so, whether they were reported and managed in accordance with national requirements. This retrospective check does not replace the Chance Finds Protocol for the remaining works.

Residual impact. With implementation of the Archaeological Chance Finds Protocol and applicable protection requirements, including immediate cessation of works, assessment of potential finds and authority clearance before works resume, the residual impact is assessed as Negligible magnitude and Not Significant.

8.4.3.4. Community Health and Safety

The national EIA documentation addresses a number of the underlying construction hazards relevant to community health and safety through technical design, sanitary, fire-safety and environmental-protection requirements. However, it does not provide a consolidated community health and safety assessment equivalent to the lender requirements applied in this Supplementary ESIA, particularly in relation to public access to active works, construction traffic interaction with vulnerable road users, and community-facing emergency preparedness. These risks are therefore assessed specifically below and are subject to the additional lender-aligned management measures identified in the Construction ESMP.

Three construction-stage community health and safety impacts are assessed in this subsection, principally affecting residents and road users along and adjacent to the alignment. Additional community-facing risks associated with workforce presence and worker accommodation, including worker-community interaction, communicable disease and SEA/GBVH, are assessed separately under the construction-stage Labour and Working Conditions and Socio-economic/Social Impacts assessment, including GBV001 and CS006. These risks are managed through the Construction ESMP, workforce and accommodation management measures, Worker Code of Conduct, SEA/GBVH provisions, SEP and Project GRM and are therefore not duplicated here.

CS001 – Public access to active construction areas

Source and pathway. The first (CS001) is the risk of incidents at work sites due to encroachment of members of the public into active work areas, storage compounds or laydown areas. The alignment passes adjacent to or through a number of villages in the southern section, and pedestrian and informal vehicular access patterns are well-established.

VER and sensitivity. The principal receptors are residents of communities adjacent to active construction areas, including pedestrians and other users of established local access routes. Children, older people and other persons less able to recognize or avoid construction hazards may be particularly vulnerable. Local communities are assessed as **High sensitivity** to construction hazards.

Impact. Uncontrolled public access to active work fronts could expose community members to moving plant and machinery, excavations, construction materials and other physical hazards. The risk is greatest where works occur close to settlements or intersect established pedestrian or informal vehicle routes. The pre-mitigation community-safety risk is assessed as Medium significance, based on the likelihood and potential consequence of public exposure to active construction hazards.

Mitigation and management response. The mitigation response combines physical security — perimeter fencing of active work fronts and storage compounds, controlled access points, signage in Kazakh and Russian, and night lighting where appropriate — with procedural controls and community-facing communication. Communities will be notified in advance of works affecting established access routes and safe alternative routes will be identified where access is temporarily restricted.

These controls will be implemented through the Construction ESMP and supported by the Project SEP and GRM. Particular attention will be given to locations where active works occur close to settlements or frequently used community routes.

For sections already under construction, the adequacy of fencing, signage and access controls will be verified through construction supervision and the ESCA corrective-action process, with deficiencies rectified for ongoing and remaining works.

Residual impact. With these controls in place, the residual significance is **Low**.

CS002 – Construction traffic risk to communities

Source and pathway. The second (CS002) is the increased traffic risk to community members from construction vehicle movements, particularly the haulage of bulk materials to and from the alignment. The principal areas of concern are the road links to the two stations, the approach routes to borrow pits, and the routes used by aggregate haulage to the embankment construction fronts.

Construction traffic may interact with pedestrians, cyclists, livestock, local vehicles and other road users on roads that were not necessarily designed for sustained heavy construction traffic. Temporary access routes and construction vehicle movements may also affect existing community access and road conditions.

VER and sensitivity. The principal receptors are residents and road users along construction haul routes and access roads, particularly where these routes pass through or close to settlements. Sensitive locations include schools and other community facilities and locations with significant pedestrian activity. The receptor sensitivity is **High.**

Impact. Increased numbers of heavy vehicles can increase the probability and potential severity of road-traffic incidents involving community members and may temporarily disrupt normal movement along affected roads. The risk varies spatially and temporally according to the location of active work fronts, borrow pits and material sources and the routes used to reach them. Taking account of the likelihood and potential consequence of construction traffic incidents, together with the variable level of community exposure along the construction corridor, the pre-mitigation community-safety risk is assessed as Medium significance. Large portions of the work fronts are located in remote areas where community exposure to construction traffic is limited.

Mitigation and management response. The mitigation response is the Contractor's Traffic Management Plan, which will include designation and signing of haul routes, speed restrictions for Project vehicles, defensive-driving training for construction drivers, and avoidance of haulage during peak community-movement periods, notably school start and finish times. Where route-specific assessment identifies elevated risk, traffic-control personnel, additional warning signage, pedestrian controls or engineered improvements at high-risk junctions and crossing points will be provided.

Advance information on significant changes to local traffic arrangements, temporary road restrictions or diversions will be communicated to affected communities. Access to residences, agricultural land and community facilities will be maintained wherever practicable.

This approach is consistent with that applied on other recent KTZ projects subject to international lender requirements, where construction traffic controls include designated haul routes, traffic-control personnel, scheduling of deliveries outside peak periods, and specific protection for vulnerable road users.

Construction traffic incidents and community complaints relating to haulage will be recorded and reviewed so that recurring locations or behaviors can trigger additional controls.

Residual impact. With implementation of the Traffic Management Plan and location-specific controls, the residual significance is **Low**.

CS003 – Construction emergency preparedness and response

Source and pathway. The third (CS003) is the risk that a construction incident with potential consequences beyond the immediate worksite — such as a major fire, chemical or fuel spill, or transport accident involving Project vehicles — is not contained or responded to sufficiently rapidly to protect nearby communities.

VER and sensitivity. The principal receptors are communities located close to active construction areas, compounds, haul routes and other locations at which credible construction emergencies could affect persons outside the Project workforce. Receptor sensitivity is **High**.

Impact. Major construction emergencies are expected to be infrequent, but could have significant consequences if emergency arrangements, communication protocols or interfaces with external emergency services are inadequate. The assessment therefore considers both the intrinsic likelihood of such events and the ability of the Project and external responders to prevent escalation. The impact is assessed as **Medium significance.**

Mitigation and management response. The Contractor will implement a Construction Emergency Response Plan coordinated with national and regional emergency services. The Plan will identify credible construction emergency scenarios, responsibilities and command arrangements, emergency contacts and communication procedures, evacuation and assembly arrangements, available emergency and spill-response equipment, and procedures for notifying potentially affected communities where an incident could extend beyond the Project boundary.

Coordination arrangements with the relevant emergency services will be documented and the adequacy of the arrangements tested through tabletop and live drills at appropriate intervals during construction. Lessons identified through exercises or actual incidents will be incorporated into subsequent revisions of the Plan.

For construction already under way, existing emergency arrangements and interfaces with external responders will be reviewed and any identified gaps corrected for the remaining construction period.

Residual impact. With an effective Construction Emergency Response Plan, coordination with external responders and periodic testing of the arrangements, the residual significance is **Low**.

8.4.3.5. Material Resources

MR001 – Demand for aggregate, gravel, soil and other construction materials

Source and pathway. Construction of the railway requires substantial quantities of soil, draining material, aggregate, ballast, concrete and other construction materials for the embankment, track formation, bridges, stations and associated infrastructure. Material demand may place pressure on existing local and regional sources where Project requirements exceed available supply capacity or require the development or expansion of borrow pits and quarries.

The national EIA confirms the scale of the earthworks requirement. The total profile earthworks volume is approximately 12.31 million m^3, comprising approximately 5.13 million m^3 of ordinary embankment fill, 3.25 million m^3 of draining fill and 3.92 million m^3 of excavation.

VER and sensitivity. The principal VER comprises material resources used for construction, including soil, sand, gravel, aggregate and other quarry products, together with the existing local and regional supply capacity for those materials. Material resources are assessed as a **Moderate-sensitivity** regional receptor in the VER register.

Embedded design mitigation. The Project design incorporates a cut-and-fill approach intended to maximize the reuse of geotechnically suitable excavated material within the railway formation. The national Environmental Impact Assessment states that excavated material is to be reused to the maximum extent practicable, with additional material drawn from concentrated soil reserves and nearby quarries only where excavated material is insufficient or unsuitable. Where geotechnical conditions require draining material, this is to be sourced from appropriate quarries.

Impact. Notwithstanding the embedded reuse of suitable excavated material, the scale of the earthworks creates substantial demand for construction materials. The principal potential impact is therefore the possibility that demand for suitable aggregate, gravel and fill could exceed existing supply capacity, increase competition for local resources, or induce additional environmental impacts through development of new extraction sites or longer-distance transport. Taking account of the embedded cut-and-fill and material-reuse approach, the impact is assessed as **Minor magnitude and Low adverse significance**.

Mitigation and management response. The Contractor will implement a Material Resources Management Plan based on the hierarchy of:

- maximizing the cut-and-fill balance and reuse of geotechnically suitable excavated material;
- sourcing additional materials from existing licensed commercial quarries and authorized soil reserves wherever feasible;
- verifying the legal and environmental status of material suppliers before procurement;
- avoiding unnecessary extraction through accurate materials planning and control of wastage; and
- subjecting any new Project-specific borrow pit or quarry to appropriate environmental and social screening, permitting and management before use.

Material sourcing will also seek to minimize unnecessary haul distances, thereby reducing the associated traffic, dust, noise and fuel-use impacts assessed elsewhere in this ESIA.

For construction already undertaken, the ESCA/IESC process should verify that material used to date was obtained from appropriately authorized sources and identify any Project-specific borrow areas or extraction sites requiring corrective environmental management or reinstatement.

Residual impact. With maximum practicable reuse of excavated material, use of established authorized sources and environmental control of any Project-specific extraction areas, the residual impact is assessed as **Not Significant**.

8.4.3.6. Vibration

NO004 – Building and Structures Sensitive to Vibration

Purpose and Status of the Assessment. A preliminary construction vibration screening has been developed for the Project to support the impact assessment in this ESIA. The screening provides a first-order indication of the spatial distribution of receptors at risk of construction-induced vibration impacts along the alignment, identifies the locations at which receptors lie within distance bands at which cosmetic or structural building damage cannot be ruled out without further investigation, and informs the scope and priorities of the detailed vibration assessment and informs the scope and priorities of the detailed vibration assessment and building-condition surveys. The Project's construction status affects the availability of true pre-construction (baseline) condition surveys: at Maktaaral, where the relevant works have not yet commenced, genuine pre-construction condition surveys remain feasible and will be undertaken before works begin. At the other identified locations, where construction has already commenced, baseline pre-construction surveys are no longer possible; for these locations the Project will instead undertake current-condition ("as-is") surveys at the earliest opportunity, documenting the existing condition of structures (including photographic records of any pre-existing cracking or dilapidation) to establish the best available reference condition for subsequent monitoring and for the handling of any damage claims through the grievance mechanism.

The screening is preliminary in three respects. First, it adopts generic distance bands derived from international guidance rather than site-specific predictions for the particular plant, working method, and ground conditions to be encountered. Second, the receptor inventory has been built from OpenStreetMap data identifying buildings, residential and industrial land-use polygons, settlement extents and man-made works, and does not at this stage classify buildings by structural category or condition. Third, no measured site vibration data is currently available against which to calibrate the screening. The screening is therefore appropriate for the identification of areas of concern and for setting out the framework for the detailed assessment, but it is not a substitute for the detailed assessment, and the receptors identified within the screening bands should be regarded as warranting investigation rather than as confirmed receivers of damaging vibration.

Methodology. The screening adopts the distance-band approach set out in the Federal Railroad Administration *Transit Noise and Vibration Impact Assessment Manual* (FRA TNVIM, 2018, Chapter 12) for first-order vibration screening, with reference also made to the FRA Handbook (DOT/FRA/ORD-11/05, 2011) and to ISO 14837-1 *Mechanical vibration — Ground-borne noise and vibration arising from rail systems*. Four distance bands have been applied:

≤10 m — closest band, capturing receptors within the immediate working zone of vibration-generating activities and most at risk of cosmetic or structural damage from heavy construction plant.

≤30 m — capturing receptors within the FRA TNVIM Category 2 (residential) annoyance screening distance and within the typical zone of vibration influence for heavy compaction and piling activities.

≤50 m — capturing the wider zone of perceptible vibration from heavy construction plant and corresponding broadly to the FRA TNVIM Category 1 vibration-sensitive equipment screening distance of approximately 60 m.

≤100 m — the outer band beyond which vibration impacts from typical heavy construction plant on competent ground are not expected to be material.

The damage assessment has been benchmarked against the guideline values of DIN 4150-3 *Vibrations in buildings — Effects on structures*, which is the most widely used international standard for assessing

the risk of construction-induced damage to buildings and is referenced in Good International Industry Practice for projects of this type. DIN 4150-3 sets out short-term guideline values for peak particle velocity (PPV) at the foundation, by frequency band and by building category:

- Line 1 (commercial / industrial buildings): 20–50 mm/s depending on frequency
- Line 2 (residential / mixed-use buildings): 5–20 mm/s depending on frequency
- Line 3 (sensitive / historic / damaged buildings): 3–10 mm/s depending on frequency

Vibration levels below the applicable Line 2 value are not expected to cause damage to typical residential buildings; levels above the Line 2 value require further investigation; and levels approaching or exceeding Line 1 indicate a significant risk of cosmetic damage and, at higher levels, of structural damage. The categories applied to receptors along the alignment will be confirmed by condition surveys — pre-construction surveys where works have not yet started (Maktaaral), and current-condition surveys at the earliest opportunity where works are already underway.

The receptor inventory has been compiled from OpenStreetMap data via the Overpass API. The inventory includes individually-mapped buildings, residential and industrial land-use polygons (including farmyard polygons), named settlement extents, and identified man-made works. Receptors are counted cumulatively across the bands: a receptor within 10 m of the centerline is also counted within the 30 m, 50 m and 100 m bands. The screening does not at this stage attempt to classify individual buildings into DIN 4150-3 building categories; this classification will be undertaken as part of any pre-construction condition surveys.

Impacts. Applied across the full alignment, the preliminary screening identifies 3 receptors within the ≤10 m band, 35 receptors within the ≤30 m band, 70 receptors within the ≤50 m band, and 142 receptors within the ≤100 m band. The majority of the modelled corridor passes through open steppe, semi-desert and floodplain habitats with no inhabited receptors within any of the bands, and the construction-vibration risk in those sections is Non-significant. The identified receptors are concentrated at four locations along the alignment, corresponding to the locations at which the alignment passes through or close to settlements. These are described in the following section. For each location, the level of risk is provisionally indicated against the DIN 4150-3 framework as follows:

- Receptors within the ≤10 m band are at risk of vibration levels that may approach or exceed the DIN 4150-3 Line 2 guideline value, with a non-trivial risk of cosmetic damage depending on the type and intensity of the vibration-generating activity, the ground conditions, and the structural condition of the receptor. Pre-construction condition surveys, real-time vibration monitoring, and method-statement controls are required at all such receptors.
- Receptors within the ≤30 m band may experience perceptible vibration during heavy construction activities and may approach the DIN 4150-3 Line 3 guideline values for sensitive buildings. Condition surveys are recommended for older or otherwise sensitive structures in this band.
- Receptors within the ≤50 m band are unlikely to experience vibration levels that approach the DIN 4150-3 damage thresholds for typical residential or commercial buildings, but may experience perceptible vibration that warrants community engagement and a complaints monitoring mechanism.
- Receptors within the ≤100 m band are not expected to experience vibration of structural concern under typical heavy construction activities, but are within the wider zone of community awareness and are included in the screening for completeness.

Location-Specific Impacts

Maktaaral / Pakhtaaral / Atakent (approximately KM 115). Maktaaral is the most exposed location on the alignment with respect to construction vibration. The alignment passes through the southern

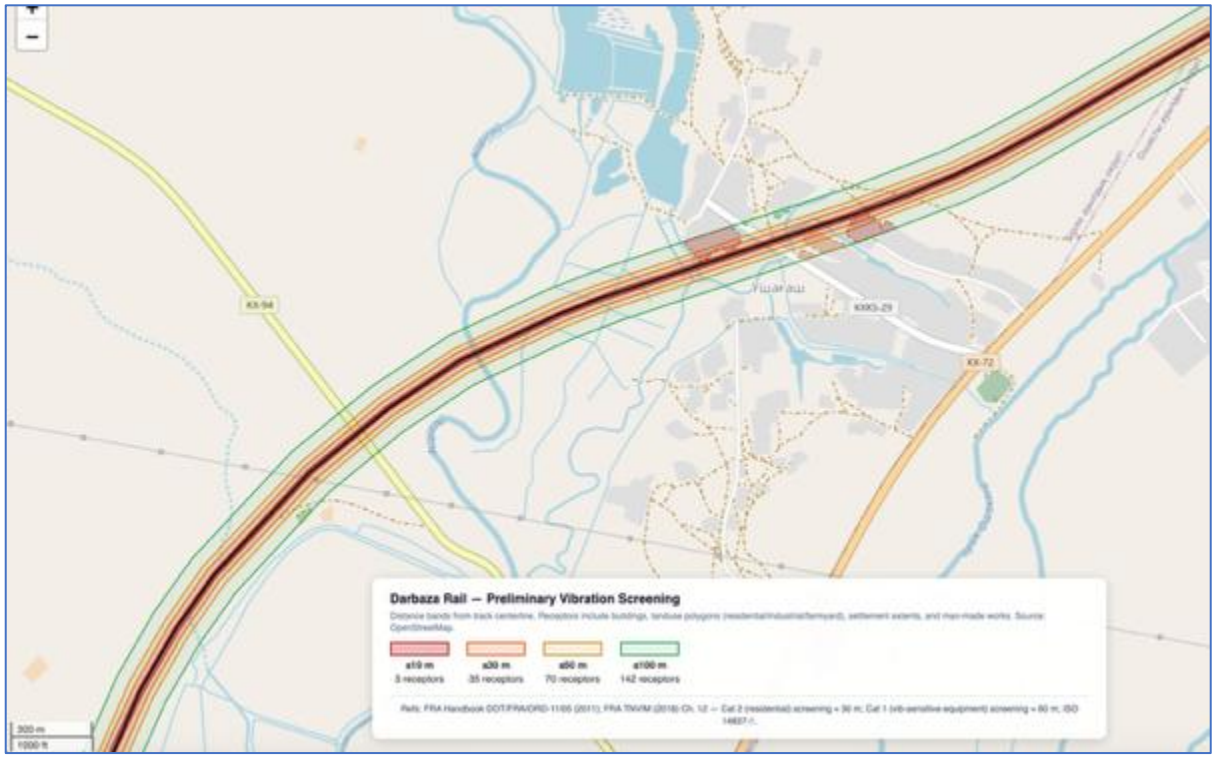
margin of the existing town, immediately south of the Atakent district, with continuous receptor density along both sides of the corridor for approximately 1.5 km. The screening identifies multiple receptors within the ≤30 m band and a small number of receptors within the ≤10 m band, principally industrial and commercial structures associated with the existing rail corridor and adjacent properties. Vibration-generating activities at this location will include earthworks, embankment compaction, piling at culvert and structure locations within the station footprint, and vibratory rollers during track formation. The Maktaaral exposure profile is shown in Figure 48.

Figure 48: Preliminary Vibration Screening at Maktaaral / Pakhtaaral / Atakent (KM 115)



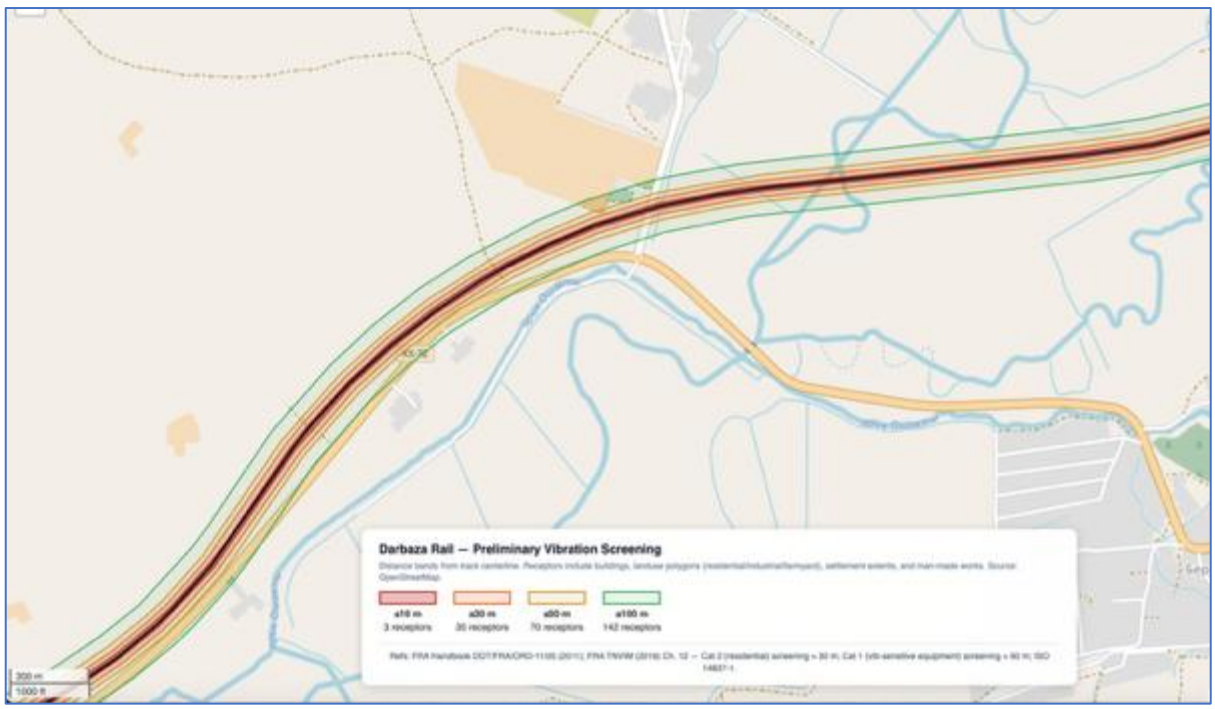
Ushagash settlement (approximately KM 50). Ushagash is the only location outside Maktaaral at which the screening identifies receptors within the ≤10 m band. Two receptor polygons are visible immediately adjacent to the alignment centerline, one on the northern side and one on the southern side, indicating that the alignment passes through the settlement at very close offset to existing structures. This makes the construction-vibration risk at Ushagash the most material in the rural sections of the alignment. The Ushagash exposure profile is shown in Figure 49.

Figure 49: Preliminary Vibration Screening at Ushagash settlement (approximately KM 50)



Sarıžylga–Bereke area (approximately KM 40). At approximately KM 40 the alignment passes close to the southern edge of the village of Sarıžylga. A small number of receptors are identified within the ≤30 m and ≤50 m bands at the village's southern margin, with the settlement of Bereke to the southeast lying partly within the ≤100 m band. No receptors are within the ≤10 m band at this location. The Sarıžylga–Bereke exposure profile is shown in Figure 50.

Figure 50: Preliminary Vibration Screening at Sarıžylga–Bereke (approximately KM 40)



Aktas / Algabas (near KM 0, south of Erdaulet station). At the northern end of the alignment, immediately south of the new Erdaulet station, the alignment passes adjacent to the settlement of Aktas (also labelled Algabas). A single receptor is identified within the ≤30 m band at the eastern edge of the settlement, with a small cluster of receptors at the road crossing (KX-11) within the ≤50 m and ≤100 m bands. The Aktas / Algabas exposure profile is shown in Figure 51.

Figure 51: Preliminary Vibration Screening at Aktas / Algabas (near KM 0)



Expected Cosmetic and Structural Impacts. On the basis of the preliminary screening, the following provisional conclusions are drawn against the DIN 4150-3 framework. These will be confirmed by the detailed assessment and the pre-construction condition surveys.

- **Risk of cosmetic damage** — that is, hairline cracks in plaster, opening of pre-existing cracks, or detachment of surface finishes — cannot be ruled out at receptors within the ≤10 m band during high-vibration activities such as embankment compaction with vibratory rollers, piling at structure locations, and heavy earthworks at the embankment toe. The receptors within the ≤10 m band are concentrated at Ushagash and within the Maktaaral corridor. Where receptors within the ≤10 m band are subsequently identified as being in poor structural condition or of historic or sensitive construction, the risk of cosmetic damage is correspondingly elevated, and the mitigation regime described below is to be applied accordingly.
- **Risk of structural damage** — that is, damage affecting the load-bearing capacity, stability or integrity of a building — is not expected at typical residential receptors under normal heavy construction activities at distances beyond 10 m, provided that vibration-generating activities are controlled to keep PPV at the foundation below the applicable DIN 4150-3 Line 2 guideline value. The risk of structural damage at receptors within the ≤10 m band depends on the structural condition of the receptor and on the intensity of the vibration-generating activity. Where receptors within the ≤10 m band are identified as being in poor structural condition, of historic or sensitive construction, or as containing vibration-sensitive equipment or contents, additional mitigation will be required and, where mitigation cannot bring vibration within acceptable limits, working method alternatives or temporary relocation arrangements will be considered.

- **Perceptible vibration and nuisance** — that is, vibration levels above the human perception threshold but below the damage threshold — will be experienced at receptors within the ≤30 m band during heavy construction activities, and intermittently at receptors within the ≤50 m band. Perception is not damage, but it is a legitimate community concern and is the principal driver of vibration-related grievances on linear infrastructure projects.

Mitigation Strategy. The mitigation framework for construction vibration is structured around a hierarchy of pre-construction characterization, real-time control, and reactive management. The following measures are committed by the Project for implementation through the Contractor's CESMP and the Pollution Prevention Plan referenced in Section 8.4.3.

- **Pre-construction condition surveys.** Condition surveys (pre-construction baseline surveys at Maktaaral, where works have not yet commenced; current-condition surveys at the earliest opportunity at the remaining locations, where construction has already begun), real-time vibration monitoring with PPV trigger and action levels at 50% and 75% of the applicable guideline value, and specific commitments at Ushagash (two receptors within 10 m of the working face) are detailed in Section 8 and the construction-phase Vibration Management Plan.
- **Real-time vibration monitoring.** Continuous monitoring of peak particle velocity will be undertaken at representative receptors within the ≤30 m band during vibration-generating activities. Monitoring trigger and action levels will be set at conservative fractions of the applicable DIN 4150-3 guideline value (typically trigger at 50% and action at 75% of the Line 2 value for residential receptors), with defined contractor and supervisor responses including reduction of working intensity, change of method, or cessation of the activity until the cause is investigated.
- **Method statement controls.** Vibration-generating activities within 30 m of identified receptors will be subject to method-statement controls including: selection of plant with appropriate vibration specifications; restriction of vibratory compaction in favor of static or oscillatory compaction where vibration-sensitive receptors are present; substitution of piling methods (e.g. bored piles or press-in piles) for impact or vibratory piling at sensitive locations; limitation of working hours for high-vibration activities; and prohibition of multiple simultaneous high-vibration activities within the same zone of influence.
- **Specific commitments at Ushagash.** Given the proximity of receptors within the ≤10 m band to the alignment, and the convergent findings of the noise modelling (Section 8.4.4 / Preliminary Operational Noise Modelling) and the vibration screening at this location, the following additional commitments apply at Ushagash: (i) condition surveys of all receptors within the ≤30 m band will be undertaken in advance of any further vibration-generating works at this location, with priority given to the two receptors within the ≤10 m band; (ii) real-time vibration monitoring will be deployed continuously during all earthworks, compaction and piling activities within 50 m of any identified receptor at Ushagash; (iii) trigger and action levels at Ushagash will be set at DIN 4150-3 Line 3 (sensitive building) values pending confirmation of building categorization by the condition surveys; and (iv) the categorization of receptors at Ushagash will be subject to early review on the basis of the condition surveys, and the monitoring regime adjusted accordingly.
- **Community engagement and grievance management.** Affected communities along the alignment will be notified in advance of vibration-generating activities, with information provided in Kazakh and Russian on the nature of the activity, the expected duration, the contractor's contact information, and the route to the project Grievance Redress Mechanism. The GRM will be the channel through which vibration-related concerns are received, investigated and resolved, including any allegation of damage to property arising from project

activities. Where damage attributable to the project is confirmed by the post-incident investigation, the Contractor will be liable for the cost of remediation in accordance with the EPC Contract.

Status and Next Steps. The preliminary vibration screening described in this section will be superseded by the detailed construction vibration assessment at the EPC stage. The detailed assessment will (i) confirm the locations of risk against site-specific predictions for the plant, methods and ground conditions to be encountered, (ii) categorize all identified receptors under DIN 4150-3 on the basis of the pre-construction condition surveys, (iii) develop the trigger and action levels and the monitoring regime for incorporation into the CESMP, and (iv) provide the basis for the contractor's method statements at all locations where receptors lie within 50 m of vibration-generating activities. The residual **Low** significance score recorded for construction vibration impact NO004 in the impact summary table (Section 8.3) is preliminary on the basis of the work reported in this section and will be finalized on the basis of the detailed assessment and the confirmed mitigation package.

8.4.3.7. Noise

NO002 – Noise Sensitive Receptors

Construction of the Project will generate elevated noise levels in the vicinity of active work fronts for the duration of the works at each location. Construction-phase noise is fundamentally different in character from operational noise: it is temporary, geographically mobile as the works progress along the alignment, and characterized by a wider range of source events including impulsive noise from piling and intermittent peak noise from heavy plant. The assessment of construction-phase noise therefore proceeds on a different basis from the operational noise assessment and the mitigation framework is correspondingly different.

This assessment is qualitative. It identifies the principal sources, the receptors of concern and the mitigation framework to be applied through the Contractor's Construction Noise Management Plan. Receptor exposure has been informed by the same alignment-level receptor inventory used in the preliminary operational noise modelling and the construction vibration screening, both of which independently identify the same six locations at which receptors lie in close proximity to the alignment.

The principal noise sources during construction along the alignment are:

- **Earthworks plant** — excavators, bulldozers, dump trucks and graders engaged in cut-and-fill, embankment formation and grading operations. These are the dominant noise sources for the majority of the alignment and will be active sequentially along the route as the construction program progresses.
- **Piling and ground improvement** — at bridge and major culvert locations, at structures within the Maktaaral and Erdaulet station footprints, and at any locations where ground conditions require ground improvement works. Piling generates impulsive noise that is distinct in character from continuous plant noise.
- **Vibratory rollers and compaction plant** — during embankment construction, compaction of the formation layers, and ballast tamping. These activities are characterized by tonal noise components in addition to broadband emissions.
- **Concrete batching** — at fixed batching plants established at strategic locations along the alignment to supply structures and station works. Batching is a continuous source for the duration of major concreting campaigns.
- **Transport** — haulage of bulk materials along access routes and haul roads, with associated noise at properties along those routes in addition to noise at the construction front.

Receptors. The principal receptors of concern are the residential and commercial property concentrations at the same six locations identified in the operational noise modelling and the construction vibration screening. Receptors located within the 100 m vibration screening band identified for construction vibration (142 receptors alignment-wide) will also be within the range at which construction noise is likely to be clearly perceptible during active works. Additional receptors along haul routes — not necessarily lying along the alignment itself — will be identified by the Contractor on the basis of the confirmed haul route and batching plant locations and incorporated into the Construction Noise Management Plan.

The greatest concentration of receptors is at Maktaaral, where the alignment passes through the southern margin of the existing town with continuous receptor density along both sides of the corridor. Ushagash is the rural location of greatest concern, with receptors immediately adjacent to the alignment. The other four locations have lower receptor counts but include receptors close enough to the alignment that construction noise will be a material consideration during the works at those locations.

Benchmarks. Construction noise will be managed against the construction noise level criteria of the IFC General Environmental, Health and Safety Guidelines (2007) and applicable national requirements. International practice for construction noise on linear infrastructure projects typically applies daytime construction noise limits in the range 65–75 dB(A) LAeq at residential receptors during working hours, with stricter limits at night-time and restrictions on high-noise activities outside daytime working hours. The Contractor's Construction Noise Management Plan will confirm the specific limits applicable to the Project, the working hour regime to be applied, and the operational arrangements for compliance with those limits.

Mitigation. The mitigation framework for construction noise follows the source–pathway–receptor hierarchy and will be operationalized through the Contractor's CESMP and a dedicated Construction Noise Management Plan.

- **At source**, the principal measures are: the selection of plant with appropriate noise specifications and confirmation of compliance with applicable noise emission standards; routine maintenance of plant and equipment to limit deterioration in noise emissions over the construction period; restriction of high-noise activities such as piling to defined daytime hours; substitution of piling methods (e.g. bored or press-in piles for impact piling) at sensitive locations where this is technically feasible; and operational controls including the prohibition of unnecessary idling, the use of broadband rather than tonal reversing alarms, and supervisor-led management of plant operations to minimize noise output.
- **Along the pathway**, temporary acoustic barriers will be deployed at high-sensitivity locations where source control alone is insufficient. Static plant such as concrete batching plants, generators and compressor sets will be located and oriented to maximize the offset and screening between the plant and the nearest sensitive receptors. Haul routes will be selected to minimize transit through residential areas where alternatives exist, and routing through villages during night-time hours will be prohibited.
- **At the receptor**, the Contractor will undertake advance notification of works to potentially affected communities, with information provided in Kazakh and Russian on the nature of the activity, the expected duration and the route to the project Grievance Redress Mechanism. Complaints received through the GRM will be investigated and responded to within defined timescales, with reactive deployment of additional mitigation where the complaint identifies a previously-unanticipated impact. Where construction noise at a particular receptor cannot be brought within applicable limits by source and pathway mitigation alone, façade insulation packages or temporary alternative accommodation will be offered to affected occupants for the duration of the limit-exceeding works.

Residual significance. Construction noise impact NO002 is assessed as Medium prior to mitigation. With full implementation of the Construction Noise Management Plan and the mitigation measures described above, residual impacts are expected to be Negligible magnitude and Not Significant at the majority of affected locations. At noise-sensitive receptors within the immediate vicinity of the Maktaaral and Erdaulet station footprints, the concentration of receptors and longer duration of station construction activities mean that residual impacts are conservatively assessed as Minor magnitude and Medium significance.

8.4.3.8. Soils and Geology and Water Quality

Three construction-stage impacts on soils, geology and water quality are identified. These arise principally from disturbance and handling of soils during earthworks, the potential for sediment and pollutants from construction areas to enter surface-water and drainage systems, and the potential disturbance of previously contaminated soil or groundwater.

SG001 – Compaction and loss of soil structure

Source and pathway. The first (SG001) is the compaction of soils and the loss of their physical, chemical and biological structure as a result of vehicle and plant movements across soil that has not been stripped, and as a result of inappropriate handling of stripped soil in storage.

VER and sensitivity. The principal receptors are soils disturbed by construction, including productive agricultural soils within the southern parts of the alignment. The Project passes through productive agricultural land in the southern part of the corridor, where loss of soil quality may affect the successful reinstatement of temporary works areas and the productive value of soil subsequently reused. Sensitivity is **Moderate**.

Impact. Construction earthworks, temporary access, movement of heavy plant and inappropriate stripping or stockpiling may compact soil, mix topsoil with less fertile subsoil or otherwise reduce its physical and biological quality. Where this occurs on productive agricultural land, the effect may reduce the effectiveness of reinstatement and subsequent agricultural productivity. The national EIA similarly identifies disturbance of the land surface, changes to the physical characteristics of soils and geological materials, and potential contamination as principal construction-stage effects on the geological environment. The impact is assessed as **minor in magnitude and of low significance**.

Mitigation and management response. The mitigation response is the Contractor's Soil Management Plan, which will require the stripping of topsoil and subsoil in separate layers, the storage of each layer in piles of no more than 3 m depth and in locations protected from wind and rain erosion and from compaction by machinery, the avoidance of soil handling under wet conditions that would damage soil structure, and the placement of soil in reverse layers during reinstatement.

Excess agricultural soil will be retained for productive purposes — landscape works on the Project, sale to third parties for agricultural or landscape use, or other beneficial reuse.

For sections already constructed, the condition and reinstatement of temporary works areas will be verified through construction supervision and the ESCA/IESC process. Where soil has been materially compacted, mixed or otherwise degraded as a result of construction, appropriate ripping, replacement of topsoil, regrading or other remedial reinstatement will be undertaken.

Residual impact. With implementation of the Soil Management Plan and appropriate reinstatement, residual significance is **Low**.

SG002 – Pollution of surface water and drainage systems

Source and pathway. The second (SG002) is diffuse and point-source pollution of watercourses, irrigation and drainage channels and the wider surface-water system from spills, fuel leaks, sediment-laden runoff from work fronts, concrete and washwater, and uncontrolled discharges from temporary site facilities.

The pathway is particularly important at watercourse and drainage crossings, including works associated with the Syr Darya crossing, and in the southern sections where the railway intersects a dense irrigation and drainage network.

VER and sensitivity. The principal receptors are the natural watercourses and engineered irrigation and drainage systems crossed by or located downstream of construction activities, including the Syr Darya/Shardara system. The Syr Darya and Shardara Reservoir have wider ecological and regional importance, while the irrigation network supports agricultural production across the southern Project area. Sensitivity is **Moderate**.

Impact. Sediment released from exposed soils or earthworks can increase turbidity and sediment deposition in receiving waters, while spills and uncontrolled construction wastewater may introduce hydrocarbons, chemicals, cementitious material or other pollutants. The national EIA specifically recognizes the need to prevent contamination of surface and groundwater at the Syr Darya crossing and identifies controls for refueling, fuels and lubricants, construction waste, bulk and liquid materials, domestic wastewater and stormwater. The impact is assessed as **low**.

Mitigation and management response. The Contractor's Pollution Prevention Plan will set out prevention and control measures, including sediment traps and silt fences at active work fronts, oil interceptors at vehicle-wash and refueling areas, bunded storage of fuels and chemicals, defined refueling protocols, spill-response equipment at each work front, and management of dewatering and other temporary discharges through settlement or treatment as required.

Specific erosion controls to prevent discharge of turbid site drainage will include silt bunding and sediment traps at watercourse crossings, protection of exposed soil surfaces, controlled drainage from active work fronts and designated washdown areas.

The national EIA additionally specifies the use of oil-catching trays or equivalent measures to prevent loss of fuels and lubricants during construction; temporary storage of construction wastes in containers on hard surfaces; regular removal of construction waste; controlled storage and transport of bulk and liquid materials; collection and appropriate management of domestic wastewater; and treatment and controlled management of stormwater and wastewater.

No untreated construction wastewater, concrete wash water or sediment-laden dewatering discharge will be released directly to a natural watercourse or irrigation channel.

For remaining works at or immediately adjacent to the Syr Darya/Shardara system, water-quality controls will include observation of turbidity and, where works have the potential to generate material sediment releases, upstream and downstream monitoring during the relevant works. Where monitoring identifies a material construction-related deterioration in water quality, the relevant activity will be reviewed and additional sediment-control measures implemented before works continue.

For sections already constructed, evidence of significant spills, uncontrolled discharges or sediment releases identified through the ESCA, construction records or GRM will be investigated and any remaining contamination or affected drainage infrastructure remediated.

Residual impact. With implementation of the Pollution Prevention Plan and watercourse-specific controls, residual significance will be **not significant**.

SG003 – Mobilization of existing soil and groundwater contamination

Source and pathway. The third (SG003) is the potential mobilization of existing soil and groundwater contamination disturbed during earthworks and the requirement for appropriate management and disposal of contaminated material excavated from the alignment.

VER and sensitivity. The principal receptors are soil and groundwater at locations where historical activities may have resulted in localized contamination, together with downstream soil or water

receptors that could be affected if contaminated material is excavated, stockpiled, transported or disposed of inappropriately. Sensitivity is **Moderate**.

Impact. The baseline does not identify the alignment as crossing any known major contaminated sites, but the historical industrial and agricultural use of the wider region means that the existence of localized contamination cannot be excluded. Excavation through such material could expose workers, spread contamination into previously unaffected soil, mobilize contaminants through runoff or groundwater, or result in inappropriate reuse or disposal of contaminated excavated material. The impact is assessed as **Minor in magnitude and Low in Significance**.

Mitigation and management response. The Contractor will undertake targeted contamination investigation at locations of elevated risk that have not yet been disturbed, including historic fuel-storage areas, former workshops and other potentially contaminating land uses. Where contamination is identified, material will be managed through a site-specific Contaminated Land Management Plan agreed with the relevant national authorities. The Plan will address segregation, characterization, transport and disposal of contaminated material, worker protection and management of contaminated groundwater.

An Unexpected Contamination and Buried Utilities/Hazards Protocol will apply to all remaining earthworks, defining stop-work, notification, characterization and management procedures where staining, odour, buried waste, contaminated groundwater or other evidence of unexpected contamination is encountered.

For areas already disturbed, construction records and the ESCA findings will be reviewed to identify locations where potentially contaminated material was encountered or where works occurred at higher-risk historical land uses. Any unresolved evidence of contamination will be investigated and remediated as appropriate.

Existing unlicensed waste-disposal sites in the vicinity of the alignment containing asbestos or other hazardous materials will remain out-of-bounds for Project activities and will not be used for disposal of Project wastes.

Residual impact. With implementation of the contamination-management and unexpected-find procedures, **no significant impacts** are anticipated.

8.4.3.9. Biodiversity

The Project's construction-stage impacts on biodiversity are by far the most numerous and the most material in the assessment, reflecting the position of the alignment within and adjacent to the Shardara Reservoir IBA/KBA, the presence of Critical Habitat for the Syr-Darya Shovelnose Sturgeon and other receptors, and the extent of steppe, semi-desert and wetland habitat along the route. The remainder of this Biodiversity subsection presents the detailed site-specific assessment by receptor group.

The potential impacts and risks of the project on existing and future biodiversity value of the area are discussed in detail in the following sections of text. This augments the summary of impacts and mitigation measures set out in Table 87. In some cases, receptors have been aggregated to avoid double counting of impacts. For example, several bird species utilise the Project area during the winter period and are therefore assessed collectively under the Wintering Bird Assemblage VER rather than repeating the same impact assessment for individual species.

During the construction phase of the project there are several likely impacts acting on a variety of receptors. In some cases, the receptors identified have been aggregated to reduce the effect of double counting of impacts. For example, several bird species utilize the project area during the winter period, rather than document the same impacts on individual species, these have been aggregated into a single VER of Wintering Bird Assemblage.

Construction-to-date context. Construction commenced before completion of the lender-aligned biodiversity assessment and Biodiversity Management Plan. The impact assessment and significance conclusions below are retained as the basis of the Project's biodiversity assessment. However, where avoidance or minimization measures identified in this Supplementary ESIA were not implemented during works already undertaken, the assessment does not retrospectively assume that those measures were in place. The extent of construction-related biodiversity impacts already realized will therefore be verified through the ESCA/IESC process and taken into account in the final quantification of residual impacts and in the development of the Biodiversity Action Plan and associated No Net Loss/Net Gain requirements.

A. Shardara Reservoir IBA/KBA.

VER and Sensitivity. The Project railway alignment crosses the eastern margins of the Shardara Reservoir IBA/KBA for approximately 16 km. This section of the alignment requires the construction of a raised embankment approximately 100 m wide and 20 m high, across the Syr Darya wetland habitats and the associated open water. The IBA/KBA as a whole is 96,000 ha in extent and thus the Project footprint within this internationally recognized area is approximately 150 ha, representing approximately 0.15% of the total IBA/KBA. The Shardara Reservoir IBA/KBA is an internationally recognized biodiversity area and is therefore a receptor of **extreme** sensitivity.

TE001 - Permanent Habitat Loss.

Impact. The most significant construction-stage impact on the IBA/KBA is the permanent loss of approximately 150 ha beneath the embankment footprint. This includes nearly 130 ha of braided channels and floodplain grassland and 20 ha of Tugai scrub reedbed marshland and open mud. These habitats individually and collectively underpin the ecological function of the site and the reasons for which it was recognized.

The impact is of **high magnitude** as the loss is permanent, concentrated in an area of high habitat diversity, including the Syr Darya river, and is certain to occur. Given the international sensitivity of the receptor, the pre-mitigation significance of this **impact is assessed as Major/Significant**.

TE002 - Temporary Habitat Loss.

Impact. In addition to the permanent loss, temporary habitat loss of at least 20 ha is anticipated for construction compounds, spoil storage and working areas within the IBA. Although temporary in nature, loss of reedbed and floodplain grassland during active construction could displace breeding waterbirds and reduce the availability of foraging and roosting habitat during ecologically critical periods, particularly spring migration and breeding between May to July. The magnitude is **Moderate** in extent and duration, and reversible, but certain to occur within an internationally sensitive designation. Given the High sensitivity of the Shardara IBA/KBA, the pre-mitigation impact is assessed as High significance.

TE005 - Hydrological Fragmentation.

Impact. The construction of the embankment across the reservoir will temporarily dam and physically separate a section of open water to the west of the embankment during construction. Based on the average reservoir depth of 6.5 m and the embankment cross-section, this could temporarily affect approximately 500 ha of the reservoir and result in the temporary loss of an estimated 3.25 million m^3 of active water storage capacity west of the embankment.

This hydrological alteration could affect water levels across the western basin of the reservoir during the construction period, with potential secondary impacts on waterbird feeding and roosting habitat, fish movement, and wetland vegetation. The impact is of **Moderate magnitude**, spatially significant within the IBA/KBA context, medium in duration, i.e. it could persist for less than a year but is likely to occur for more than one year, and potentially frequent in occurrence during construction. The impact is, however, largely reversible once the embankment construction is complete as the designs include

four bridges that will be cut into strategic locations along the embankment to improve water flow. The four bridges are in addition to the main Syr Darya river crossing. Given the High sensitivity of the Shardara IBA/KBA, the pre-mitigation impact is assessed as High significance.

TE003 - Disturbance.

Impact. Construction activities, including earthworks, piling, vehicle movements, and associated noise and artificial lighting, will result in sustained disturbance to waterbirds and other wildlife within and adjacent to the IBA/KBA. The notable disturbance zone is expected to extend up to 500 m from active works based on typical disturbance distances reported for waterbirds and raptors during infrastructure construction. Noise and light disturbances may extend many kilometres in the right conditions, but 500 m is considered an appropriate buffer and is consistent with several robust and internationally recognised published reviews (Carney and Sydeman (1999), Goodship and Furness (2022) and Ruddock and Whitfield (2007)). 500 m has been found to be a reasonable distance at which point significant disturbances dissipate to negligible or low levels for most wintering and breeding bird assemblages and most species.

Disturbance will be most significant during the winter (October to March) and spring migration (March to May) periods, when the reservoir supports its largest assemblages of internationally important waterbird populations. The February 2026 monitoring survey confirmed the continued presence of steppe eagle, white-tailed eagle, and significant numbers of wintering waterbirds during active bridge construction, demonstrating the vulnerability of the IBA population to construction-period disturbance. The magnitude of disturbance is assessed as Moderate. The effect is not permanent, but extends over the construction period (approximately 18 – 24 months), occurs frequently during active works and is expected to occur where construction takes place within or adjacent to sensitive habitat. Given the High sensitivity of the Shardara IBA/KBA, the pre-mitigation impact is assessed as High significance.

TE004 - Pollution.

Impact. There is a risk of sedimentation of the Syr Darya channel and reservoir from the embankment construction, earthworks, and haul road operations, as well as the risk of accidental fuel or chemical spillage from plant and equipment. Sedimentation can reduce water clarity, affect benthic communities and fish spawning habitat, and degrade conditions for diving waterbirds. Given the confined nature of the reservoir and the long residence time of the water body, pollution risks require careful management. Probability is assessed as moderate (standard construction practice would reduce likelihood), extent is regional given the downstream connectivity of the reservoir, and reversibility is medium.

Mitigation for Protected Areas. The following mitigation measures represent the Project's formal commitments to avoid, minimize, and manage impacts on protected areas. They have been developed to ensure compliance with ADB's SPS and IFC's PS6. These commitments define the overarching approach and obligations to be applied throughout project planning, construction, and reinstatement. Mitigation commitments for impacts on the IBA/KBA during construction include:

- Confirm the alignment design minimizes footprint within the IBA/KBA, with bridge structures retained at all strategic locations to maintain hydrological connectivity and preserve waterflow through the embankment
- Restricting and controlling any construction related works outside the minimum footprint
- Seasonal restrictions on the most disruptive activities (in particular piling, blasting, and embankment placement) during the peak winter and spring migration periods, where practicable

- Good international practice for pollution control will be implemented across all works: silt bunding and sediment traps at all watercourse crossings, bunded fuel and chemical storage at minimum 50 m from any watercourse, designated washdown and refueling areas, daily plant inspections, a Spill Response Plan with pre-positioned response equipment, and a 20 m no-works buffer to all watercourses outside designated crossing points;
- Erosion control measures at all watercourse crossings and exposed earthworks within and adjacent to the IBA/KBA: progressive reinstatement of exposed surfaces, temporary seeding or matting of stripped batters and stockpiles, and check dams/interceptor drains on haul roads and exposed slopes, in addition to the sediment traps and silt bunding above;
- Strict control of vehicle movements and compounds to pre-approved areas outside ecologically sensitive foreshore zones;
- Light-pollution control - directional, low-lumen, warm-spectrum lighting only, with shielding to prevent spill onto open water, reedbed, and floodplain habitat. No lighting outside active work fronts;
- The strict prohibition of all activities that could result in the pollution of any open water, including but not limited to, the restriction of any refueling, cleaning, discharge of waste or use of chemicals along the embankment within the reservoir or within 50 m of any river.
- Implement noise control on all plant (silenced compressors, broadband reversing alarms, plant maintained to manufacturer noise specification) and limit piling to daylight hours

Residual Impact(s). Despite the implementation of mitigation, the permanent loss of approximately 150 ha from the IBA/KBA and the associated temporary hydrological and disturbance impacts, represents a residual significant adverse impact. Given the receptor's international sensitivity, no combination of on-site mitigation measures alone can achieve the requisite No Net Loss (NNL), let alone Net Gain (NG), and thus additional conservation actions are required.

Additional conservation actions will be developed and implemented through the Project's Biodiversity Action Plan (BAP). The actions will be designed in consultation with relevant stakeholders and align with existing IBA and KBA management priorities, including known risks and opportunities. Indicative actions are introduced in the Project's Preliminary BAP (see Appendices) and include local reedbed or Tugai scrub management, restoration or habitat protection, community training and capacity building, and the provision of surveying resources to improve the collection of data and our understanding of IBA/KBA.

The successful implementation of the final BAP must achieve measurable biodiversity gains for the IBA/KBA in perpetuity. Over time, the actions will therefore compensate for the permanent land take. This will require long-term leadership and support by KTZ, community engagement and enduring and sustainable funding for decades to come. At this stage, it is theoretically possible that the residual impacts can be offset and the Project achieves NNL for the Shardara Reservoir IBA/KBA. Further assessment and the development of the full BAP is required.

B. Wintering Bird Assemblage.

VER and Sensitivity. The Shardara Reservoir supports a wintering bird assemblage of international significance, qualifying as an IBA under Criterion A4iii (assemblages exceeding 20,000 waterbirds). Peak winter counts have historically exceeded 100,000 individuals, with the February 2025 survey recording approximately 4,440 individuals from the bird transect completed along the embankment alignment (i.e. comprising less than 1% of the reservoirs extent only). The assemblage includes eight IBA qualifying species and multiple Kazakhstan Red Data Book species.

The February 2025 surveys recorded 38 species and approximately 3,133 and 4,440 individuals on the two survey days respectively. The assemblage included high numbers of Eurasian Coot, Gadwall, Great Cormorant, Pygmy Cormorant and Common Teal, together with Dalmatian Pelican and other species of conservation concern. The wintering bird assemblage is the primary reason for the IBA designation and is therefore assessed as a receptor of High sensitivity.

TE028 - Permanent Habitat Loss.

Impact. The permanent loss of 150 ha of habitat from within the IBA will reduce the extent of habitat for this assemblage. This includes shallow open water (critical for diving ducks and coots), riparian grassland (important for geese and dabbling ducks), and reedbed (roosting and shelter for many species). While this represents a small fraction of the total reservoir area (c.0.15%), the loss of ecologically productive foreshore habitat in the shallowest and most accessible part of the IBA is likely of high significance for the assemblage.

As described under Land Take, the permanent habitat-loss pathway is common to the biodiversity receptors dependent upon the affected wetland habitats and is not reassessed separately here. For the Wintering Bird Assemblage, the residual significance of permanent habitat loss is assessed as Medium prior to offset action, consistent with the assessment in the Land Take table.

TE026 - Disturbance.

Impact. Construction activity between October and March will likely result in the displacement of significant numbers of wintering waterbirds from near the embankment. Relevant sources include construction plant and vehicle movements, earthworks, piling, human presence, noise and artificial lighting.

Regular monitoring during active construction in February 2026 confirmed that waterbirds continue to use the reservoir adjacent to construction operations, suggesting partial tolerance of disturbance, but counts were substantially lower than in the same area during the February 2025 survey. The February 2026 survey recorded 30 species and was undertaken while construction operations along the embankment and at the Syr Darya bridge were ongoing

The magnitude is therefore assessed as being moderate to high, certain, continuous, and affecting an assemblage of international significance.

TE027 - Hydrological Fragmentation.

Impact. The temporary damming and the associated changes to the reservoir's hydrology could reduce the area and quality of shallow foraging habitat available to the winter assemblage in the western basin. The effect depends on the timing and method of embankment construction relative to the winter period and on the duration of temporary changes in water level and connectivity. This is a moderate-magnitude impact, dependent on the timing and method of embankment construction relative to the winter season.

TE029 – Direct Harm During Site Clearance

Impact. Site clearance and construction activity within wetland and foreshore habitats also create a risk of direct injury or mortality to individual birds, particularly where birds are resting or sheltering within vegetation or where clearance occurs during periods of high bird use. The risk is localized and principally associated with clearance of temporary works areas and movement of construction equipment outside established work zones.

The impact is assessed as Minor magnitude and Medium adverse significance before mitigation**,** reducing to **Low**following implementation of the controls described below, consistent with Table 87.

Mitigation for wintering bird assemblage. Mitigation to be implemented with respect to the IBA will help address some of these impacts. In addition, mitigation for the wintering assemblage includes:

- Wherever possible, the most intensive construction works in open water should be scheduled outside the peak winter waterbird period (October to March)
- Construction monitoring should include regular and continual waterbird counts

Where monitoring identifies material displacement of wintering birds from important feeding or roosting areas, the timing, intensity or spatial extent of disruptive construction activities will be reviewed and additional controls implemented where practicable.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. In particular, the Project will not assume retrospectively that seasonal restrictions or other disturbance-minimization measures were implemented where this has not been demonstrated. Available 2025 and 2026 monitoring data, construction records and subsequent surveys will therefore inform the final assessment of realized effects and the BAP loss accounting.

Residual Impact. The permanent loss of wintering from the reservoir cannot be fully compensated on-site, but the disturbance, kill/injury, and fragmentation impacts are manageable through standard construction management measures. Residual significance is moderate for permanent habitat loss, and low for disturbance and other temporary impacts following mitigation. The permanent loss requires offset actions, which will be developed and implemented through the BAP. At this stage it is possible that the residual impacts can be offset and the Project will achieve NNL. Further assessment and the development of the full BAP is required.

C. Migratory Bird Assemblage.

VER and Sensitivity. The Shardara Reservoir sits at the intersection of the Afro-Eurasian and Central Asian migratory flyways and supports large concentrations of migratory waterbirds, waders, and raptors during spring and autumn passage. The spring bird survey surveys completed along the alignment of the embankment (May 2025) recorded peak counts of 800 Black-tailed Godwit (IUCN Near Threatened), 600 White Stork, and significant numbers of waders and swallows.

The migratory bird assemblage is identified in the VER register as an assemblage of international importance because of the diversity and abundance of migratory species using the Central Asian and associated migratory flyways, and is therefore assessed as a receptor of High sensitivity.

TE018 - Permanent Habitat Loss and Disturbance.

Impact. As described for the wintering assemblage, the permanent loss of floodplain habitat and construction disturbance will affect the quality and extent of habitat available to migrating species, particularly during the spring passage between March and May, and the autumn passage between August and October. The IBA is one of the most important stopover areas in southern Kazakhstan for migratory waterbirds and waders, and any reduction in habitat availability or increase in disturbance during migration could have negative consequences for migratory bird assemblages and survival of individual birds.

The impact is assessed as Moderate magnitude and High adverse significance, with High residual significance prior to offset action.

TE016 - Disturbance

Impact. Construction activity has the potential to disturb migratory birds using the reservoir and adjoining wetland habitats, particularly during the spring passage between March and May and the autumn passage between August and October. Noise, vehicle and plant movements, human activity and artificial lighting may temporarily displace birds from feeding and resting areas or reduce the suitability of habitat close to active construction fronts.

Because migrating birds are present for relatively short periods and may be dependent on suitable stopover habitat to replenish energy reserves, repeated disturbance during peak migration periods could affect habitat use and individual condition.

The impact is assessed as Minor magnitude and Medium adverse significance before mitigation, reducing to **Low** following mitigation, consistent with Table 87.

TE017 – Hydrological Fragmentation

Impact. Temporary damming and associated changes in water levels and hydrological connectivity during embankment construction may alter the extent and quality of shallow-water and foreshore habitats used by migratory birds for feeding and resting during passage.

The effect is temporary and largely reversible once hydraulic connectivity through the embankment is established. Its ecological importance depends principally on whether the period of altered hydrological conditions coincides with peak spring or autumn migration.

The impact is assessed as Minor magnitude and Medium adverse significance before mitigation, reducing to **Low** following mitigation, consistent with Table 87.

TE019 – Direct Harm During Site Clearance

Impact. The probability of direct mortality during site clearance is low for most migratory species, which are transient rather than resident. However, birds settling on newly cleared areas, exposed ground or temporary waterbodies may be exposed to construction vehicles or plant during peak passage periods.

The impact is assessed as Minor magnitude and Medium adverse significance before mitigation, reducing to **Low** following mitigation.

Mitigation for migratory bird assemblage. Mitigation to be implemented with respect to the IBA will help address some of these impacts. In addition, mitigation for the migratory assemblage includes:

- Wherever possible, the most intensive construction works in open water should be scheduled outside the peak migration waterbird period (March to May and again in September and October)
- Construction monitoring should include regular and continual waterbird counts

Where monitoring identifies material displacement from important feeding or stopover areas, the timing, intensity or spatial extent of disruptive activities will be reviewed and additional controls applied where practicable.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. The Project will not retrospectively assume that seasonal restrictions or other disturbance-minimisation measures were implemented where this cannot be demonstrated. Available survey data and construction records will therefore be used to inform the final accounting of realised impacts and the BAP.

Residual Impact. The permanent loss of habitat suitable for migrating birds within the reservoir cannot be fully compensated on-site. Disturbance, direct harm and hydrological-fragmentation effects are, however, manageable through the construction controls described above. Residual significance is therefore High for permanent habitat loss prior to offset action, consistent with TE018 in the Land Take assessment, and Low for disturbance, fragmentation and direct-harm impacts following mitigation.

The permanent habitat loss requires offset action through the BAP. The Preliminary BAP identifies the Migratory Bird Assemblage as requiring No Net Loss through offset action.

At this stage it is considered possible that the residual impacts can be offset and that the Project can achieve NNL. Further assessment, continued migration-season monitoring and development and implementation of the full BAP are required.

D. Breeding Bird Assemblage.

VER and Sensitivity. Field surveys completed during June and July 2025 identified a large previously undescribed mixed-species breeding colony in an extensive reedbed approximately 1.2 km east of the embankment alignment towards the south-eastern most corner of the IBA. The colony supports approximately 1,500 pairs of pygmy cormorant, 1,000 pairs of glossy ibis (Kazakhstan RDB Vulnerable), and 300 to 400 pairs of little egret (Kazakhstan RDB Rare), together with several other herons and colonial waterbirds. This colony represents a nationally significant aggregation of breeding birds and the pygmy cormorant meets the thresholds for Critical Habitat.

TE032 - Permanent Habitat Loss.

Impact. The permanent loss of reedbed and associated wetland used by breeding birds would very likely reduce the available breeding habitat for waterbirds. The discovered colony is located approximately 1.2 km from the nearest point of the alignment, outside the direct construction footprint and therefore not subject to direct impacts.

However, 9 ha of reedbed will be lost from the reservoir and while it this habitat is not directly associated with the nationally significant breeding aggregation, its loss would likely negatively affect the reservoir's carrying capacity for breeding species. Further, the loss of the wider wetland from the footprint of the embankment will result in reduced foraging habitat for the breeding population, including the pygmy cormorant.

As described under Land Take, this permanent habitat-loss pathway is common to the biodiversity receptors dependent upon the affected wetland habitats. The detailed receptor-specific consequence for the breeding assemblage is retained here.

The impact is assessed as Moderate magnitude and Medium adverse significance**,** with the residual significance as stated in Table 87.

TE030 - Disturbance.

Impact. Construction noise, light, and human activity during the breeding season, between April and August, has the potential to disturb breeding birds, particularly given the proximity of the Project's alignment and the sensitivity of waterbirds to disturbance, specifically during incubation and chick-rearing.

Large colonial waterbird species typically respond to human disturbance at distances of 100–500 m and the colony at approximately 1.2 km from the Project and therefore outside the likely zone of significant disturbance (under normal construction noise levels), but peak construction activities, particularly piling and blasting would generate noise levels sufficient to affect the colony at this distance.

Further, it is currently not yet known how the colony or the pygmy cormorant use the wetland during the breeding season, for example, where they forage. The embankment is a reasonable distance from the colony but we do not yet know if they return to exactly the same reedbed location, where they forage and so on. The Project could potentially act as a visual either restricting the colonies movement west towards the open reservoir or reducing visibility of potential predators and making the reedbed possibly less favourable.

Kill/Injury. The likelihood of direct mortality of breeding birds during site clearance and construction is very low. The colony's location outside the direct construction footprint.

The impact is assessed as Minor magnitude and Medium adverse significance before mitigation, reducing to Low following mitigation, consistent with Table 87.

TE031 – Hydrological Fragmentation

Impact. Temporary damming and associated changes in water level and hydrological connectivity during construction of the embankment could alter the extent and quality of wetland and shallow-water habitats used by breeding birds for feeding.

The effect is principally indirect because the identified colony lies outside the direct construction footprint. Its significance therefore depends on the extent to which birds from the colony use the western basin and other habitats affected by temporary changes in reservoir hydrology.

The impact is assessed as Minor magnitude and Medium adverse significance before mitigation, reducing to **Low** following mitigation.

TE033 – Direct Harm During Site Clearance

Impact. The likelihood of direct mortality of birds associated with the identified colony during site clearance and construction is very low because the colony lies outside the direct construction footprint. However, breeding birds, nests or young occurring elsewhere within or immediately adjacent to the construction footprint could be harmed where vegetation clearance takes place during the breeding season.

The impact is assessed as Minor magnitude and Medium adverse significance before mitigation, reducing to **Low** following mitigation.

Mitigation for breeding bird assemblage. Mitigation to be implemented with respect to the IBA/KBA will address some of the impacts. In addition, mitigation for the breeding assemblage includes:

- wherever possible, the most intensive construction works near the colony should be scheduled outside the peak breeding period taken to be between March and July
- construction monitoring should include regular and continual breeding bird counts and nest surveys within 500m of the alignment (the ecology of the colony must be better understood)

Where monitoring identifies active nests within or immediately adjacent to areas proposed for clearance, appropriate species-specific exclusion buffers will be established and maintained until breeding has been completed.

Monitoring of the identified colony will also seek to improve understanding of the principal foraging areas and movement routes used by Pygmy Cormorant and other colonial waterbirds. This information will inform adaptive management during the remaining construction works and development of the BAP.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. Where vegetation clearance or other potentially disturbing works occurred during the breeding season without the specified surveys or controls, the assessment will not retrospectively assume that avoidance was achieved. Available construction records and biodiversity monitoring will be considered in the final residual-impact and BAP accounting.

Residual Impact. The permanent loss of breeding bird habitat, including the loss of the critical habitat for the pygmy cormorant from the reservoir cannot be fully compensated on-site, but the disturbance, fragmentation and kill/injury impacts are manageable through standard construction management measures.

Residual significance is Low for the individual construction impacts identified in Table 87 following mitigation, including TE032. The permanent loss requires offset actions, which will be developed and implemented through the BAP. At this stage it is possible that the residual impacts can be offset and the Project will achieve NNL. Further assessment and the development of the full BAP is required.

E. Raptor and Vulture Assemblage.

VER and Sensitivity. The area surrounding the embankment supports a raptor assemblage of at least 11 species, including two globally threatened species, steppe eagle and white-tailed eagle, and several Kazakhstan Red Data Book species. Surveys during 2025 and 26 recorded raptors using the IBA include both resident and migratory species, with the western marsh harrier as the most abundant. Historical records include several additional including the threatened species eastern imperial eagle, greater spotted eagle, Pallas's fish-eagle and saker falcon, that have not been recorded in current surveys.

Disturbance and Kill/Injury. Construction activities will displace raptors from the active construction area. All raptors are sensitive to human disturbance, with well recorded 'flush distances' of between 150 and 500 m depending on species. Of particular concern is the risk of nest abandonment if active nests are present within or close to the construction footprint during the breeding season. This is of particular not for the western marsh harrier, which has, over the years, been recorded more frequently than other raptors and is assumed to breed. Direct mortality during site clearance is considered very low probability for raptors, given their high mobility and sensitivity to human approach.

Mitigation for raptor and vulture assemblage. Mitigation to be implemented with respect to the IBA will help address some of these impacts. In addition, mitigation for the assemblage includes:

- Pre-construction nest survey of all suitable habitat within 500 m of the alignment
- Construction monitoring should include regular and continual monitoring counts

Residual Impact. The implementation of the mitigation measures to avoid and reduce impacts on the local raptor and vulture assemblage will likely reduce the residual significance of temporary construction impacts to a level that is low.

F. Other Bird Species (Little Bustard, Yellow-eyed Pigeon).

VER and Sensitivity. Little bustard *Tetrax tetrax* (IUCN Near Threatened) is a species of steppe grassland, and although not recorded during the Project's field surveys it could potentially be present in open grazed desert/steppe sections of the alignment north of the reservoir. The yellow-eyed pigeon *Columba eversmanni* (IUCN Vulnerable) is known to breeding in relatively few locations, one of which is the northern cliffs of the Shardaya Reservoir and is thus particularly susceptible in these locations where the railway is close. Both species are listed in the Kazakhstan Red Data Book.

Impacts. Construction impacts on both species are primarily related to disturbance and possible mortality, particularly at foraging and nesting sites within and adjacent to the Project's alignment. The risk of direct mortality is very low. Little bustards will flush and move off site relatively quickly and the proximity of the alignment to existing settlements and agriculture suggests any risk of mortality is very low.

The risks to the yellow-eyed pigeon are comparative higher if the species is nesting in the cliffs along the northern edge of the reservoir. The likelihood of direct loss is still however, relatively low given the direct impacts are be restricted to approximately 100 m or potentially up to 200 m of the cliffs during earth works, no pigeons were recorded during the Project bird surveys and the reservoir's northern embankment stretches more than 80 km.

The magnitude is assessed as moderate for both species, given their national sensitivity and the potential for nest loss, although the likelihood is low.

Mitigation for other bird species. Mitigation for other bird species includes:

- Pre-construction nest survey of all suitable habitat within 500 m of the alignment;
- Where active nests are identified, establishment of an appropriate species-specific exclusion buffer and avoidance of vegetation clearance or other potentially damaging works until the young have fledged or the nest is confirmed no longer active; and

- Construction monitoring should include regular and continual monitoring counts.

These measures are consistent with the Project-wide construction biodiversity commitment requiring pre-construction nest surveys and delaying vegetation clearance where active nests are identified.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. Where clearance or earthworks have already occurred without the specified nest surveys, the assessment will not retrospectively assume that avoidance was achieved. Available construction and biodiversity-monitoring records will be reviewed for evidence of impacts on nesting birds.

Residual Impact. The implementation of the mitigation measures to protect other bird species will ensure the residual significance of temporary construction impacts is low.

G. Fish.

VER and Sensitivity. IUCN Red List fish species have been identified as present/possibly present within the Syr Darya river system and therefore potentially within the construction footprint where it crosses the river (and surrounding reservoir). Of key concern is the Syr Darya shovelnose sturgeon *Pseudoscaphirhynchus fedtschenkoi* (IUCN Critically Endangered). The fish also meets the thresholds for Critical Habitat. The sturgeon is the world's small sturgeon species and is endemic to the Syr Darya river, where it has been subject to extensive pressures from dams, changes in water flow, habitat loss and degradation, and overfishing. While there have been no confirmed recent records, consultation with local fishermen and a 2019 American/Kazakh expedition indicate that the species may persist in very low numbers in the Syr Darya system.

Additionally, other species such as the Arum Barbel *Luciobarbus brachycephalus*, IUCN Endangered was confirmed in fish sampling completed as part of the nearby Saryagash Bypass Road Project. Therefore, although the following focuses on the Syr Darya Shovelnose Sturgeon, the impacts, assessment, mitigation and residual impact are all also relevant to the barbel and other fish present.

Impact. Construction of bridge footings and crossing structures within and adjacent to the Syr Darya river will generate underwater noise and vibration, which could disturb fish including the sturgeon. For a Critically Endangered species present in potentially very low numbers, any disturbance to feeding, spawning, or refuge behaviour could have disproportionate conservation consequences. Magnitude is assessed as high given the species' status, but probability of encountering and impacting remaining individuals is low to moderate.

Sedimentation from earthworks, embankment placement, and bridge construction within or near the river channel represents the highest-probability pollution pathway for the sturgeon. Increased turbidity and sedimentation can suppress benthic invertebrate communities that form the food base for the species, smother spawning gravel, if present near or below the dam (downstream), and reduce dissolved oxygen. Accidental fuel or chemical spillage during river crossing works could further result in toxic effects. Magnitude is assessed as high, permanent or long-term, and at the international level the species IUCN listing, and the reversibility is uncertain although possible across multiple years.

Direct mortality from dredging or excavation activities in the river cannot be excluded but the probability is low, especially given the species' very low density. However, the severity of any such impact, however unlikely, would likely be extremely high given the species' Critically Endangered status.

Mitigation for the Syr-Darya Shovelnose Sturgeon. Mitigation for the Syr-Darya Shovelnose Sturgeon during construction will include:

- adoption of in-water construction exclusion periods aligned with any predicted spawning activity
- adoption of coffer dam or water diversion methods to minimise in-channel working time

- coordination with Kazakhstani fishery and biodiversity authorities on monitoring requirements.

The pollution-prevention, sediment and erosion controls described for the Shardara Reservoir IBA/KBA also apply to works at the Syr Darya crossing. These include controls on sediment-laden runoff, fuel and chemical storage and refuelling, spill preparedness and restrictions on potentially polluting activities close to open water.

For remaining in-water works, the timing and method of construction will be informed by the applicable fish monitoring and consultation with the relevant authorities. If the Syr-Darya Shovelnose Sturgeon is confirmed within or close to the construction area, the adequacy of the proposed construction method and exclusion periods will be reviewed before potentially harmful in-water works proceed.

For works already undertaken at the Syr Darya crossing, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. Available construction records, fish monitoring and information on the methods and timing of in-water works will be reviewed in establishing the realised impact and the final BAP requirements.

Residual Impact. Given the conservation status of the species, the residual impact is assessed as being potentially highly significant, dependent on whether the species is confirmed present in the construction area. Long-term monitoring of fish populations in the Syr Darya crossing section should be maintained throughout construction. Because the Syr Darya river and associated open water is Critical Habitat for the sturgeon, additional conservation actions are required to offset any temporary adverse effects and importantly to achieve the requisite NG outcome for Critical Habitat. Indicative conservation actions are presented in the Preliminary BAP (see Appendices), which indicate that, at this stage it is possible to achieve NG for the Syr Darya shovelnose sturgeon. Further assessment and the development of the full BAP is, however required.

H. Reptiles.

VER and Sensitivity. Central Asian tortoise *Testudo horsfieldii* (IUCN Vulnerable) Kazakhstan RDB Category II, CITES Appendix II is known to be present in the PRoject area. The species is a slow-moving herbivore of steppe, semi-desert, and loess slope habitats, found along the terrestrial sections of the alignment, north of the reservoir. It is primarily threatened by collection for the pet trade and habitat loss.

The European Glass Lizard, a National Red Data Book species has also been recorded along the Project alignment.

Impact. Vegetation clearance and earthworks along the Project alignment will result in the loss of steppe/desert and scrub used by the tortoise for foraging, sheltering, and overwintering. Approximately 650 ha of steep/desert pasture and scrub will be permanently lost. There remains a small possibly of directly mortality as the species spends much of its time underground. Magnitude is assessed as moderate within the regional context (given the conservation status of the species), and permanent, although reversible for temporary laydown areas.

The construction of the railway embankment across the steppe/desert landscape will fragment reptile habitat and impede the movement of this slow-moving species. Unlike more mobile species, the Central Asian tortoise is at significant risk to moving construction traffic and earth works.

Direct mortality of tortoises during vegetation clearance and earthworks is a realistic risk. The nearby Saryagash Bypass field survey recorded 365 reptiles, including 190 Central Asian tortoises trapped in trenches along a 10 km stretch. This illustrates the scale of the abundance of the specie and therefore the potential mortality risk. The probability of mortality without mitigation is assessed as high.

While tortoises are less sensitive to noise disturbance than some vertebrate species, e.g those with excellent hearing, sustained construction vibration and ground disturbance can affect foraging and overwintering behaviour. This is assessed as a low-magnitude, medium-duration impact.

Mitigation for Central Asian Tortoise. Mitigation measures to be adopted in respect of the Central Asian Tortoise and the European Glass Lizard during construction include:

- pre-clearance surveys of suitable habitat before vegetation clearance and earthworks;
- capture and translocation of Central Asian Tortoises and other notable reptiles identified within areas subject to clearance, undertaken by appropriately qualified personnel and in accordance with applicable national requirements;
- all open trenches and excavations to be either covered overnight, fitted with reptile escape ramps at a minimum gradient of 1:3 and intervals of no more than 50 m, or protected by reptile-exclusion fencing;
- daily inspection of open excavations for trapped animals during active works;
- restriction of vehicles and construction plant to designated access routes and work areas to minimise unnecessary habitat disturbance and mortality risk; and
- reinstatement of steppe/desert habitat within temporary construction areas following completion of works.

Where practicable, areas within the temporary works zone will be left uncompacted following reinstatement to facilitate burrow creation and recolonisation by reptiles and other ground-dwelling fauna.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection is particularly important for reptiles. It is not possible retrospectively to confirm that notable or threatened reptiles were not killed during the initial earthworks where pre-clearance surveys and associated controls were not implemented or documented. The assessment therefore does not assume that avoidance was achieved for those works.

Available construction records, biodiversity observations and subsequent surveys will be used, where practicable, to establish the extent of habitat affected and inform the final biodiversity loss accounting and BAP requirements.

Residual Impact. The implementation of mitigation measures is not likely to be sufficient, especially as it is not possible to retrospectively confirm whether any notable or threatened reptiles were killed during the Projects initial earth works and subsequent operations. It is therefore not possible either confirm avoidance of impacts or the requisite No Net Loss and residual impacts therefore remain. Additional actions, as part of the BAP are required. It is, at this stage theoretical that the adverse impacts could be reversed and NNL achieved but further work as part of the BAP is required.

I. Mammals.

VER and Sensitivity. Two mammal species of conservation significance are relevant the Project, the goitered gazelle *Gazella subgutturosa* (IUCN Vulnerable, Kazakhstan RDB Category III) and the marbled polecat (*Vormela peregusna*, IUCN Vulnerable, Kazakhstan RDB Category III). Both species are associated with the steppe/desert and semi-arid sections of the alignment, north of the reservoir.

Impact. Construction activity may displace Goitered Gazelle and Marbled Polecat from the immediate construction corridor for the duration of works although both species are mobile enough to avoid direct mortality. The magnitude is assessed as moderate medium size, regional in its extent (given the extent of available steppe/desert habitat in the landscape), medium in duration, and reversible after construction.

The creation of a permanent railway embankment will create a likely physical barrier to the movement of steppe/desert mammals across the alignment. For goitered gazelle, which undertakes seasonal movements across the landscape linear infrastructure is a well-documented barrier but the impacts are likely to be very low. The species is unlikely to be regularly present and the Project's alignment is continually close to or adjacent to agricultural land and settlements indicating that fragmentation of open habitat is very unlikely. The magnitude is assessed as low for goitered gazelle as broadly unlikely, although irreversible. Marbled polecats have smaller home range and therefore the immediate barrier effect is significantly reduced. The species is also more mobile, specifically on embankments.

Direct mortality during site clearance is possible for both species but the probability is very low given both species' ability to detect and avoid human activity. Pre-clearance habitat and burrow checks for the polecat must be undertaken as it uses burrows all year around.

Mitigation for mammals. Mitigation for Goitered Gazelle and Marbled Polecat during construction will principally comprise minimization of unnecessary disturbance and maintenance of opportunities for movement across the Project corridor. Measures will include restricting construction vehicles and personnel to designated work areas and access routes; avoiding unnecessary disturbance of steppe/desert habitat outside the permanent and temporary Project footprint; reinstating temporary construction areas following completion of works; and maintaining existing drainage structures, underpasses and other suitable crossing opportunities through the railway formation.

Construction personnel will be prohibited from hunting, capturing or deliberately disturbing wildlife.

Where Goitered Gazelle or other notable mammals are regularly observed close to active construction fronts, construction activities will be managed to avoid deliberate pursuit or displacement and animals will be allowed to move away from the works without obstruction.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. Available biodiversity observations and construction records will be reviewed to identify any recorded mortality or other material effects on notable mammals.

Residual Impact. With implementation of the mitigation measures described above, temporary construction disturbance is expected to be localized and reversible, and the residual construction impact on Goitered Gazelle and Marbled Polecat is assessed as **Low significance**.

The permanent fragmentation effect associated with the completed railway remains relevant following construction and is therefore addressed further under the operational assessment, including the effectiveness of crossing structures and other measures intended to maintain landscape connectivity.

J. Invertebrates.

VER and Sensitivity. The waved pincertail *Onychogomphus flexuosus* dragonfly (IUCN Vulnerable) is locally rare but also represents the inveretebrate assemblage associated with the water bodies of the Aral Sea basin, including the reservoir. The species is potentially present in the wetland habitats of the reservoir, including near the Project. The species is dependent upon aquatic and marginal habitats during different stages of its life cycle and is therefore potentially sensitive to construction activities affecting water quality, aquatic habitat and riparian vegetation.

Impact. The main construction stage risks to the waved pincertail, and other invertebrates associated with wetlands is, sedimentation, fuel or chemical spillage, and construction drainage entering watercourses and wetlands. As an aquatic invertebrate dependent on clean, well-oxygenated water, the larval stages are particularly sensitive to sedimentation and turbidity, which can smother the gravel and cobble substrate required for its larval development, and reduce the abundance of invertebrate prey. The magnitude is assessed as moderate, medium in and duration and reversible with effective pollution management.

Direct mortality of adult waved pincertail during site clearance is possible but of low in probability given the species' mobility. Destruction of larval habitat through earthworks in wetland areas is a more significant concern, as larvae may be killed or displaced by substrate disturbance.

Mitigation for invertebrates.

- The strict prohibition of all activities that could result in the pollution of any open water, including but not limited to, the restriction of any refueling, cleaning, discharge of waste or use of chemicals along the embankment within the reservoir or within 50 m of any river
- pollution prevention measures near all water, including silt bunding, oil interceptors, spill kits
- restriction of in-channel and in-wetland works to the minimum area and duration necessary

Residual Impact. With effective pollution prevention, the residual impact on waved pincertail and other invertebrates of conservation concern during construction is assessed as low significance. The species may recolonise from adjacent watercourses once water quality recovers.

K. Flora.

VER and Sensitivity. The baseline identified numerous flora species of conservation significance present or potentially present along the alignment. The following species are considered by local botanists are being likely present or possibly present: Lehmann's Eminium *Eminium lehmannii*, Suworow's onion *Allium suworowii*, Grey-leaved poplar *Populus pruinose* and Cytvar wormwood *Artemisia cina* are all Kazakhstan RDB species and considered likely present at or near the Project. Further, salt marsh physandra *Physandra halimocnemis*, Naked liquorice *Glycyrrhiza glabra*, and Common harmala *Peganum harmala* are all listed in the Kazakhstan RDB specifically relevant to southern regions and may be present, although were not recorded. The desk based research also confirmed the presence of Lehmann's Tulip *Tulipa lehmanniana* (IUCN Near Threatened) and *Salvia korolkowii* (IUCN Vulnerable) within 20 km of the Project. These species vary in regional and national value but none were recorded during eh 2026 field surveys.

Impact. Vegetation clearance and earthworks along the 115 km alignment will result in the loss of steppe/desert, loess slope, and semi-desert habitats within the construction footprint that may support populations of these species. The precise area of suitable habitat for each species in uncertain but conservative estimates indicate that it comprises several hundred hectares although presence is very likely to be highlight localised. *Merendera robusta* is known to be present and *Salvia korolkowii* is potentially present on undisturbed loess cliff formations at the north-eastern end of the reservoir, which may be directly affected by earthworks in this section. *Eminium lehmannii* was recorded at a single point in the nearby Saryagash road survey, indicating localised distribution. The magnitude of habitat loss is assessed as moderate for all species permanent within the construction footprint, but largely reversible in the temporary construction footprints, given appropriate reinstatement.

Mitigation for flora. Mitigation for flora during construction will include:

- Reinstatement of steppe/desert and semi-desert communities in temporary works areas using locally-sourced native seed and the strict exclusion of non-native or invasive species.

Where remaining works affect previously undisturbed natural or semi-natural habitat, pre-clearance surveys will be used to identify notable flora within the construction footprint and inform appropriate avoidance or other species-specific measures where required.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. The assessment will not retrospectively assume that notable flora were absent from areas already cleared solely because they were not recorded during the subsequent 2026 surveys. The extent of permanent and temporary habitat already affected will therefore be incorporated into the final biodiversity loss accounting and BAP.

Residual Impact. Following the implementation of the above mitigation measures, the residual impact on flora is assessed as low significance. However, reinstatement of temporary works areas cannot compensate directly for permanent loss within the railway footprint. As recognised under Land Take, achievement of the applicable lender biodiversity outcomes remains conditional on implementation of the Biodiversity Action Plan.

L. Invasive Species.

VER and Sensitivity. From the IBAT data, the Project area supports several established non-native and invasive species of concern, including the common myna *Acridotheres tristis*, muskrat *Ondatra zibethicus*, zebra mussel *Dreissena polymorpha*, and introduced fish, including common carp and 32 other non-native species, Hydrilla *Hydrilla verticillata*, and tamarisk species *Tamarix ramosissima* and *T. hispida*). Russian olive *Elaeagnus angustifolia* has also established along the watercourse margins. The relevant sensitivity therefore relates principally to the risk of construction facilitating further spread or establishment within habitats not currently affected, rather than the introduction of invasive species into an otherwise unaffected landscape.

Impact. Construction activities, including vegetation clearance, earthmoving, importation of fill and aggregates, and movement of plant and equipment comprise well-documented pathways for the introduction and spread of invasive plants and animals. The mobilisation of disturbed soils along the 115 km alignment, combined with the creation of bare ground receptive to colonisation, significantly increases the risk of expansion of already-established invasive plant species. Hydrilla and tamarisk are particularly likely to spread into disturbed riparian and wetland habitats adjacent to and within the reservoir. The spread of zebra mussel could be facilitated by any construction water management activities involving transfer of water between the river and reservoir at certain times of the year. The magnitude of invasive species spread is assessed as high, very high in potential extent, long-term duration (invasive establishment is difficult to reverse), continuous frequency, and low reversibility without intensive management.

Mitigation for invasive species. Mitigation for invasive species during construction will include:

- pre-construction survey of the full alignment to record and map all invasive species present
- species-specific management protocols for clearance, treatment, and disposal of invasive species
- strict biosecurity procedures for all plant and equipment (cleaning and inspection at site entry points)
- prohibition on use of non-native species in reinstatement or landscaping
- installation of sediment barriers to intercept water-borne seed dispersal at all drainage outfalls.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. Areas already disturbed will be included within the invasive-species survey and subsequent surveillance programme so that existing infestations and any apparent spread associated with construction can be identified and managed. This is particularly relevant where soil has already been moved between construction areas or temporary works areas have been reinstated.

Residual Impact. With the implementation of robust biosecurity and management, the residual risk of large-scale invasive species establishment or spread is reduced from high to moderate significance. The residual risk cannot reasonably be reduced to Low at the construction stage because invasive species are already present within the wider Project area, construction provides multiple potential dispersal pathways over a long alignment, and establishment may only become apparent after construction activities have ceased. Ongoing surveillance during operation is therefore required to identify and respond to new or expanding infestations.

M. Ecosystem Services.

VER and Sensitivity. The reservoir provides numerous ecosystem services that are important to the local and regional economy and livelihoods of the Turkestan Region: irrigation, water supply and hydropower generation, the provision of drinking water to approximately 32,000 people, a major fishery supporting three processing plants producing approximately 6,000 tonnes of food annually, flood regulation, transboundary water management, and cultural and recreational services.

Impacts. The temporary damming effect associated with the construction of the embankment across the reservoir is likely to reduce the capacity of water storage in the reservoir by up to approximately 3.25 million m^3, specifically in the western basin (based on the average reservoir depth of 6.5 m and the embankment cross-section). While this represents a small fraction of the reservoir's total storage capacity of 5.7 km^3 (less than 0.06%), the local effect on water levels within the western basin could affect irrigation abstraction, local fisheries and grazing regimes, and waterbird habitat during the construction period. The magnitude is assessed as moderate in the regional context, medium in duration, but with a low to moderate probability at the reservoir scale.

The importance of maintaining irrigation services is also confirmed by the LARP. During the census and socio-economic survey, 141 APs (137 households and 4 legal entities) raised concerns regarding the continued availability or functionality of irrigation water, with affected persons identifying continuity of irrigation access as one of the principal livelihood concerns associated with Project implementation. These concerns relate principally to construction effects on irrigation infrastructure and access rather than to the relatively small reduction in overall Reservoir storage capacity assessed here, but they demonstrate the sensitivity of agricultural livelihoods to interruption of this ecosystem service.

Construction activities, including in-channel works, sedimentation, and the loss of water storage capacity in the western basin, may affect fish populations in the construction zone and adjacent areas. Given the reservoir's significance as Kazakhstan's largest fishery, any construction-induced reduction in fish productivity or access to spawning habitat is of economic and ecological significance. The probability is moderate, although the impact is reversible after construction, when the water quality recovers. The effect is localized to the western basin and the immediate Syr Darya crossing and is of medium duration, being limited to the embankment and in-channel construction period (in the order of one year for the western-basin damming effect) and reversible thereafter as water levels and water quality recover; no permanent loss of the reservoir fishery or its productive capacity is predicted.

The LARP does not identify fisheries-related economic displacement associated with Project land acquisition. However, the LARP was prepared principally to assess land acquisition and associated livelihood impacts and does not constitute a survey of the wider Reservoir fishing community. Potential construction effects on reservoir fisheries and fishing activity are therefore addressed through this ESIA and the associated biodiversity and stakeholder-engagement measures rather than through the LARP.

The wider reservoir-based fishing communities and herder associations that use the Reservoir's provisioning, grazing and cultural services are nonetheless recognized as relevant stakeholders in the reservoir-based habitat actions to be developed through the BAP. KTZ has committed to community-level consultation with these groups during development of the Final BAP, including identification of potential co-benefit and co-management opportunities.

This engagement will be coordinated with the Project SEP and LARP process so that livelihood concerns raised by reservoir users during BAP consultation are recorded and, should a previously unidentified fisheries-related livelihood impact emerge, addressed through the appropriate Project instrument.

Mitigation and residual impact for ecosystem services. The mitigation measures described previously for the Shardara Reservoir IBA/KBA, aquatic habitats and species will also directly and indirectly

mitigate construction impacts on ecosystem services and are not repeated in full here. Of particular relevance are maintenance of water and fish connectivity through the embankment and associated hydraulic structures; sediment, erosion and pollution controls during in-channel and reservoir works; protection of water quality during construction; controls on the construction footprint within reservoir and wetland habitats; reinstatement of temporary construction areas; and continued monitoring of aquatic habitats, fish populations and relevant Reservoir conditions during construction.

For irrigation-related ecosystem services, the LARP provides an additional livelihood-protection mechanism. Where construction affects irrigation canals, pipelines, drainage systems, water-access points or related infrastructure, the EPC Contractor is required to restore or reconstruct the affected infrastructure in coordination with local authorities, irrigation users and affected households. Where feasible, temporary bypasses or alternative irrigation arrangements will be provided during construction to maintain access to irrigation water.

Where construction activities temporarily restrict access to agricultural land, temporary alternative access routes, crossings or local bypasses will be provided where reasonably feasible. Temporarily occupied agricultural land will be reinstated following completion of works, including restoration of topsoil, irrigation and drainage infrastructure where required. Construction activities affecting cultivated land will, where feasible, be planned to minimize disruption during critical planting and harvesting periods.

Affected households will also be eligible for compensation for verified temporary crop losses, temporary inability to cultivate land, temporary loss of access to land or other temporary livelihood impacts associated with Project construction in accordance with the LARP Entitlement Matrix. Transitional support may additionally be provided for verified temporary livelihood disruption where required.

The LARP also recognizes that some irrigation- and access-related construction impacts remain subject to verification during implementation. KTZ is therefore required to continue verification and ensure that access to agricultural land and irrigation water is restored, maintained or otherwise addressed through appropriate corrective measures.

For works already undertaken, the construction-to-date verification described at the beginning of the Biodiversity subsection applies. The assessment will not retrospectively assume that water-quality, sediment-control, irrigation-protection or ecological mitigation measures were implemented where this cannot be demonstrated. Available monitoring, construction and LARP records will therefore be considered in confirming whether material effects on ecosystem services or associated livelihoods have occurred.

Residual Impacts. The temporary reduction in western-basin storage capacity represents less than 0.06% of total Reservoir storage and is not expected to materially affect the overall irrigation, flood-regulation, water-supply or hydropower functions of the Reservoir. Similarly, construction-related effects on fisheries are expected to be temporary and localized, with no permanent reduction in the productive capacity of the Reservoir fishery predicted.

For irrigation-dependent livelihoods, the principal construction risk relates to localized interruption or alteration of irrigation infrastructure rather than loss of the Reservoir's overall water-storage function. The LARP and ESMP provide mechanisms for restoration of affected irrigation infrastructure, maintenance of temporary access to water, compensation for verified temporary livelihood losses and continuing verification of outstanding cases.

Subject to implementation of these measures for the remaining works, and completion of corrective action where impacts from works already undertaken are identified, residual construction impacts on ecosystem services are assessed as **Low adverse**, consistent with the existing assessment.

The wider reservoir-based fishing and herding communities will nevertheless remain stakeholders in development of the Final BAP, both to inform reservoir-based habitat actions and to identify opportunities for conservation measures that also provide appropriate community co-benefits.

8.4.3.10. Occupational Health and Safety

VER and sensitivity. The principal receptor is the construction workforce, including KTZ personnel and workers employed by Integra and its subcontractors across the Project's dispersed construction fronts. The national environmental impact assessment anticipated a peak construction workforce of approximately 1,211 personnel, distributed across the railway alignment, station works and bridge/interface works, while the current workforce is approximately 800 personnel. Workers are directly exposed to potentially fatal construction hazards and are therefore assessed as a High-sensitivity receptor.

Construction of a railway project of this scale and complexity involves a broad range of occupational health and safety hazards. The assessment below identifies the principal high-risk activities and systemic risks identified for the Project but is not intended to constitute an exhaustive task-level hazard register. The Contractor's site-specific risk assessment and OHS Management System shall identify and control all occupational hazards associated with each work activity and work front, including hazards arising as construction methods, locations and interfaces change.

WH001 – Worker Accommodation

Impact. Poorly managed worker accommodation can expose workers to unsanitary conditions, inadequate potable water and sanitation, food-hygiene risks, fire and life-safety hazards and poor living conditions. This is particularly relevant given the dispersed nature of the Project, the presence of approximately 10 worker accommodation camps and the substantial contractor and subcontractor workforce.

Worker accommodation shall meet the applicable national requirements and the IFC/EBRD Workers' Accommodation: Processes and Standards (2009) benchmark, including requirements for room occupancy, sanitation, potable water, food hygiene, fire and life safety, welfare and camp management. Each subcontractor operating accommodation shall prepare and implement a Camp Management Plan, with routine inspections and periodic independent review.

WH002–WH004 and WH010 – High-Risk Construction Activities

Impact. The Project involves high-risk construction activities with the potential to cause serious injury or fatality. These include working at height during bridge and elevated works (**WH002**), lifting operations and associated struck-by or dropped-object risks (**WH003**), and excavation work with the potential for collapse, falls or entrapment (**WH004**).

Other material hazards will be identified through the Contractor's site-specific risk assessment (**WH010**). These include, but are not limited to, work near or over water, motor-vehicle and mobile-plant movements, electrical and energized systems, machinery, temporary works, hot work, confined spaces and interfaces between multiple contractors and simultaneous activities.

The significance of individual hazards will vary according to the activity and location, but the credible consequence of inadequate control includes serious injury or fatality. The Project therefore requires a risk-based OHS management system rather than reliance on a fixed list of prescribed controls.

This approach is also consistent with the construction configuration described in the national environmental impact assessment, which envisages simultaneous work streams covering linear railway construction, station development, bridge works and interfaces with existing water channels and railway infrastructure, each presenting a different combination of occupational hazards.

Mitigation and management response. Integra shall implement an Occupational Health and Safety Management System consistent with applicable Kazakhstan requirements, the WBG General and

Railway EHS Guidelines and ISO 45001 or an equivalent international standard. The system shall apply to Integra and all subcontractors and shall be based on documented site- and task-specific risk assessment.

Controls shall apply the hierarchy of controls and include, as relevant:

- task-specific risk assessments and safe systems of work;
- permit-to-work systems for high-risk activities;
- competent and adequately trained personnel and supervision;
- certified plant, lifting equipment, access equipment and safety systems;
- fall prevention and protection for work at height;
- lifting plans, competent lifting supervision and exclusion zones;
- shoring, benching, safe access and daily competent-person inspection of excavations;
- controls for work near water, including appropriate fall-prevention, flotation and rescue arrangements;
- separation of workers from moving vehicles and mobile plant;
- isolation, lock-out/tag-out and other controls for electrical and energised systems and machinery;
- appropriate PPE as the final level of protection;
- routine workplace inspections, toolbox talks and OHS monitoring; and
- stop-work authority where an imminent threat to health or safety is identified.

The ESMP already requires Working at Height procedures and permits, lifting plans and certified equipment, and excavation procedures incorporating shoring, benching, safe access and daily inspection.

WH005 – Emergency Preparedness and Response

Impact. Serious construction incidents may occur at dispersed or remote work fronts where immediate emergency assistance is not readily available. Relevant scenarios include serious injury, fire, structural or excavation collapse, incidents over water, electrical incidents, major spills and vehicle accidents.

Site-specific Emergency Response Plans shall therefore be prepared based on the hazards identified for each active work front. These shall define emergency responsibilities, communications and notification arrangements, first-aid and rescue capability, emergency equipment, evacuation arrangements and interfaces with external emergency services. Arrangements shall be tested through periodic drills and updated where exercises or actual incidents identify deficiencies.

Construction workers are also exposed to high summer temperatures. The Climate Resilience Assessment identifies heat stress as a material construction-phase occupational risk, with projected WBGT conditions reaching approximately 32°C and the risk treated as **High for construction OHS planning**.

The Contractor shall therefore implement the OHS Heat Action Plan required by the construction ESMP, including heat-risk monitoring, work/rest regimes, provision of drinking water and shaded recovery areas, acclimatisation, worker and supervisor training, and modification or suspension of strenuous work when applicable heat-stress thresholds are exceeded. The Heat Action Plan shall be incorporated into site-specific risk assessments and daily work planning during periods of elevated temperature.

WH006 – Workers' Grievance Mechanism

A dedicated workers' GRM shall be maintained for all categories of Project worker, including subcontracted and migrant labour. The mechanism shall permit confidential and anonymous complaints, be available in languages understood by the workforce and provide protection against retaliation. Grievance handling and closure shall be documented and subject to KTZ oversight.

The workers' GRM complements, but does not replace, the mechanisms for workers to report unsafe conditions, near misses or imminent hazards through the OHS Management System and exercise stop-work authority where necessary.

Construction-to-date and corrective action

Because construction is already underway, the assessment cannot assume that the above management arrangements have been implemented consistently throughout works completed to date. The parallel ESCA identified OHS deficiencies requiring corrective action, and the Supplementary ESIA therefore distinguishes between the controls required for remaining works and verification/correction of conditions at active construction fronts.

For the remaining construction period, the ESCA-derived corrective actions require site-level OHS supervision with stop-work authority, routine OHS training, weekly toolbox talks, PPE enforcement and a documented emergency-response equipment inventory at each active work front.

Integra and KTZ shall verify implementation of the OHS Management System across all active work fronts and subcontractors, with priority given to high-risk activities. Where deficiencies are identified, corrective actions shall be implemented promptly and tracked to closure.

Residual Impact. Construction OHS risks cannot be eliminated because the works inherently involve potentially fatal hazards. However, with effective implementation of the Contractor's risk-based OHS Management System, competent supervision, task-specific controls, emergency preparedness and the ESCA corrective actions, the likelihood of serious incidents can be substantially reduced.

The residual significance of WH001–WH005 and WH010 is assessed as Low, subject to full implementation and verification of these measures. The workers' grievance mechanism similarly reduces the labour-management risk associated with lack of access to an effective grievance process. The summary impact table records the corresponding residual outcomes.

The social risks associated with workforce influx and worker accommodation—including workforce-community interaction and SEA/GBVH—are assessed separately under Labour and Working Conditions, Community Health and Safety and GBVH, rather than being treated as OHS hazards here.

8.4.3.11. Employment sourcing and local hire

VER and Sensitivity. The relevant VER is the local workforce and employment market within the Project-affected districts. The receptor is assessed as Moderate sensitivity. Employment opportunities within the corridor are relatively limited and livelihoods remain strongly dependent on agriculture, livestock, self-employment and small-scale trade and services. The LARP socio-economic survey similarly identifies agricultural self-employment as the dominant occupation among affected household heads and confirms the importance of agriculture and livestock as household income sources.

SE002 – Employment Sourcing and Local Hire

Impact. Construction of the Project provides direct and indirect employment opportunities within the corridor districts. The national environmental impact assessment anticipated a construction workforce of up to approximately 1,211 personnel, distributed across the railway alignment, stations, bridge works and other construction activities. The current construction workforce comprises approximately 800 personnel employed by Integra and approximately 10 subcontractors. Skilled and

specialist roles, including rail laying, welding, piling, bridge construction and crane operations, are predominantly sourced from outside the corridor districts because of the limited local availability of these specialist skills. Semi-skilled, unskilled, plant-support, security and ancillary positions provide the principal opportunities for recruitment from the affected districts and wider Turkistan Region.

The employment effect is potentially beneficial through generation of jobs, household income, skills and expenditure within the local economy. The scale of the workforce anticipated in the national environmental impact assessment confirms that construction represents a potentially material, although temporary, source of employment within the Project area. However, the predominance of non-local workers in specialist positions creates a risk that the employment benefits of construction are captured principally outside the Project-affected communities, particularly if local workers are not provided fair access to positions for which they are suitably qualified.

Mitigation and management response. The Contractor's Labour Management Procedures and Workforce Management Plan will maximize local employment opportunities where the required skills are available, while maintaining recruitment on the basis of competence and the requirements of individual positions.

Recruitment measures will include:

- prioritization of suitably qualified workers from the Project-affected districts and wider Turkistan Region for semi-skilled, unskilled and ancillary roles;
- transparent, non-discriminatory recruitment procedures and clearly communicated employment criteria;
- prohibition of recruitment practices that discriminate on the basis of gender, ethnicity or other protected characteristics;
- communication with local communities regarding the types, numbers and duration of employment opportunities available, to manage unrealistic expectations;
- use of local suppliers and procurement of locally available goods and services where reasonably feasible; and
- recording and reporting of local and non-local employment and local procurement.

The Project has committed to maximizing local hire from the affected districts and Turkistan Region for positions where the necessary skills are available and to monitoring the proportion of local employment through the Labour Management Plan and Project environmental and social reporting.

Where appropriate, recruitment and workforce planning should also identify opportunities for on-the-job training and skills development that increase the ability of local workers to access semi-skilled positions during the remaining construction period.

Residual Impact. Implementation of transparent recruitment procedures and prioritization of suitably qualified local workers will increase the proportion of construction expenditure and employment benefits retained within the Project-affected districts while reducing the risk of inequitable access to employment opportunities.

The residual impact is therefore assessed as Low adverse in relation to the risk of limited local benefit capture, with a corresponding beneficial local employment effect where local-hire and local-procurement measures are successfully implemented. This is consistent with the SE002 rating in the construction impact table.

The separate social risks arising from the presence of a substantial predominantly non-local workforce—including pressure on local services, worker-community interaction and SEA/GBVH—are assessed under Community Health and Safety and GBVH and are not duplicated here.

Gender Based Violence and Harassment (GBHV)

VER and Sensitivity. The relevant receptors are the Project workforce and members of communities potentially exposed to gender-based violence and harassment (GBVH), sexual exploitation and abuse (SEA), or sexual harassment (SH) associated with Project construction.

The Project baseline identifies a number of contextual factors relevant to vulnerability. The construction workforce is predominantly male and comprises approximately 800 workers employed through Integra and approximately ten subcontractors, with workers accommodated across multiple locations along the corridor. In the surrounding rural communities, traditional household structures and gender roles remain influential, particularly in the southern districts, and women's participation in formal public meetings is generally lower than men's. Rural women may also face practical constraints in accessing services and formal reporting mechanisms.

No specific GBVH concerns were raised during Project stakeholder engagement or the LARP socio-economic survey. This does not, however, demonstrate the absence of risk, particularly given recognized under-reporting of GBVH and the sensitivity of disclosure.

GBV001 – Gender-Based Violence and Harassment

Impact pathways. (a) Workforce-to-workforce harassment and abuse, including sexual harassment, gender-based bullying, and discriminatory treatment, particularly affecting the smaller proportion of female workers in administrative, technical and supervisory roles. (b) Workforce-to-community harassment and abuse, including sexual exploitation, abuse, and transactional sex involving community members in adjacent settlements; the workforce influx context is particularly material in the southern districts (Zhetysay, Maktaaral) where worker camps interface with rural settlements with substantial de facto women-headed households arising from male out-migration of resident community members. (c) Community-level secondary effects, including increased domestic violence as a community-level response to workforce-induced economic and social disruption. (d) Cross-border setting at Maktaaral with the additional complexity of migrant workers and state-actor (KNB, customs) personnel.

Mitigation. The Project applies the IFC GPN GBVH (2020) framework through the construction-phase and operational-phase ESMPs and the Gender Action Plan committed under the ESCA Corrective Action Plan. The principal measures are:

Code of Conduct binding on all workers (including subcontractor and migrant labour), with explicit prohibition of harassment, abuse, transactional sex, and discriminatory treatment, and explicit disciplinary measures including immediate dismissal for serious violations.

Mandatory GBVH prevention training as part of worker induction (1-day minimum), with refresher training at 6-month intervals; specific training for supervisors and management staff on GBVH recognition, response and reporting; specific training for the GBVH focal points and Designated Persons at each work front.

Workers' Grievance Redress Mechanism with confidential GBVH reporting channels, multi-channel access (in-person, telephone, written, online), anonymous reporting permitted, available in Kazakh, Russian and (where the workforce composition requires) Uzbek, with independent review by KTZ. Specific protections against retaliation.

Community-level GRM with women-only contact points and confidential reporting, partnership arrangements with regional crisis centers (Union of Crisis Centers of Kazakhstan; Shymkent regional crisis center) and the national 150 helpline for survivor referral, and explicit referral pathways to medical care (FAPs / District-level hospitals) and police (Department of Internal Affairs) where the survivor consents.

Pre-screening of contractors and subcontractors against GBVH performance criteria, including past-record disclosure, organizational policies, and training capacity. Inclusion of GBVH performance in subcontractor monitoring and KPIs.

Worker accommodation arrangements designed to minimize community-interface GBVH risk: site-located accommodation with controlled access; clear separation between worker accommodation and adjacent settlements; restrictions on off-site movement in the immediate vicinity of worker camps.

Designated GBVH focal points at each work front and at KTZ-level, with named individuals trained to receive complaints, initiate the response, and refer to external support.

Community engagement program that includes GBVH-specific outreach, with materials in Kazakh, Russian and Uzbek, and engagement specifically with women-headed households in the affected settlements.

Residual Impacts. Construction-phase residual is Low subject to full implementation of the Code of Conduct, training, GRM and contractor-screening framework. Operational-phase residual is Low, with the operational workforce (smaller, predominantly KTZ corporate, lower influx differential) less material than the construction workforce influx. Monitoring of GBVH-related GRM complaints, training delivery, and disciplinary actions is reported in the semi-annual E&S monitoring report.

8.4.3.12. Waste Management

Waste management on a Project of this scale, in a region with limited formal waste-management capacity, presents a material risk of secondary impacts on soil, water, biodiversity and visual amenity if not actively managed. Three construction-stage impacts are identified.

WM001 – Poor Site Management and Housekeeping

Impact. Poor general site-management practices, including uncontrolled accumulation of waste at work fronts, inappropriate storage of materials and inadequate housekeeping, could result in broader environmental degradation affecting ecology, soil and water quality and visual amenity. The national environmental impact assessment requires construction wastes to be temporarily accumulated at designated locations close to the relevant work fronts before transfer to specialist waste-management organizations and places responsibility for removal of construction debris and clearance of construction areas on the construction contractor.

Mitigation. The Contractor's Construction Waste Management Plan will establish site-management and housekeeping requirements across all active work fronts, camps, laydown areas and other construction facilities. Routine inspections and audits will be undertaken to identify and correct poor waste-management and housekeeping practices.

Residual impact. With implementation of the Construction Waste Management Plan and routine inspection and audit regime, residual significance is Low.

WM002 – Capacity of Waste Treatment and Disposal Facilities

Impact. The national environmental impact assessment provides a quantitative forecast of the principal waste streams expected during construction. The national environmental impact assessment forecasts total construction-stage waste generation of approximately 84,613 tonnes, of which approximately 84,509 tonnes comprises mixed construction and demolition waste generated from demolition and construction activities. The remaining identified streams comprise municipal waste and relatively small quantities of welding waste and hazardous or potentially hazardous wastes associated with paints, solvents and equipment maintenance.

Table 89: **Construction Waste Forecast Identified in the National Environmental Impact Assessment**

Waste stream	Waste code	Predicted quantity	National EIA management approach
Mixed construction and demolition waste	17 09 04	**84,509.2 t**	Temporary storage followed by transfer to specialist organization
Mixed municipal waste	20 03 01	**90.825 t**	Containerized collection and transfer to municipal waste facility
Paint/lacquer containers containing organic solvents or other hazardous substances	15 01 10*	**10.943 t**	Separate metal containers and transfer to specialist organization
Welding waste	12 01 13	**1.373 t**	Separate metal container and transfer to specialist organization
Absorbents, filters, oily rags and protective clothing contaminated by hazardous materials	15 02 02*	**0.954 t**	Separate contained storage and transfer to specialist organization
Total	—	**84,613.3 t**	—

The national environmental impact assessment identifies the mixed construction and demolition waste as comprising principally concrete, soil, sand, crushed stone and other used construction materials. It also establishes temporary storage and subsequent transfer to specialist organizations, with construction waste not to remain on the Project site for more than three months. The national waste-management table confirms the corresponding forecast quantities and management routes.

Given the scale of the predicted construction and demolition waste stream, the availability and capacity of appropriately authorized waste-management facilities represents an important consideration. The Contractor's Construction Waste Management Plan will therefore confirm the quantities of each waste stream actually being generated, identify the authorized recovery or disposal route for each stream, and demonstrate that the receiving facilities have sufficient capacity before waste is transferred off site. Waste generation will be managed in accordance with the waste hierarchy, prioritizing reduction, reuse, recycling and recovery before final disposal.

Mitigation Measures. The Contractor's Construction Waste Management Plan will therefore include an assessment of licensed waste-management capacity within an appropriate distance of the alignment and a forecast of the principal Project waste streams. Waste generation will be managed in accordance with the waste hierarchy, prioritizing reduction, reuse, recycling and recovery before disposal.

The Contractor shall specifically assess the potential for beneficial reuse of suitable construction and demolition materials within the Project or through authorized off-site reuse before classifying the material for disposal.

Where available licensed capacity is insufficient for a particular waste stream, the Contractor will be required to reduce generation of that waste where practicable, transport it to an appropriate alternative licensed facility, or establish a Project-specific managed facility subject to the necessary environmental assessment and licensing requirements. Waste forecasts and available capacity will be periodically reviewed during construction.

Residual impact. With confirmation of adequate disposal capacity and implementation of alternative arrangements where required, the residual impact is assessed as Non-significant, consistent with WM002 in Table 87.

WM003 – Inappropriate Disposal of Construction and Demolition Waste

Impact. The national environmental impact assessment identifies approximately 84,509 tonnes of mixed construction and demolition waste, principally comprising concrete, soil, sand, crushed stone and other construction materials. Inappropriate disposal of construction and demolition waste could result in contamination of soil and water, ecological effects, visual degradation and risks to surrounding communities. Particular concern arises from the potential use of unlicensed legacy waste sites in the vicinity of the alignment, which have already been identified as out-of-bounds under the assessment of soils and geology. The national assessment requires organized collection and temporary storage followed by transfer to specialist waste-management organizations and establishes a maximum temporary storage period of three months for construction waste.

The Construction Waste Management Plan will build on these requirements by establishing designated waste-storage areas, segregation of waste streams, authorized transport and receiving facilities, and documented chain of custody from generation to final recovery or disposal. The use of unlicensed legacy waste-disposal sites identified in the Project area will be prohibited.

Hazardous wastes will be segregated from general construction waste, appropriately labelled and temporarily stored on impermeable hardstanding with appropriate secondary containment pending transfer to an authorized facility. The ESMP requires 110% secondary containment for hazardous-waste storage and retention of disposal manifests and other chain-of-custody records.

Residual impact. Subject to implementation of these measures, the residual significance of inappropriate waste disposal is assessed as Low.

8.4.4 Operation and Maintenance

The Operations and Maintenance stage covers the routine running of the railway following commissioning and the periodic maintenance of the track, overhead line equipment, drainage structures, bridges and stations over the operational life of the Project. The line will not be electrified for traction; diesel-powered locomotives will be used. The operational service is planned to accommodate a maximum capacity of 46 trains per day, approximately one every 30 minutes, with a mix of freight and passenger services operating on a 24-hour basis. The two 10 kV overhead lines on either side of the embankment provide auxiliary power to signaling, lighting and ancillary infrastructure.

Operations-stage impacts are characteristically long-term, recurrent and lower in absolute magnitude than the corresponding construction impacts, but with the important difference that they persist for the operational life of the railway. The mitigation framework therefore moves from the Contractor's construction-stage plans into KTZ's operational management systems: the Operational Environmental and Social Management System, the Operational Emergency Response Plan, the maintenance regimes for track and overhead infrastructure, and the long-term monitoring commitments. These arrangements are described in Section 10.

It is also relevant that the Project provides a lower-carbon means of transporting freight than equivalent road transport. The Project's GHG assessment indicates that freight carried by the railway has a substantially lower emissions intensity per tonne-kilometre than equivalent heavy-road freight. This represents a wider transport-sector benefit of the Project but does not offset or reduce the Project's own operational Scope 1 and Scope 2 emissions, which are assessed separately under Greenhouse Gas Emissions. The modal-shift benefit is therefore treated as relevant strategic context rather than as mitigation of the operational impacts assessed below.

8.4.4.1. Agriculture

VER and Sensitivity. The relevant VER comprises agricultural production processes, agricultural land users and livestock owners using land adjacent to and across the railway alignment. Livestock movement, access to agricultural land and the continued functioning of irrigation and drainage systems are important components of agricultural activity within the Project area.

AF006 – Death or Injury to Domesticated Livestock

Impact. The risk of death or injury to domesticated livestock that enter the railway boundary (**AF006**) is principally a function of inadequate maintenance or breach of stock-proof fencing along the alignment, combined with the established movement patterns of livestock across the alignment in the agricultural section of the route.

The presence of an operational railway introduces a permanent collision hazard for livestock entering the Right of Way. Given the frequency of train movements during full operation and the potential consequence of livestock entering the operational railway, the impact magnitude is assessed as **Moderate**, resulting in **Medium significance** before mitigation. This is consistent with the assessment presented in Table 88.

Mitigation and management response. The mitigation response comprises: (i) the provision of stock-proof fencing along the full length of the Right of Way, designed to a specification appropriate to the livestock present in the area; (ii) inclusion of fencing inspection and maintenance in KTZ's routine track inspection regime with defined timescales for repair of breaches; and (iii) the livestock/agricultural crossing provision incorporated into the Project design, together with any additional or upgraded passages confirmed through detailed design and consultation with affected communities, to maintain livestock movement across the alignment and reduce the incentive for stock to cross at unauthorized points.

The community engagement program will include awareness-raising for local livestock owners about the operational hazards of the railway and a community-facing reporting mechanism for fence breaches. KTZ will also provide local livestock owners with an emergency telephone number for reporting livestock observed on railway land and maintain protocols for informing train drivers of hazards on the line and for the safe removal of livestock.

These measures also respond directly to concerns raised during consultation regarding the need for stock-proof fencing along the alignment.

Residual Impact. With the installation and ongoing maintenance of stock-proof fencing, provision of agricultural underpasses, community awareness and arrangements for reporting and responding to livestock incursions, the likelihood of livestock entering the operational railway will be substantially reduced. The residual significance of **AF006 is assessed as Low**.

AF007 – Operational Drainage Effects on Agricultural Land

Impact. During operation, the railway embankment and associated culverts and drainage structures have the potential to alter local drainage conditions affecting adjacent agricultural land. Culverts concentrate flows through defined openings beneath the railway and, where outlets are inadequately protected or drainage structures become obstructed, this could result in increased flow velocities and downstream erosion of agricultural land. Conversely, blockage or insufficient hydraulic capacity could result in upstream ponding or localized flooding, potentially affecting crops and agricultural soils.

These effects would be localized around individual drainage structures rather than affecting agricultural production across the wider Project area. However, because the drainage structures will remain in place for the operational life of the railway, inadequate maintenance could result in recurrent effects at affected locations.

Mitigation and management response. KTZ will incorporate culverts and other railway drainage structures into the routine operational inspection and maintenance program. This will include:

- periodic inspection and clearance of culverts to remove sediment, vegetation, debris and other obstructions;
- inspection following significant rainfall, flooding or other events with the potential to obstruct or damage drainage structures;

- inspection of culvert inlets and outlets for evidence of upstream ponding, downstream scour, erosion or instability;
- maintenance of outlet protection and erosion-control measures where required;
- prompt repair or clearance where inspection identifies impaired hydraulic performance; and
- investigation of complaints or observations from adjacent farmers concerning recurrent ponding, erosion or crop damage potentially associated with railway drainage.
- Where monitoring identifies recurrent erosion, ponding or agricultural impacts associated with an operational drainage structure, KTZ will implement appropriate corrective measures, which may include additional scour protection, modification of inlet or outlet arrangements, drainage improvement or other site-specific engineering measures.

These requirements will form part of KTZ's scheduled maintenance regime for drainage infrastructure rather than relying solely on reactive maintenance following a flooding or erosion event.

Residual Impact. With drainage structures maintained in functioning condition, routine clearance of culverts and inspection for upstream ponding and downstream erosion, significant effects on adjacent agricultural land are unlikely. Where localized problems occur, the inspection and corrective-action regime provides a mechanism for their identification and remediation. The residual significance is therefore assessed as **Low**.

8.4.4.2. Community Health and Safety

VER and Sensitivity. The relevant VER comprises members of the public living in, travelling through or otherwise using areas adjacent to the operational railway, including pedestrians, road users, livestock owners and other users of authorized and unauthorized crossing points. The receptor is considered **High sensitivity** because interaction with moving trains can result in serious injury or fatality.

CS004 – Trespass on Railway Infrastructure

Impact. The first operations-stage community health and safety impact is the risk of injury or fatality to members of the public through trespass on railway infrastructure — entering the Right of Way on foot, crossing the line at unauthorized locations, or interfering with operational equipment. The risk is greatest in the southern, more settled section of the alignment where the line passes adjacent to or through villages and where pedestrian access patterns predate the new line.

Mitigation and management response. The mitigation response comprises perimeter fencing of the Right of Way along the full length of the alignment, provision of safe authorized crossing points at appropriate intervals, community engagement and rail-safety awareness programmes in adjacent settlements, particularly in schools, warning signage in Kazakh and Russian, and enforcement through KTZ's operational security arrangements in coordination with national authorities.

Operational monitoring will include inspection and maintenance of perimeter fencing, maintenance of signage and authorized crossings, and recording and review of trespass incidents. Where recurrent trespass is identified at a particular location, KTZ will investigate the underlying cause, including whether the location indicates an unmet access or crossing need, and implement appropriate corrective measures.

Residual Impact. With the provision and maintenance of perimeter fencing, authorized crossings, community awareness and operational monitoring, the likelihood of public access to the live railway will be substantially reduced. The residual significance of **CS004 is assessed as Low**.

CS005 – Accidents at Level and Farm Crossings

Impact. The second operations-stage impact is the risk of accidents at level crossings or other points of interaction between trains and road users, including vehicles, pedestrians and livestock. Level crossings are the principal location for road-user/rail interaction risk. Collision with a train has the potential to result in serious injury or fatality, while agricultural crossings may also involve slow-moving machinery, long loads or livestock movements requiring longer crossing times.

Mitigation and management response. The national EIA documentation identified seven unguarded level crossings at the relevant stage of Project design. The current Project level-crossing register identifies 13 at-grade crossings, comprising nine agricultural crossings on roads of local significance and four crossings serving public roads. The Supplementary ESIA therefore assesses the current 13-crossing arrangement. The Supplementary ESIA requires the level of protection at each public crossing to be reviewed against actual and forecast road use and community-risk conditions, with additional protective measures, including barriers where warranted, incorporated where necessary to achieve an acceptable level of safety. Community awareness material on safe crossing use will be provided, including through school visits.

Crossings on minor or unsealed roads will be assessed individually for the appropriate level of protection, with conservative defaults applied where road-usage information is limited. At agricultural crossings, the crossing protection and operating arrangements will take account of the potential for slow-moving agricultural machinery, long loads and livestock movements, including the additional crossing time that these users may require.

Operational monitoring will include testing of crossing-protection systems, maintenance records and review of level- and agricultural-crossing incidents and near misses. Where incident patterns identify a recurring hazard, the crossing arrangements will be reviewed and additional engineering, operational or awareness measures introduced as necessary.

Residual Impact. With appropriate crossing design, automated protection at public crossings, arrangements for agricultural crossings and an ongoing inspection and maintenance regime, the likelihood of road-rail collision will be substantially reduced. The residual significance of **CS005 is assessed as Low**.

8.4.4.3. Hazardous Cargo Transport

HC001 – Hazardous Cargo Transport Accident Risk

VER and Sensitivity. The receptors potentially affected by hazardous-cargo incidents include communities along the railway alignment; the Syr Darya River and Shardara Reservoir IBA/KBA; irrigation networks and agricultural land in Zhetysay and Maktaaral districts; groundwater; operational workers and emergency responders; and the cross-border interface at Maktaaral.

These receptors vary in sensitivity, but include communities potentially exposed to fire, explosion or toxic releases and internationally important aquatic and wetland receptors potentially affected by a major chemical release. The overall receptor sensitivity is therefore considered **High**.

Impact. The national feasibility-stage EIA identifies railway emergencies arising principally from collision or derailment, including fire, and specifically recognizes the transport of explosive, chemically hazardous and fire-hazardous cargoes as an operational accident risk. It identifies compliance with the applicable national dangerous-goods transport requirements as the principal regulatory control. The Project is expected to operate at up to 46 trains per day, predominantly freight services, and the subsequent detailed design also provides at Maktaaral for a dedicated track for holding wagons carrying hazardous goods and managing emergency situations.

The Supplementary ESIA therefore assesses the potentially higher-consequence scenarios associated with dangerous-goods traffic, including derailment or collision with cargo release, leakage from tank

wagons and incidents at sensitive locations such as the Syr Darya/Shardara crossing and the Maktaaral cross-border interface.

The principal impact pathways comprise:

- **derailment with cargo release**, including scenarios arising from track failure, heat-induced buckling, foundation settlement or washout, rolling-stock failure, collision or other external causes;
- **level-crossing collision with cargo release**, where collision may result in damage or rupture of a dangerous-goods wagon;
- **cross-border interface events at Maktaaral**, associated with cargo handling, classification verification and associated border operations; and
- **slow leakage from tank wagons**, potentially resulting in progressive contamination of soil, groundwater or surface water.

The consequences depend on the cargo involved and may include fire or explosion, toxic or corrosive exposure, contamination of soil or water, and impacts extending beyond the railway Right of Way. Particular consequence-sensitive locations include communities adjoining the railway, the Syr Darya bridge and Shardara IBA/KBA, and irrigation networks in the southern part of the corridor.

The impact is characterized as low probability but potentially high consequence. Table 88 therefore assigns Major magnitude and Medium significance before mitigation to HC001.

Mitigation and management response. The operational hazardous-cargo accident-risk framework will comprise two complementary elements.

First, existing KTZ corporate and regulatory controls will apply to the transport of dangerous goods, implementing applicable Kazakhstan requirements and RID/COTIF provisions, including dispatch controls, wagon inspection requirements, train-composition requirements and other established operational rules.

Second, prior to commencement of operations, KTZ will undertake a Project-specific structured hazard assessment covering the transport, handling, temporary holding and storage of dangerous goods associated with the Project. The assessment will identify credible accident scenarios including derailment, collision, fire, explosion and accidental release of toxic, flammable, corrosive or oxidising materials, and will evaluate potential consequences for workers, communities and environmental receptors, including areas where the railway passes through or close to settlements.

The assessment will apply an appropriate risk-assessment methodology proportionate to the hazards identified, including HAZID and, where warranted, HAZOP and/or QRA, and will inform the final engineering controls, dangerous-goods operating procedures, routing and handling requirements, emergency preparedness and response arrangements, coordination with emergency services and community information requirements. Transport and handling arrangements will also incorporate applicable WBG General EHS Guideline requirements for hazardous-material transportation.

For hazardous cargo traversing the Shardara IBA/KBA, additional Project-specific operational controls will be confirmed through this pre-operation hazard assessment and incorporated into KTZ operational procedures. These may include restrictions on the carriage of unsterilized hazardous bulk liquids, routing and scheduling controls for incompatible dangerous goods, appropriate speed restrictions across the Syr Darya bridge and adjacent embankment, and pre-positioned spill-response equipment under the Operational Pollution Emergency Response Plan.

The Operational Pollution Emergency Response Plan will establish cargo-specific response procedures, emergency communication and notification arrangements, coordination with the territorial emergency services and relevant water-management authorities, and pre-positioned containment

and response equipment at strategic locations. Emergency arrangements will be tested through joint exercises and revised where exercises or actual incidents identify deficiencies.

Community information and emergency communication requirements for settlements potentially affected by credible hazardous-cargo scenarios will be determined through the hazard assessment, including, where relevant, instructions concerning evacuation, shelter-in-place and emergency notification.

Residual Impact. Hazardous-cargo transport remains intrinsically a low-probability/high-consequence risk. Existing regulatory and KTZ operating controls, together with the Project-specific hazard assessment, operational controls and emergency-response arrangements, will materially reduce both the probability of an incident and its potential consequences but cannot eliminate the underlying risk associated with the carriage of dangerous goods.

Residual significance is therefore assessed as Medium, consistent with HC001 in Table 88. Particular residual-risk locations include the Shardara crossing, where a major release could affect the IBA/KBA and downstream water resources, and level crossings, where road-rail interaction represents an important accident initiating event.

Monitoring will include hazardous-cargo movements, accidents and near misses, implementation of the hazard-assessment recommendations and outcomes of emergency-response exercises, with relevant results included in Project operational E&S reporting.

8.4.4.4. Noise

Purpose and Status of the Assessment (impacts NO001, NO003). A preliminary operational noise model has been developed for the Project to support the impact assessment in this ESIA. The model has been prepared at the ESIA disclosure stage to provide a first-order indication of the spatial distribution of predicted operational noise levels along the alignment, to identify the locations at which predicted noise levels approach or exceed applicable guideline values for residential receptors, and to inform the scope and priorities of the detailed operational noise modelling to be undertaken at the EPC stage.

The model is preliminary in three respects. First, the source term has been derived from generic FRA reference data for diesel-hauled freight rolling stock rather than from a measured or specification-confirmed source term for the rolling stock to be procured for the Project. Second, the propagation modelling adopts a simplified geometric attenuation regime appropriate to first-order screening rather than the full three-dimensional propagation modelling required for the detailed assessment. Third, the receptor inventory has been built from OpenStreetMap data and identifies inhabited features by category but does not at this stage distinguish between dwellings of different occupancy or sensitivity. The model is therefore appropriate for the identification of areas of concern and for setting out the framework for the detailed assessment, but it is not a substitute for the detailed assessment, and the predicted exceedances reported below should be regarded as indicative pending confirmation.

Methodology. The model has been benchmarked against the noise level criteria of the IFC General Environmental, Health and Safety Guidelines (2007) and the IFC EHS Guidelines for Railways (2007), which together adopt the WHO guideline values of 55 dB(A) LAeq for residential receptors during the day (07:00–22:00) and 45 dB(A) LAeq at night (22:00–07:00). These guideline values are widely used by lenders applying international safeguards to new linear transport infrastructure and provide the reference framework against which predicted operational noise levels are evaluated in this ESIA.

The source characterization adopts the Federal Railroad Administration Transit Noise and Vibration Impact Assessment Manual (FRA TNVIM, 2018, Chapter 11) Sound Exposure Level (SEL) prediction methodology, which is one of the most extensively validated international methodologies for predicting noise from heavy freight rail operations. Propagation has been modelled using a soft-

ground attenuation regime at 15·log(distance), consistent with FRA practice for unobstructed propagation across open terrain, with an additional air absorption term of 0.5 dB per 100 m, in line with the FRA Handbook (DOT/FRA/ORD-11/05, 2011). The operational scenario modelled corresponds to the Project's design operating profile: diesel freight, one locomotive plus fifty cars, line speed 50 km/h, and 46 movements per day distributed across the 24-hour operational cycle.

The receptor inventory has been compiled from OpenStreetMap data accessed via the Overpass API. An expanded receptor set has been used, which includes residential buildings, named places, land-use polygons identifying inhabited areas, and identified man-made works. Each receptor falling within either the daytime or the night-time exceedance contour has been counted; receptors falling within both contours are reported under the night-time count to avoid double-counting in the alignment-wide totals.

The model produces two prediction contours along the alignment. The daytime exceedance contour is bounded at the distance from the centerline at which the predicted LAeq under the modelled operational scenario equals the IFC daytime guideline value of 55 dB(A). The night-time exceedance contour is bounded at the corresponding distance for the IFC night-time guideline value of 45 dB(A). At the modelled operational scenario, these distances are approximately 39 m and approximately 166 m respectively. Receptors lying within these contour bands are identified as predicted to experience operational noise levels at or above the applicable IFC guideline value in the absence of mitigation.

Alignment-wide Findings. Applied across the full 114.8 km of the alignment, the preliminary model identifies a total of 58 receptors within the daytime exceedance contour and 267 receptors within the night-time exceedance contour. As the night-time guideline value is the lower of the two and the predicted noise levels at night-time receptors are dominated by individual train pass-bys rather than by cumulative daytime traffic, the night-time exceedance corridor is the binding constraint for the design of operational noise mitigation along the alignment.

The exceedances are not uniformly distributed along the alignment. The majority of the modelled corridor passes through open steppe and semi-desert with no inhabited receptors within either contour, and operational noise impacts in those sections are predicted to be Non-significant. Predicted exceedances are concentrated at six locations along the alignment, corresponding to the locations at which the alignment passes through or close to settlements and station footprints. These are described in the following section.

Location-Specific Findings

Maktaaral station and adjacent settlement

The modernized station at Maktaaral sits at the southern end of the alignment within the existing town and is the location of the highest predicted concentration of receptors within the night-time exceedance contour. The model identifies approximately 29 receptors within the daytime exceedance contour and approximately 157 additional receptors within the night-time exceedance contour at this location, giving a combined total of approximately 186 receptors at Maktaaral within the night-time exposure band. The exceedance arises from the combination of the proximity of residential properties to the station footprint, the prevalence of horn use at the station approaches and the level crossings within the town, and the use of the station for passenger and freight activity including idling at platforms and adjacent sidings. The Maktaaral exposure profile is shown in Figure 52.

Figure 52: Maktaaral Station Noise Contours



Erdaulet station. The new station at Erdaulet at the northern end of the alignment (KM 0) is the second major source of station-related operational noise. The settlement of Erdaulet sits immediately north of the station footprint, and the alignment exits the station to the south on a curve that brings the night-time contour into close proximity with the village of Aktas to the southwest. Predicted exceedances arise from station idling, horn use at the station approach, and passenger and freight activity. The Erdaulet exposure profile is shown in Figure 53.

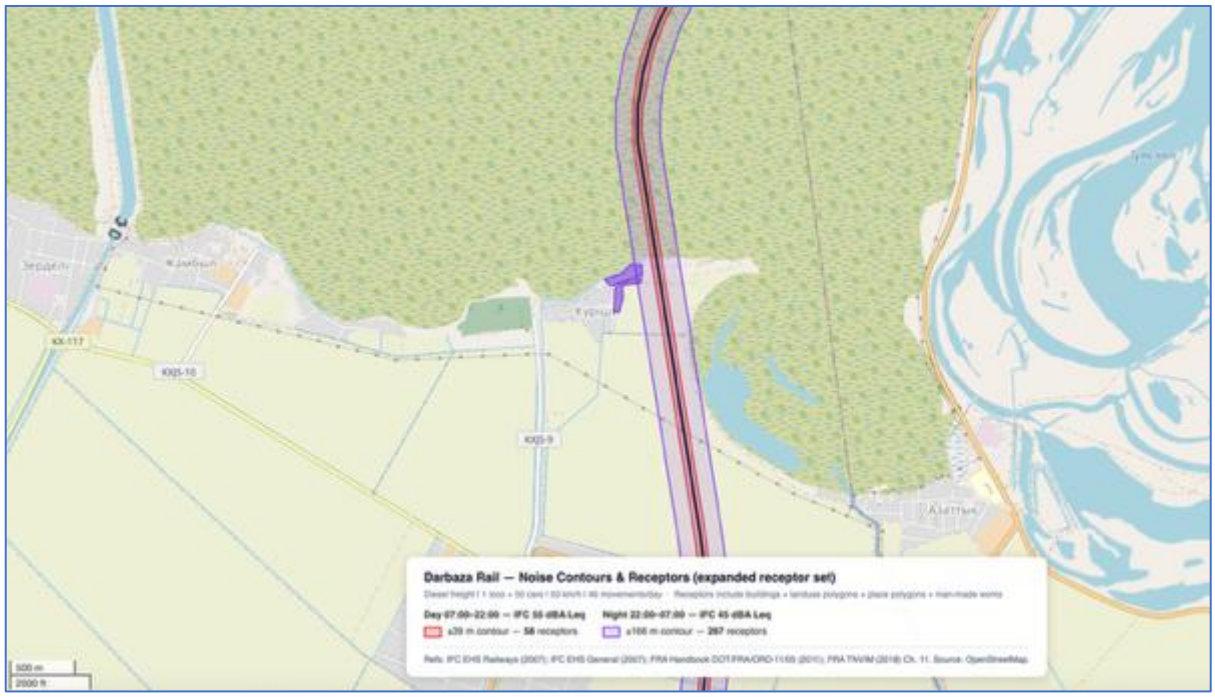
Figure 53: Erdaulet Station Noise Contours



Küriş village. Approximately mid-way along the alignment the modelled corridor passes immediately east of the village of Küriş, with the night-time exceedance contour overlapping the eastern edge of

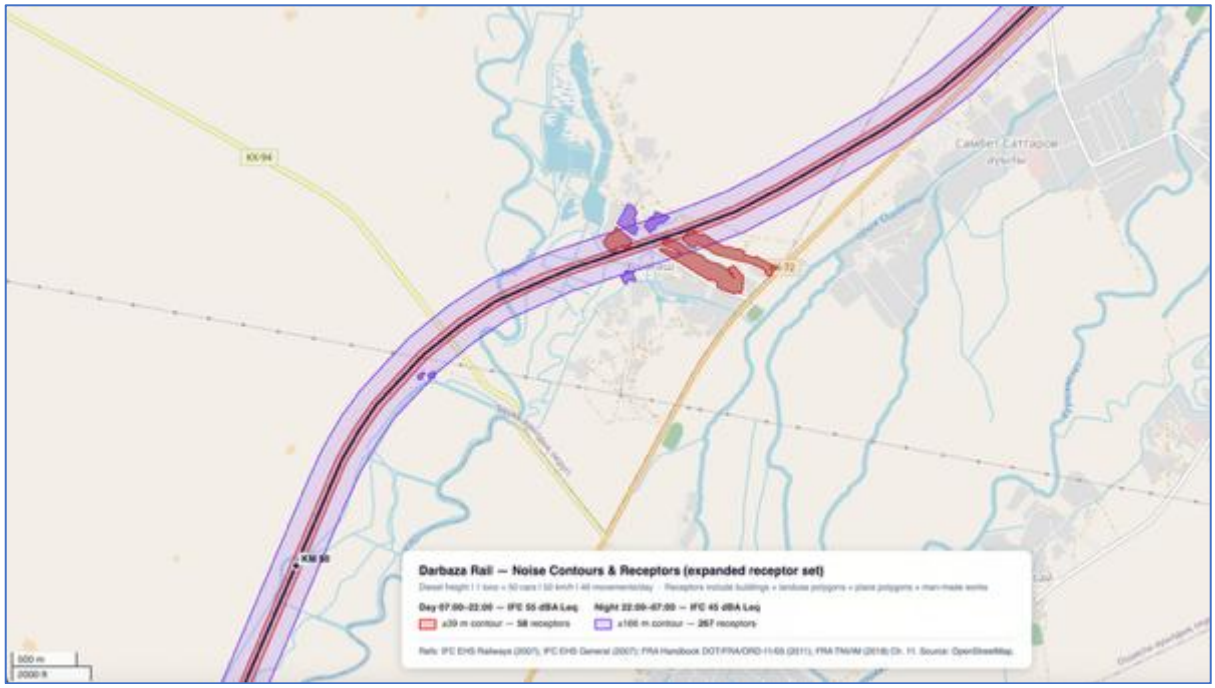
the settlement. The exceedance is localized, affecting a discrete cluster of receptors at the village's eastern margin. The Küriş exposure profile is shown in Figure 54.

Figure 54: Kuris Village Noise Contours



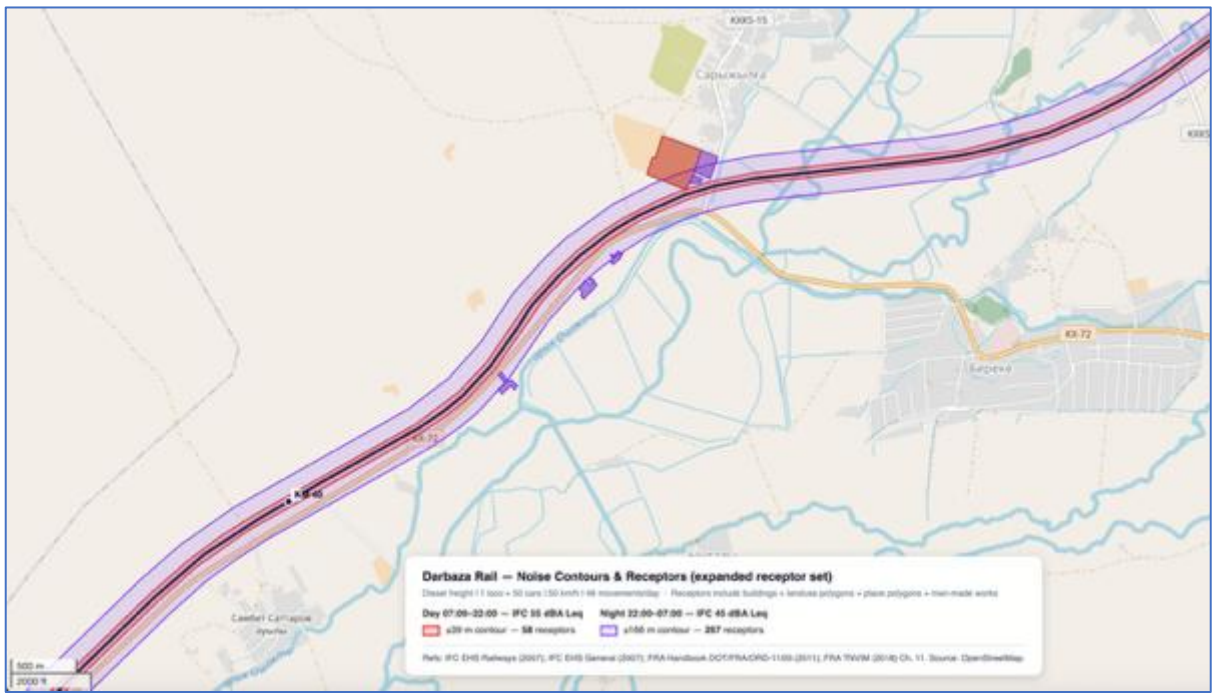
Ushagash settlement. The model identifies a notable concentration of receptors within both the daytime and the night-time exceedance contours at Ushagash settlement, where the alignment passes through the settlement footprint. The Ushagash exposure profile is of particular note in the context of this ESIA because the concerns raised by residents at the May 2026 consultation (recorded in Section 9) include reports of vibration-related cracking at one or two dwellings at Ushagash, indicating that the receptor inventory at this location includes properties already considered sensitive by their occupants. The model's prediction of exceedance is consistent with the concerns raised by the community. The Ushagash exposure profile is shown in Figure 55.

Figure 55: Ushagash Village Noise Contours



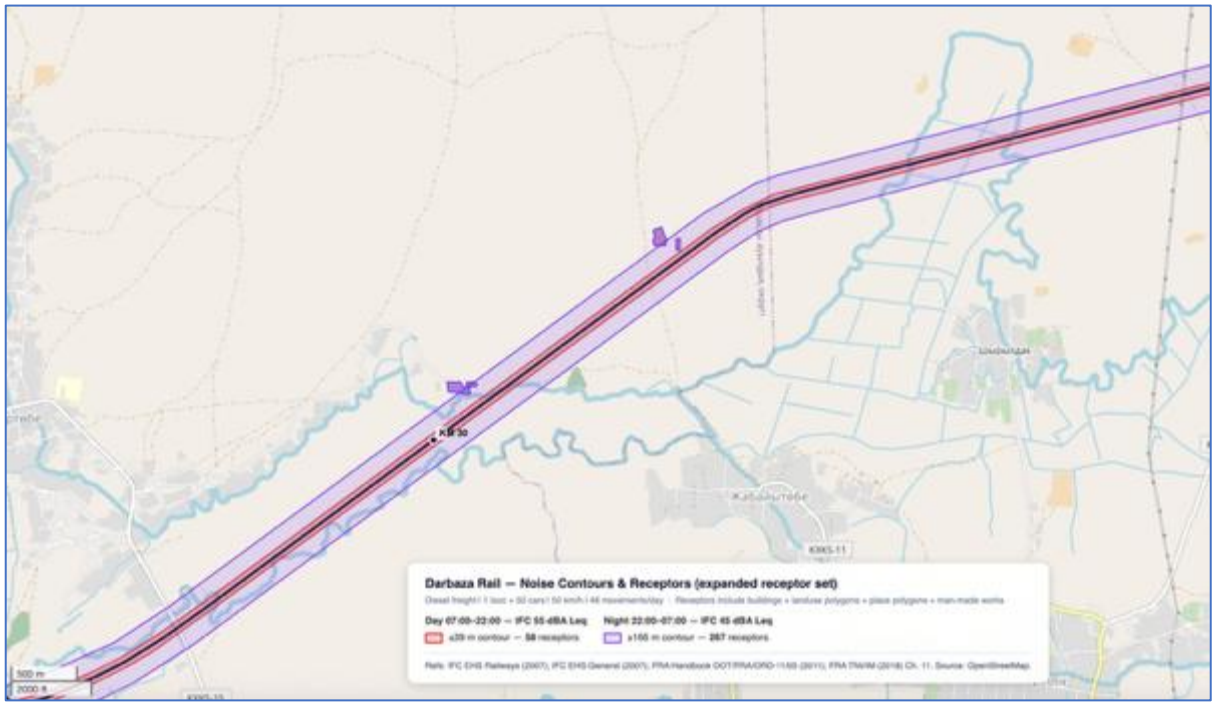
Sarıžylga–Bereke (KM 40). At approximately KM 40 the alignment passes through the village of Sarıžylga, with the daytime contour overlapping a built feature at the village's southern edge and the night-time contour extending across a number of additional receptors. The settlement of Bereke lies a short distance to the southeast of the alignment at this point and several of its peripheral receptors are also within the night-time exceedance contour. This location is the subject of a substantive community concern recorded at the May 2026 consultation in relation to the dimensions of the agricultural underpass at PK 365+09 (Section 9), although the underpass and the operational noise impact are distinct issues. The Sarıžylga–Bereke exposure profile is shown in Figure 56.

Figure 56: Sarıžylga–Bereke Village Noise Contours



Şyrıldak–Jabaytöbe (KM 30). At approximately KM 30 the alignment passes between the settlements of Şyrıldak (to the east) and Jabaytöbe (to the southeast), with localized exceedance of the night-time contour at a small number of receptors at the western edges of both settlements. The Şyrıldak–Jabaytöbe exposure profile is shown in Figure 57.

Figure 57: Şyrıldak–Jabaytöbe Village Noise Contours



KTZ operational noise commitment. KTZ commits to keeping operational noise from the railway within the IFC EHS Guideline limits at the nearest homes in each of the six places where the modelling predicts a problem — Maktaaral, Erdaulet/Aktas, Küriş, Ushagash, Sarıžylga–Bereke and Şyrıldak–Jabaytöbe. The limit is measured at the outside wall of the nearest affected home, and is met by dealing with the noise in order — first reducing it at the source, then blocking it along the path between the railway and the home, and only then protecting the home itself (the source–pathway–receptor approach). Compliance is checked using the standard environmental-noise measurement method, ISO 1996-2. The limits that apply are:

- Homes, schools, hospitals, sanatoria, kindergartens and libraries: 55 dB(A) by day (07:00–22:00) and 45 dB(A) at night (22:00–07:00), measured as an average noise level (LAeq);
- Industrial and commercial premises: 70 dB(A), day and night;
- Outdoor spaces used by people (parks, recreation areas, daytime agricultural areas, and places of cultural or religious gathering): 55 dB(A) while in use, measured at the centre of the area, following the WHO Community Noise guideline (1999);
- Wildlife within the Shardara IBA/KBA and neighboring natural habitat: thresholds set for each species by the biodiversity noise and vibration modelling, with no species displaced from breeding habitat during the breeding season.

The exact mix of measures needed at each location will be settled by the detailed operational noise modelling carried out at the EPC (detailed design and construction) stage. If a limit still cannot be met after the full set of measures has been applied, the IFC General EHS fallback applies — operational noise must not raise existing background levels by more than 3 dB at the nearest home — and the reasons will be recorded in the Operational ESMP.

Mitigation approach. Noise is dealt with in the order set out above (the source–pathway–receptor hierarchy described in Section 8.4.4). KTZ has committed to building noise barriers at both stations — the new station at Erdaulet and the upgraded station at Maktaaral — as part of the station works. These barriers will be sized at the EPC stage to bring noise at nearby homes within the day and night limits. The two stations are the priority because they have the most homes close to the track and the most noise: idling locomotives, horn use, and passenger and shunting activity together produce a higher level of activity than anywhere else on the line.

At the four other locations — Küriş, Ushagash, Sarıžylga–Bereke and Şyrıldak–Jabaytöbe — barriers are expected to be needed, but their exact position, length and height, and any additional measures, will be confirmed by the detailed modelling. That modelling will use the real noise output of the trains once the rolling stock is bought, detailed terrain and building data, and a verified list of the actual homes near the line, checked on the ground and with the affected communities. Where it shows that barriers alone will not bring noise within the limits, further measures will be added in order: first more at the source — horn-use rules, limits on where locomotives idle, and rail and wheel maintenance to keep rolling noise down — and, if source and path measures together are still not enough, insulation of the affected homes (windows and walls), to the standard normally used for new railways and roads.

Next Steps. The preliminary modelling in this section will be replaced by the detailed operational noise assessment at the EPC stage. That assessment will: confirm where exceedances actually occur, using the real train noise output and detailed modelling; set the size and performance of the barriers committed at Maktaaral and Erdaulet; determine what is needed at Küriş, Ushagash, Sarıžylga–Bereke and Şyrıldak–Jabaytöbe; build the source-control and home-protection measures into the operational ESMP; and set the baseline for ongoing operational noise monitoring.

Following completion of the detailed operational noise and vibration assessment, targeted supplemental disclosure and consultation will be undertaken with affected communities and receptors at the six locations currently identified as having predicted noise exceedances, together with any additional locations identified through the detailed assessment. Engagement will explain the predicted noise and vibration effects, proposed mitigation measures, monitoring arrangements and the mechanism for raising noise- or vibration-related grievances. The outcomes of this engagement will inform finalization of location-specific mitigation and monitoring measures.

Residual impact. Even with mitigation, residual operational noise at Maktaaral and Erdaulet stations is assessed as Medium. This is because barriers, however well designed, cannot remove horn use at level crossings, idling locomotives during station stops, or passenger and shunting activity. The residual is concentrated at the homes closest to the stations — about 186 at Maktaaral within the night-time noise band, and at Erdaulet the cluster of homes on the south-east approach curve and the village of Aktas to the south-west. The detailed work at the EPC stage will confirm this home by home, set out who qualifies for insulation, and schedule any temporary alternative accommodation needed during the noisiest construction periods. A Medium residual is accepted as an unavoidable part of operating a station in a residential area, consistent with normal practice for new stations.

8.4.4.5. Vibration

Purpose and Status of the Assessment. A preliminary operational vibration screening has been developed for the Project to support the impact assessment in this ESIA. The screening provides a first-order indication of the spatial distribution of receptors at risk of exposure to perceptible operational vibration from passing trains, identifies the locations at which receptors lie within distance bands at which the applicable international annoyance and sleep-disturbance criteria may be exceeded, and informs the scope and priorities of the detailed operational vibration assessment and trackform design decisions to be undertaken at the EPC stage.

The screening is preliminary in three respects, consistent with the operational noise and construction vibration screenings reported above. First, the source term has been derived from generic FRA

reference data for diesel-hauled heavy freight rolling stock rather than from a measured or specification-confirmed source term for the rolling stock to be procured. Second, the propagation modelling adopts a generic soft-soil attenuation regime rather than site-specific ground response data, and building coupling loss has not been applied**,** meaning the predictions are conservative and represent ground-surface levels rather than levels experienced within receiving buildings. Third, the receptor inventory has been built from OpenStreetMap data and identifies inhabited features by category but does not at this stage distinguish between dwellings of different occupancy, building construction, or vibration sensitivity. The screening is therefore appropriate for the identification of areas of concern and for setting out the framework for the detailed assessment.

The operational vibration screening is distinct in scope from the construction vibration screening reported in the preceding section. Construction vibration is assessed against the DIN 4150-3 damage criteria because the principal risk of construction-induced vibration is damage to nearby buildings from heavy plant. Operational vibration from diesel-hauled freight trains, by contrast, does not generate ground-surface velocities sufficient to cause structural or cosmetic damage to typical buildings on properly-maintained track. The principal residual risk from operational vibration is human perception, annoyance and sleep disturbance at receptors within close range of the alignment, and the screening is benchmarked accordingly against the human-response criteria of FRA TNVIM and ISO 2631-2.

Methodology. The screening adopts the framework of ISO 14837-1:2005 Mechanical vibration — Ground-borne noise and vibration arising from rail systems — Part 1: General guidance (Section 4, source-path-receiver model). The source vibration level has been taken from the Federal Railroad Administration Transit Noise and Vibration Impact Assessment Manual (FRA TNVIM, 2018) Table 8-1, with a reference vibration level (Lv) at 15.2 m from the track of 75.9 VdB for a heavy freight train consisting of one locomotive and fifty cars at 50 km/h. Propagation has been modelled with a 30·log(distance) attenuation appropriate to typical soft soil conditions. The operational scenario corresponds to the Project's design profile: 46 movements per day, classified as "Occasional Events" under FRA TNVIM (between 30 and 70 events per day).

The criteria applied to evaluate the predicted levels are taken from FRA TNVIM Table 8-2 (Category 2 residential receptors) and ISO 2631-2 Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 2: Vibration in buildings. The criteria distinguish between event frequency categories: more stringent criteria apply where vibration events are frequent, less stringent criteria apply where they are occasional. For the 46 movements/day operational profile of the Project, the "Occasional Events" criterion of 72 VdB at Category 2 (residential) receptors is the principal benchmark, with the more stringent "Frequent Events" criterion of 65 VdB included for reference. The 75 VdB and 60 VdB thresholds are included in the screening to bracket the range of receptor exposure.

The screening produces four distance bands along the alignment corresponding to the four threshold VdB levels:

- **75 VdB band: d ≤ 16 m** — receptors within this band are predicted to experience operational ground-surface vibration above the FRA TNVIM Category 1 (vibration-sensitive equipment) threshold and clearly above the human perception threshold; perception during train pass-by is very likely and annoyance is probable.
- **72 VdB band: d ≤ 21 m** — receptors within this band are predicted to experience operational ground-surface vibration at or above the FRA TNVIM Category 2 (residential) Occasional Events criterion; this is the principal threshold of regulatory significance for this Project.
- **65 VdB band: d ≤ 35 m** — receptors within this band are predicted to experience operational ground-surface vibration at the FRA TNVIM Category 2 Frequent Events criterion; perception

during train pass-by is likely but the criterion is not the binding one for the Project's 46-train operational profile.

- **60 VdB band: d ≤ 52 m** — receptors within this band are predicted to experience vibration at or above the typical human perception threshold for whole-body vibration; perception during train pass-by is possible but annoyance is unlikely.

Building coupling loss — the reduction in vibration that occurs as ground-surface vibration is transmitted through building foundations into floor and wall structures — has not been applied to the predicted levels. Typical building coupling losses for residential dwellings are in the range 5 to 15 dB, meaning that vibration levels actually experienced within buildings are typically lower than the ground-surface levels reported in the screening. The screening predictions should therefore be regarded as conservative.

The receptor inventory has been compiled from OpenStreetMap data and includes residential buildings, residential and industrial land-use polygons (including farmyard polygons), named settlement extents and identified man-made works. Receptors are counted within each cumulative band: a receptor within 16 m is also counted in the 21 m, 35 m and 52 m bands.

Alignment-wide Findings. Applied across the full alignment, the preliminary screening identifies:

- 13 receptors within the 75 VdB / 16 m band**;**
- 18 receptors within the 72 VdB / 21 m band**;**
- 51 receptors within the 65 VdB / 35 m band**;** and
- 73 receptors within the 60 VdB / 52 m band**.**

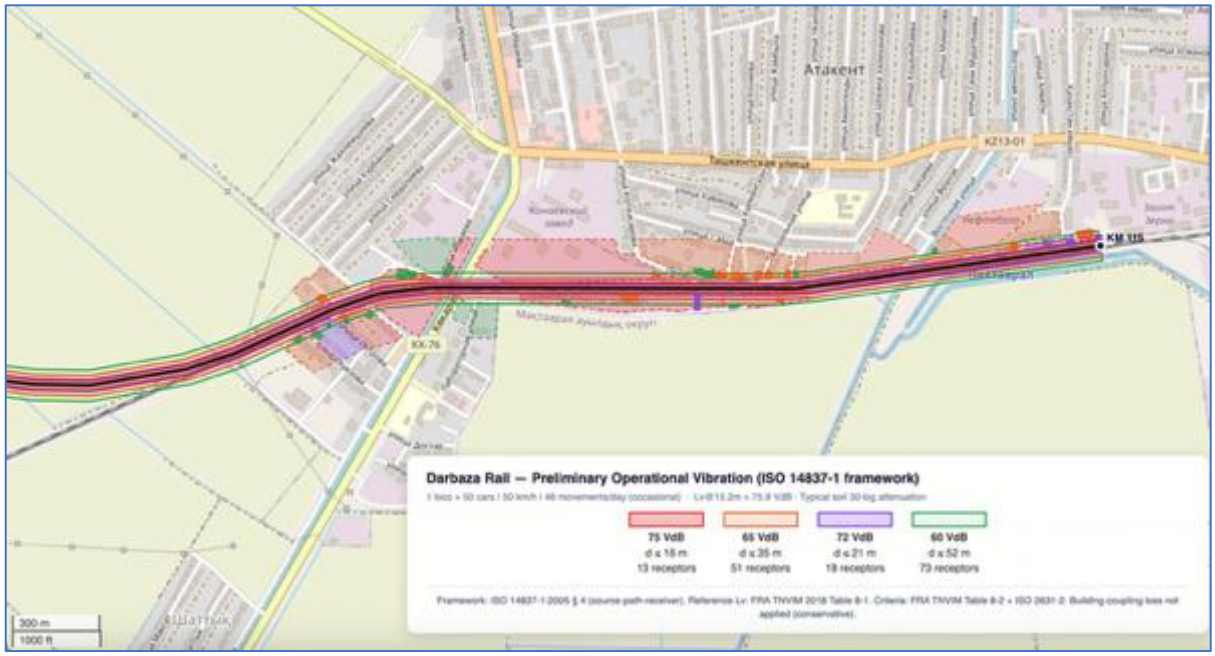
The principal regulatory threshold for the Project's operational profile is the 72 VdB Occasional Events criterion, against which 18 receptors are predicted to experience operational vibration at or above the threshold prior to mitigation. The screening identifies receptors above the 72 VdB threshold at only two locations along the alignment: Maktaaral and Ushagash. At all other locations identified in the operational noise and construction vibration screenings (Erdaulet/Aktas, Küriş, Sarıžylga–Bereke, and Şyrıldak–Jabaytöbe), receptors lie beyond the 21 m operational vibration threshold and operational vibration is not predicted to exceed the applicable Category 2 Occasional Events criterion.

The 73 receptors within the wider 60 VdB / 52 m band along the alignment are within the range at which operational vibration may be occasionally perceptible during train pass-by but is unlikely to be a source of annoyance. These receptors are included in the screening for completeness and to provide a basis for community communication during the operational phase.

Location-Specific Findings

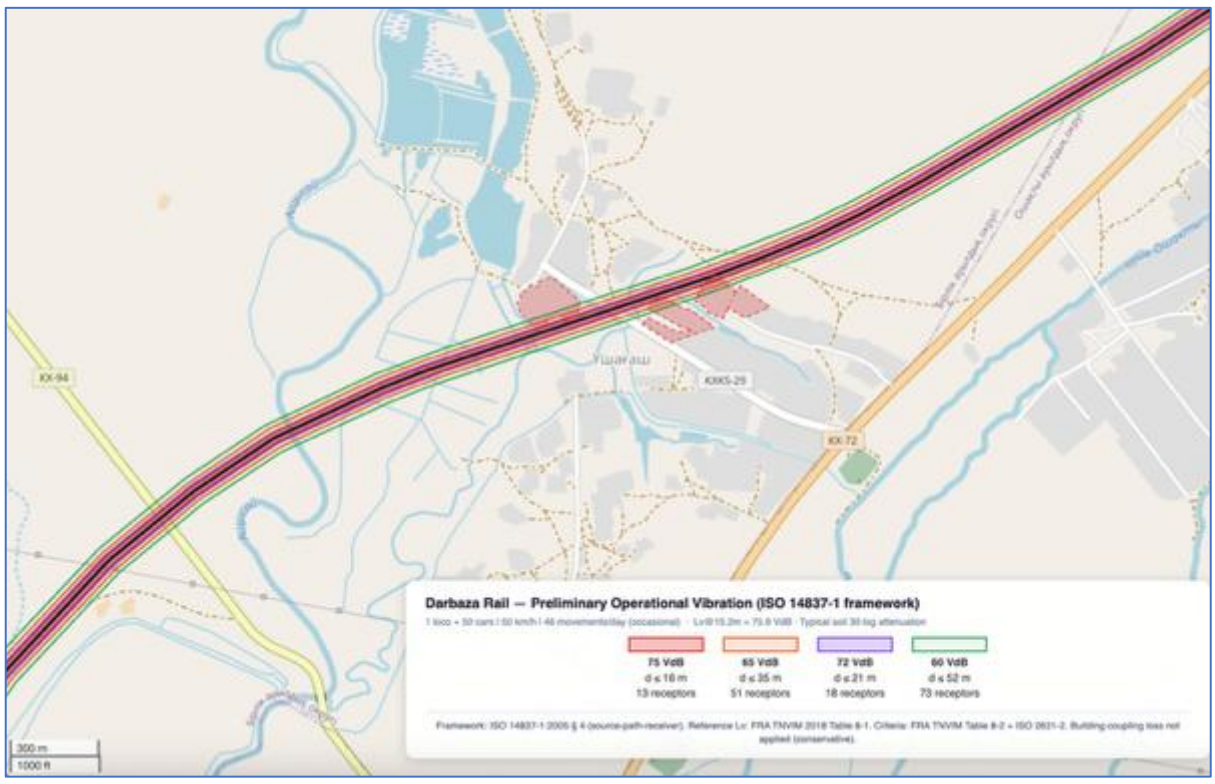
Maktaaral / Pakhtaaral / Atakent (approximately KM 115). Maktaaral is the most exposed location with respect to operational vibration, as it is also for operational noise and construction vibration. The alignment passes through the southern margin of the existing town with continuous receptor density along both sides of the corridor for approximately 1.5 km. The screening identifies the great majority of the 18 receptors within the 72 VdB threshold at this location, comprising residential and commercial structures along the corridor. The Maktaaral exposure profile is shown in Figure 58.

Figure 58: Preliminary Operational Vibration at Maktaaral / Pakhtaaral / Atakent (KM 115)



Ushagash settlement (approximately KM 50). Ushagash is the only other location at which receptors are identified within the 72 VdB threshold for operational vibration. Three receptor polygons sit immediately adjacent to or on the alignment centerline within the 75 VdB / 16 m band. This is consistent with the close offset of receptors at Ushagash identified in the construction vibration screening and in the operational noise modelling. The Ushagash exposure profile is shown in Figure 59.

Figure 59: Preliminary Operational Vibration at Ushagash settlement (approximately KM 50)



Expected Impacts. On the basis of the preliminary screening, the following provisional conclusions are drawn against the FRA TNVIM and ISO 2631-2 frameworks. These will be confirmed by the detailed assessment.

- **Risk of structural or cosmetic damage.** Operational vibration from diesel-hauled freight trains on properly-maintained ballasted track does not generate ground-surface vibration velocities sufficient to cause structural or cosmetic damage to typical buildings. The DIN 4150-3 short-term Line 2 guideline value applicable to residential buildings (5–20 mm/s PPV) corresponds to vibration levels substantially above those predicted by the operational screening, and the operational profile does not include the impulsive, high-amplitude vibration events characteristic of construction activities that can approach the damage thresholds. The risk of operational vibration causing damage to receptors along the alignment is therefore assessed as Non-significant.
- **Risk of perceptible vibration, annoyance and sleep disturbance.** The principal residual risk from operational vibration is human perception during train pass-by, annoyance from repeated perception, and sleep disturbance at night-time movements. At the 18 receptors predicted to experience operational vibration above the 72 VdB Occasional Events criterion, annoyance during train pass-by is probable in the absence of mitigation. At the 13 receptors within the 75 VdB band, perception and annoyance are very probable, and the additional risk of sleep disturbance at night-time movements is material. The 46 movements per day operational profile, with services running on a 24-hour basis, means that night-time exposure is unavoidable without operational restrictions on the timing of services.

Note on building coupling loss. The predicted levels are ground-surface levels; vibration experienced within buildings is typically 5–15 dB lower as a result of foundation and structural coupling losses. The conservative nature of the predictions means that the number of receptors actually experiencing internal vibration levels above the perception threshold is likely to be smaller than the screening suggests. The detailed assessment will quantify the actual receptor-by-receptor exposure with site-validated coupling-loss data.

Mitigation Strategy. Standard railway design and operational practice for the Project includes:

- At source. At the two locations of predicted exceedance (Maktaaral and Ushagash), the detailed EPC-stage assessment will determine whether mitigation additional to the base track design is required. Established technical vibration-mitigation options include under-sleeper pads (USPs), ballast mats, resilient rail fastenings and, where appropriate, rail dampers. The specific combination of measures will be selected on the basis of the magnitude of the predicted exceedance, trackform constraints and ground-response characteristics confirmed through site testing.

  Operational source-control measures complement the trackform measures: routine rail and wheel maintenance to limit the development of rail roughness, wheel flats and other defects that increase vibration emissions; speed restrictions through high-sensitivity locations where source-control alone cannot deliver compliance with the applicable criteria; and rolling stock procurement specifications including vibration-related criteria consistent with current European practice.
- **Along the pathway.** Pathway measures for operational vibration on linear infrastructure are limited compared with noise, because ground-borne vibration cannot be intercepted by surface barriers. Where the detailed assessment identifies locations at which trackform measures alone cannot bring vibration within applicable limits, trench isolation (the construction of a barrier in the ground between the alignment and the receptor, typically a slurry-filled trench or a row of bored piles) may be deployed; trench isolation is a specialist measure used only where the case is clear and the receptor density justifies the investment.

- **At the receptor.** Where source and pathway measures together are insufficient to bring predicted vibration within the applicable Occasional Events criterion, additional measures at the receptor may be considered, including engagement with the affected occupants to confirm the nature and timing of the exposure, agreement of operational mitigation arrangements (for example reduced night-time movements during particularly sensitive periods), and in extreme cases (which are not expected to apply on this Project) the consideration of property-specific isolation measures or compensation arrangements.
- **Community engagement and monitoring.** Affected communities at Maktaaral and Ushagash will be informed of the predicted operational vibration exposure as part of the operational community engagement programme. Monitoring of operational vibration at representative receptors at the two locations will be undertaken during the early operational period to confirm the predicted exposure against measured levels and to inform any adaptive management response. Vibration-related concerns received through the project Grievance Redress Mechanism will be investigated and responded to within defined timescales, with the mitigation response reviewed where monitoring or investigation of a grievance identifies a previously unanticipated impact or exceedance. Where required, further technically feasible measures will be selected and implemented in accordance with the source – pathway – receptor hierarchy described above.

Residual Significance. Residual Significance. With implementation of the standard design and operational controls, together with any additional Project-specific vibration mitigation identified as necessary through the detailed EPC-stage assessment, the residual significance of operational vibration impact NO003 is assessed as Low at all locations along the alignment. This conclusion will be verified through the detailed assessment and early operational monitoring.

Status and Next Steps. The preliminary operational vibration screening described in this section will be supplemented by the detailed operational vibration assessment at the EPC stage. The detailed assessment will (i) confirm the predicted exposure at Maktaaral and Ushagash against site-validated source and propagation data, (ii) apply building coupling loss to determine receptor-by-receptor internal vibration levels, (iii) specify the trackform mitigation package at each of the two locations and confirm its noise-reduction performance, (iv) develop the operational monitoring programme for incorporation into the Operational ESMP, and (v) provide the basis for the ongoing engagement of affected receptors during the operational life of the Project.

8.4.4.6. Maktaaral biosecurity disinfection complex

VER and Sensitivity. The Maktaaral cross-border facilities include a dedicated disinfection complex/service building, disinfection barrier and associated reservoir as part of the sanitary-epidemiological control facilities at the border crossing. The national EIA also identifies dedicated sanitary-epidemiological personnel for operation of the facility.

The principal receptors associated with operation of the complex are the shallow Quaternary aquifer and local surface-water network, regional water resources and existing users of the Maktaaral potable-water supply, the operational workforce, and communities in the vicinity of the facility. The principal operational pathways comprise generation and handling of hazardous and biosecurity-related wastes (WM004), potential community health and safety risks associated with chemical handling and biosecurity operations (CS008), and operational water demand, which is assessed separately under WR001 in Section 8.4.4.[Water Resources].

WM004 – Hazardous Waste Generation

Impact. Veterinary and sanitary biosecurity disinfection of cross-border rolling stock and cargo will generate potentially hazardous waste streams, including disinfectant residues, contaminated wash-water, single-use PPE and biological materials. Inappropriate storage, handling or disposal of these

materials could result in contamination of soil, shallow groundwater or surface water and could expose workers or other persons to hazardous substances.

The national EIA confirms that Maktaaral incorporates separate domestic, stormwater and industrial wastewater systems, together with pumping stations and treatment infrastructure. Separate systems are therefore provided for process and domestic wastewater rather than relying on a common uncontrolled discharge pathway.

The impact magnitude is assessed as **Minor**, resulting in **Medium significance** before mitigation.

Mitigation and management response. Hazardous wastes generated by the facility will be segregated at source, appropriately labelled and contained, recorded through a documented chain-of-custody system and transferred to authorized waste-management facilities. Disinfection wash-water and other process wastewater will be collected through the dedicated industrial wastewater system and treated or otherwise managed in accordance with applicable discharge and waste-management requirements.

Chemicals used for disinfection and water or wastewater treatment will be transported, stored, handled and used in accordance with applicable safety requirements and manufacturer instructions. Measures will include secure and appropriately labelled storage, secondary containment where required, segregation of incompatible substances, availability of Safety Data Sheets, trained personnel and PPE, spill and emergency-response arrangements, and appropriate collection and disposal of chemical containers, residues and associated hazardous wastes through authorized routes.

Biological and other biosecurity-related wastes will be managed through an appropriate authorized treatment or disposal route. Operational arrangements will include coordination between KTZ and the relevant veterinary, sanitary-epidemiological and border-control authorities.

Residual Impact. With implementation of these measures, the residual significance of **WM004 is assessed as Low**.

Water demand.

Operational water demand associated with Maktaaral Station and the biosecurity disinfection facilities is assessed under WR001 – Operational Water Demand at Maktaaral in Section 8.4.4.[Water Resources]. The assessment considers the quantified water demand identified in the national EIA, reliance on the existing potable-water network, water-reuse provisions and the requirement to confirm available supply capacity before commissioning. The residual significance of WR001 is assessed as Low.

CS008 – Community Health and Safety

Impact. Potential community health and safety risks associated with operation of the disinfection complex include accidental release of disinfectant or treatment chemicals, acute exposure following a spill or loss of containment, and inappropriate management or release of materials subject to veterinary or sanitary biosecurity controls.

The national EIA confirms that the disinfection complex is a dedicated component of the controlled Maktaaral border facility and that specialist sanitary-epidemiological personnel will be assigned to its operation.

These risks are principally localized to the facility and its immediate surroundings. The impact magnitude is assessed as **Minor**, resulting in **Medium significance** before mitigation.

Mitigation and management response. The disinfection complex will operate within the secured Maktaaral border facility with controlled access. The chemical-management controls described under **WM004** will minimize the likelihood of accidental releases and associated exposure.

Operational controls will include appropriate biosecurity and sanitary procedures, trained specialist personnel, safe storage and handling of disinfection chemicals, spill and exposure-response arrangements, appropriate PPE, coordination with relevant emergency services and veterinary, sanitary-epidemiological and border-control authorities, and periodic audit of biosecurity and chemical-management procedures.

Where credible facility incidents could affect persons outside the controlled site, appropriate community information and emergency-communication arrangements will be maintained.

Residual Impact. With controlled access, competent operation, chemical-management controls, biosecurity procedures and emergency preparedness in place, the residual significance of CS008 is assessed as Low, consistent with Table 88.

8.4.4.7. Yerdaut locomotive servicing point

VER and Sensitivity. Yerdaut will function as the principal operational servicing and maintenance facility for the Project line. The station includes locomotive servicing and fuelling facilities, wagon maintenance, fuel and lubricant storage, compressor facilities, wastewater infrastructure and associated operational support facilities.

The relevant receptors are soil and the shallow Quaternary aquifer in the vicinity of the facility, local water resources and existing users of the potable-water supply, and the operational workforce. The principal operational pathways comprise hazardous and non-hazardous waste generation (WM005), fuel storage and spill risk (SG004) and occupational health and safety risks associated with locomotive and wagon servicing (WH011). Operational water demand is assessed separately under WR002 in Section 8.4.4.[Water Resources].

WM005 – Hazardous Waste Generation

Impact. Routine locomotive and wagon servicing at Yerdaut will generate hazardous and non-hazardous wastes, including used oils, contaminated absorbents and wiping materials, oil filters, welding waste, metal swarf and other maintenance residues.

The national EIA provides a quantified operational waste inventory for Yerdaut and estimates total waste generation at approximately **234.6 t/year**. Identified waste streams include mixed municipal waste, welding waste, metal shavings, contaminated absorbents and filter materials, contaminated protective clothing and wastewater-treatment residues.

Inappropriate storage or disposal of these wastes could result in contamination of soil or shallow groundwater and exposure of depot workers to hazardous substances. The impact magnitude is assessed as **Minor**, resulting in **Medium significance** before mitigation.

Mitigation and management response. KTZ will implement an operational Waste Management Plan for the Yerdaut facility. The Plan will apply the waste hierarchy and require segregation of waste streams at source, appropriate labelling and storage, recycling or recovery where feasible, and transfer of wastes only through authorised transporters and treatment or disposal facilities.

Hazardous wastes, including used oils, contaminated absorbents, filters, batteries and chemically contaminated materials, will be stored on impermeable surfaces with appropriate secondary containment and documented through a manifest and chain-of-custody system until final recovery or disposal.

Residual Impact. With implementation of the operational Waste Management Plan and controlled storage, transport and disposal arrangements, the residual significance of **WM005 is assessed as Low**.

SG004 – Fuel Storage and Spill Risk

Impact. The principal soil and groundwater pollution risk at Yerdaut arises from bulk diesel storage, unloading and locomotive refuelling operations.

The national EIA confirms that the fuel installation includes diesel-storage tanks, a fuel-unloading gantry, packaged and bulk oil storage, a drainage collection tank and product-pumping infrastructure. It also identifies an enclosing containment wall as part of the fuel-storage installation.

Loss of containment during fuel delivery, storage or refueling could result in hydrocarbon contamination of soil and shallow groundwater, with potential secondary transport through the depot drainage system.

The impact magnitude is assessed as **Minor**, resulting in **Medium significance** before mitigation.

Mitigation and management response. The embedded containment and drainage provisions identified in the national EIA will be supplemented by operational controls including impermeable surfaces in fuel unloading, storage and refueling areas; appropriate secondary containment; routine inspection of tanks, pipework, valves, pumps and containment systems; controlled fuel-delivery and refueling procedures; spill-response equipment; and training of relevant personnel.

Yerdaut fuel-storage and refueling scenarios will also be incorporated into the Operational Pollution Emergency Response Plan, including procedures for containment, recovery and remediation following a spill.

Residual Impact. With the embedded containment and drainage infrastructure and implementation of the operational inspection, maintenance and spill-response regime, the residual significance of **SG004 is assessed as Low**.

WH011 – Occupational Health and Safety

Impact. Locomotive and wagon servicing activities expose operational personnel to potentially serious occupational hazards, including interaction with heavy rolling stock, lifting operations, fuel and oil handling, work at height, confined-space entry, welding and hot work, compressed-air systems, and electrical or battery servicing.

The credible consequence of inadequate control includes serious injury or fatality. The impact magnitude is therefore assessed as **Moderate**, resulting in **Medium significance** before mitigation.

Mitigation and management response. These activities will be managed through KTZ's OHS management system and site- and task-specific safe systems of work for Yerdaut. Controls will include task-specific risk assessments; permit-to-work systems; lifting plans and certified equipment; isolation and lock-out/tag-out; confined-space entry and rescue procedures; hot-work permits; safe access and fall protection; controls for fuel and chemical handling; appropriately competent and trained personnel; PPE; and routine workplace inspections and audits.

Emergency scenarios associated with the servicing point, including fire, major fuel spills and serious maintenance incidents, will be incorporated into the Operational Emergency Response Plan and tested through periodic drills.

Residual Impact. With effective implementation of KTZ's OHS management arrangements and Yerdaut-specific safe systems of work, the residual significance of **WH011 is assessed as Low**.

WR002 – Operational Water Demand

Water demand. Operational water demand associated with Yerdaut Station and the locomotive servicing facility is assessed under WR002 – Operational Water Demand at Yerdaut in Section 8.4.4.[Water Resources]. The assessment considers the quantified station demand identified in the national EIA, reliance on the existing potable-water network and the requirement to confirm available supply capacity before operation. The residual significance of WR002 is assessed as Low.

8.4.4.8. Severance of irrigation network

AF008 – Operational Severance and Degradation of Irrigation Network Performance

VER and Sensitivity. The relevant VER comprises irrigation infrastructure intersected by or located immediately adjacent to the railway, together with irrigation-water users, agricultural production and rural livelihoods dependent upon the continued functioning of that infrastructure. The southern part of the Project corridor crosses an extensive engineered irrigation and drainage network supporting irrigated agriculture in Zhetysay and Maktaaral districts. The receptor is assessed as **Moderate sensitivity**, consistent with the VER register.

Impact. The national environmental assessment and Project design recognize the extensive irrigation and drainage network crossed by the railway and provide culverts and small bridge structures at these crossings to maintain hydraulic continuity during construction and operation. The feasibility-stage assessment also confirms that crossings with engineering infrastructure form part of the artificial-structures design and that hydrological and hydraulic calculations were undertaken as part of the design process.

Notwithstanding this design provision, there remains a residual operational risk that individual crossings may not fully replicate pre-construction hydraulic performance following completion and reinstatement, or that interaction between the railway embankment and irrigation infrastructure may result in localized changes in flow becoming apparent over time. These could include sediment accumulation, blockage, erosion, altered flow distribution or reduced conveyance capacity, with consequent effects on water availability or agricultural production downstream.

Such effects would be expected to be localized around individual crossing structures rather than affecting the irrigation network as a whole. However, because irrigation is important to agricultural production and rural livelihoods in the southern Project area, failure to identify and correct persistent hydraulic problems could result in recurrent effects for affected water users.

The impact is assessed as **Minor magnitude and Medium significance before mitigation**, consistent with Table 88.

Mitigation and management response. KTZ will incorporate the operational performance of irrigation and drainage infrastructure intersected by the railway into its inspection and maintenance program. Inspections will identify evidence of impaired flow, sediment accumulation, blockage, erosion, structural damage, upstream ponding or other changes potentially attributable to the Project.

Intersected irrigation canals will be inspected **quarterly during the first three years of operation**, reducing to annual inspection thereafter where satisfactory hydraulic performance has been demonstrated. Additional inspections will be undertaken following significant flooding or other events with the potential to affect crossing performance.

The Project GRM will remain accessible to irrigation-water users and adjacent farmers. Complaints or observations concerning changes in water availability, flow, erosion, ponding or agricultural effects potentially associated with railway infrastructure will be investigated and recorded.

Where monitoring or stakeholder complaints identify a Project-related deterioration in hydraulic performance, KTZ will implement appropriate corrective measures. Depending upon the cause and location, these may include clearance of sediment or debris, repair of damaged infrastructure, erosion protection, modification of inlet or outlet arrangements, or retrofit or modification of the affected crossing structure.

Residual Impact. With operational monitoring, maintenance and timely corrective intervention where hydraulic-performance problems are identified, significant long-term effects on irrigation-water users and agricultural production are unlikely. The residual significance of **AF008 is assessed as Low**, consistent with Table 88.

8.4.4.9. Worker Health and Safety and Labour and Working Conditions

Operational activities will require a permanent and shift-based workforce undertaking railway operations, inspection and maintenance, electrical maintenance and emergency-response functions. The national EIA identifies the proposed operational staffing structure and incorporates occupational health and safety, worker welfare and emergency-preparedness provisions. The Supplementary ESIA builds on these national requirements by assessing the principal operational worker health, safety and labour risks, including live-rail maintenance, electrical safety, emergency response, labour and working conditions, and worker accommodation and crew-rest facilities. The individual impacts and associated mitigation measures are assessed below.

WH007 – Worker Injury during Maintenance of Track and Railway Infrastructure

VER and Sensitivity. The relevant VER comprises operational personnel undertaking inspection, repair and maintenance of track, bridges, signalling infrastructure and other railway assets. These workers are assessed as Moderate sensitivity, reflecting their exposure to potentially serious railway-maintenance hazards and their dependence on effective operational controls, competent supervision and safe systems of work.

Impact. Operational inspection and maintenance will expose workers to hazards associated with working on or adjacent to an operational railway, including the risk of being struck by moving trains or maintenance vehicles, falls during work at height, manual-handling and equipment-related injuries, and exposure to fuels, lubricants and other hazardous materials. The national EIA identifies operational railway maintenance and technical personnel and includes occupational-safety functions within the proposed staffing structure. It also states that the Project's technical solutions meet applicable sanitary-hygiene, safety and occupational-health requirements. The more specific risks associated with working on an operational railway are addressed through this Supplementary ESIA.

The impact is assessed as Moderate magnitude and High significance before mitigation.

Mitigation and management response. KTZ's occupational health and safety and railway operational-management framework will be supplemented by Project-specific safe systems of work. These will include defined possession and work-authorization arrangements; task-specific risk assessment and permit-to-work procedures; lookout, warning and separation arrangements where work is undertaken without full possession; competence-based training and authorization of maintenance personnel; appropriate supervision; and provision and enforcement of task-appropriate PPE.

The operational H&S management arrangements will also provide for incident and near-miss reporting and investigation, periodic inspection and audit, and tracking of corrective actions to closure. Prior to operation, KTZ will verify that the relevant Project-specific requirements and applicable corrective actions arising from the parallel ESCA and ESMS Audit have been incorporated into the operational management arrangements.

Residual Impact. With effective implementation of these measures, the likelihood of serious worker injury during routine railway maintenance will be substantially reduced. The residual significance of WH007 is assessed as Low.

WH008 – Electrocution during Maintenance of Electrical Systems

VER and Sensitivity. The relevant VER comprises operational electrical and maintenance personnel authorized to inspect, maintain or repair the Project's electrical distribution and associated railway systems. These workers are assessed as Moderate sensitivity, reflecting the potentially fatal consequences of exposure to energized electrical infrastructure.

Impact. The Project includes 10 kV electrical distribution infrastructure and associated transformer installations. The national EIA identifies the 10 kV distribution system and incorporates electrical-safety design provisions including grounding and equipotential bonding. Inspection, maintenance or

repair of this infrastructure could expose workers to electric shock, electrical burns, arc-flash or fatal electrocution where systems are inadequately isolated or safe working procedures are not followed.

The impact is assessed as Moderate magnitude and Medium significance before mitigation, consistent with Table 88. The receptor currently identified for WH008 in Table 88 as local residents should be corrected to operational electrical maintenance personnel, to correspond with the impact being assessed.

Mitigation and management response. Electrical maintenance will be undertaken through Project-specific electrical safe systems of work, including isolation and verification of isolation; lockout/tagout; earthing where required; permit-to-work arrangements; defined competence and authorization requirements; electrical-safety training; appropriately rated and insulated equipment; and task-specific electrical PPE.

These arrangements will be incorporated into the Project's operational OHS management system before relevant maintenance activities commence and periodically reviewed through inspection, incident reporting and audit.

Residual Impact. With effective isolation procedures, competent and authorized personnel and implementation of electrical safe systems of work, the residual significance of WH008 is assessed as Low.

WH009 – Worker Injury or Fatality during Railway Emergencies

VER and Sensitivity. The relevant VER comprises operational railway workers and emergency-response personnel who may be exposed to derailments, collisions, fires, hazardous-material releases or other railway emergencies. These workers are assessed as Moderate sensitivity, reflecting the potentially high-consequence and time-critical nature of emergency-response activities.

Impact. Operational emergencies may include derailments, train collisions, fires and incidents involving dangerous goods. Such events could result in serious injury or fatality to railway workers and emergency responders.

The national EIA recognizes accident and emergency risks and requires compliance with industrial and fire-safety requirements, regular equipment inspection, personnel training and established emergency-response planning. It also provides for emergency warning systems, response equipment, fire protection, first aid and advance planning of personnel actions during emergencies.

The impact is assessed as Moderate magnitude and Medium significance before mitigation.

Mitigation and management response. Building upon the emergency provisions contained in the national EIA, KTZ will implement a Project-specific Operational Emergency Response Plan covering notification and escalation procedures; command and response responsibilities; coordination with external emergency services; first aid and medical response; availability and maintenance of emergency-response equipment; and training and periodic emergency exercises.

Appropriate emergency and pollution-response equipment will be available at strategic locations along the railway, including equipment relevant to incidents affecting the Shardara IBA/KBA crossing. Hazardous-cargo accident scenarios and associated community and environmental controls are assessed separately under HC001.

Residual Impact. With trained personnel, appropriate emergency-response equipment, coordination with external responders and periodic testing of emergency arrangements, the residual significance of WH009 is assessed as Low.

Operational Labour and Working Conditions

VER and Sensitivity. The relevant VER comprises KTZ employees and contractor and subcontractor personnel employed during railway operation. Workers are assessed as Moderate sensitivity,

reflecting their dependence on KTZ and their respective employers for appropriate terms and conditions of employment, working hours, rest, welfare and access to effective grievance mechanisms.

Impact. Operational labour risks may include inconsistent application of labour requirements, inadequate contractor and subcontractor oversight, excessive or poorly managed working hours, insufficient rest and fatigue, discrimination or harassment, and ineffective access to worker grievance mechanisms.

The national EIA identifies both conventional daytime positions and continuously staffed operational activities involving 12-hour shift arrangements. These arrangements do not in themselves indicate excessive working hours or non-compliance, but they demonstrate the importance of appropriate roster, rest-period and fatigue-management arrangements, particularly for safety-critical operational personnel.

The parallel ESCA and ESMS Audit provide the more detailed assessment of KTZ's existing corporate labour-management arrangements. The Supplementary ESIA therefore does not duplicate that assessment but requires relevant findings and corrective actions to be incorporated into the Project's operational arrangements.

Mitigation and management response. KTZ will apply its labour-management framework to the Project in accordance with Kazakhstan labour legislation and applicable lender requirements. Operational arrangements will address documented terms and conditions of employment; working hours, rest and leave; fatigue management for shift-working and safety-critical personnel; contractor and subcontractor labour performance; worker welfare; and prevention of discrimination and harassment.

A dedicated worker GRM will remain accessible to KTZ employees and contracted workers and will allow concerns to be raised confidentially and without retaliation. Prior to operation, KTZ will verify that applicable labour-related corrective actions arising from the ESCA and ESMS Audit have been incorporated into Project operational arrangements and that outstanding Project-specific gaps have been addressed.

Residual Impact. With application of KTZ's labour-management framework, contractor oversight, appropriate working-time and fatigue controls and an effective worker GRM, adverse labour and working-condition effects are expected to be limited and effectively managed.

WH012 – Operational Worker Accommodation and Crew-Rest Facilities

VER and Sensitivity. The relevant VER comprises operational personnel using Project-provided accommodation, locomotive-crew rest facilities or other employer-controlled accommodation and welfare facilities. These workers are assessed as Moderate sensitivity, reflecting their dependence on the employer for the adequacy, safety and management of the facilities provided.

Impact. The national EIA confirms dedicated operational worker-welfare infrastructure, including 10-bed locomotive-crew rest facilities, rather than merely identifying a hypothetical future need for worker accommodation. Inadequate design, maintenance or management of these facilities could affect worker health, safety and welfare through inadequate rest or living space, potable-water supply, sanitation, hygiene, ventilation, heating and lighting, fire and life safety, security or other welfare arrangements.

Where KTZ or its contractors provide broader residential accommodation in addition to the confirmed crew-rest facilities, similar risks would apply according to the nature and duration of occupation.

The impact is assessed as Minor magnitude and Medium significance before mitigation.

Mitigation and management response. Project-provided accommodation and crew-rest facilities will comply with applicable Kazakhstan requirements. Where facilities constitute worker accommodation

within the scope of the IFC/EBRD *Workers' Accommodation: Processes and Standards* guidance, they will also be managed in accordance with the relevant principles of that guidance.

Requirements will address, as applicable to the nature and duration of use, occupancy and rest space; potable-water supply; sanitation and washing facilities; ventilation, heating and lighting; food preparation and storage where provided; hygiene and waste management; fire and life safety; first aid and access to medical services; security and freedom of movement; and appropriate welfare and facility-management arrangements.

KTZ will periodically inspect Project-provided accommodation and crew-rest facilities and correct identified deficiencies. Where facilities are provided or managed by contractors or other third parties on behalf of KTZ, compliance with applicable requirements will form part of contractor oversight. Accommodation- and welfare-related concerns will also be eligible for submission through the operational worker GRM.

Residual Impact. With compliance with applicable national requirements, appropriate worker-accommodation and welfare standards, periodic inspection and access to the worker GRM, the residual significance of WH012 is assessed as Low.

8.4.4.10. Biodiversity

The purpose of this section is to identify and evaluate the long term impacts to biodiversity and ecosystem services associated with the operation of the Project. Once constructed, up to 46 trains are likely to operate daily with associated noise and movement. The railway will also require continual power, regular maintenance and vegetation management, as necessary. As such, the operational impacts to biodiversity could arise from:

- Bird collision with, or electrocution by the overhead distribution wires
- Collision with trains
- Increased noise and movement disturbance from trains and during maintenance
- Pollution of air, water and soil during operation from fuel/cargo spillage and drainage

A. Shardara Reservoir IBA/KBA

Killing/Injury. The two parallel 10 kV OHL present on either side of the embankment though the IBA/KBA do not pose any direct impact to the physical integrity of the site or its habitats, but they represent a collision risk for the constituent birds for which the site is internationally recognized. Large, low-flying species such as raptors, vultures, geese, ducks, swans, and pelicans, which are all confirmed present in large numbers at the Project area are at particular risk when flying between roosting and foraging areas. These species groups generally have either poor front-facing visibility due to the position of their eyes or given their size, poor maneuverability, thus making them particularly susceptible to collision with OHLs. The risk is increased in low light, around dawn and dusk and in poor weather, and at night. The OHLs are present in only a small fraction of the wider IB/KBA (less than 1%) but the field data confirms that the reservoir within a few kilometres of the Project supports many thousands of birds throughout the year. The loss of which, could affect the diversity or abundance of species using the reservoir. The magnitude is assessed as high with long-term, irreversible mortality.

Pollution (impact TE081). During railway operation, there is an ongoing risk of pollution from locomotive fuel spillage, cargo spillage and drainage from the ballast and track into the reservoir and Syr Darya river. Railway operations represent a low-probability but potentially high-consequence pollution risk, particularly given the proximity of the track to the reservoir and its international importance. The magnitude is assessed as moderate, high in its consequence if a large spillage events were to occur, but with low-to-moderate probability under normal operational conditions and managed through standard railway procedures.

Disturbance. Operational train movements, including noise, the sounding of horns, and idling at passing loops on the IBA embankment section, will result in a long-term, low-level disturbance footprint within the IBA. Some trains may remain idle for up to 45 minutes. In contrast to construction, operational disturbance is typically intermittent, limited in spatial extent relative to the total IBA, and at lower absolute noise levels. The acoustic impacts of railways are relatively well studied. Noise attenuates at approximately 3 dB as the distance away from the source doubles with habitat, ground conditions and weather potentially increasing the reductions up to 5–6 dB as the distance doubles. In practical terms, this means that at 200 m from the active trackside, noise levels are typically 10 to 15 dB lower than at the source (including the initial 25 m), which is equal to a reduction of approximately 68–82% or the noise. Visual disturbance from train movements and associated artificial lighting at night follows a similar reduction pattern with ecologically relevant thresholds for most bird species being between 200 and 300 m from the alignment (Reijnen et al., 1995; Lucas et al., 2017). Research on waterbird and raptor responses to railway infrastructure consistently demonstrates that behavioural disturbance, including alert posture, flushing, and habitat avoidance, is concentrated within a relatively narrow corridor adjacent to the alignment. Reijnen et al. (1995) documented significant reductions in breeding bird density within approximately 100 to 300 m of trafficked linear infrastructure, with effects declining sharply beyond this zone. Lucas et al. (2017), similarly evidenced that the majority of documented avoidance responses occur within 200 to 500 m from active railways.

Research on waterbird responses to railway disturbance also suggests that habituation over time is likely for most species (Lucas et al., 2017), although certain sensitive species, particularly the internationally important wintering waterbird assemblage and migratory raptors, may exhibit persistent avoidance of the immediate embankment corridor. If 250 m is taken as an average distance from the Project alignment for disturbance impacts to dissipate, it is reasonable to estimate that c.800 ha of the reservoir will be indirectly impacted by noise, light and movement disturbance (i.e. 250 m either side of the alignment for 16 km).

The magnitude of this impact is therefore assessed as low to moderate, permanent in duration, infrequent to frequent in occurrence depending on the final train timetable, and local to sub-regional in spatial extent. Critically, the available evidence supports the conclusion that operational disturbance impacts, whilst adverse and long-term, will be substantially attenuated beyond approximately 200 to 300 m from the alignment, thereby limiting their effective footprint to a narrow corridor within the wider IBA/KBA.

Hazardous Cargo Derailment. A distinct and higher-consequence pollution scenario arises from the designation of the Darbaza–Maktaaral line as the primary freight corridor for dangerous goods under the RID/COTIF framework, including chemicals and mineral-chemical fertilizers (Section 2.16.1). Unlike comparable rail infrastructure such as the Almaty Bypass, the Project is not subject to a dangerous goods exclusion. Trains carrying these cargoes will transit the approximately 16 km embankment section within the Shardara Reservoir IBA/KBA, including the 500 m Syr Darya bridge crossing.

A derailment involving a wagon carrying liquid chemicals or bulk fertilizer at or near the bridge or embankment section represents a low-probability but very high-consequence event. The potential consequences include: acute chemical contamination of the Syr Darya channel and the Shardara Reservoir; acute toxicity to waterbird and fish populations, including Critical Habitat-triggering species (Dalmatian Pelican, Syr-Darya Shovelnose Sturgeon); contamination of the reservoir's fishery, which supports approximately 6,000 tonnes of annual fish production and drinking water for approximately 32,000 people in Shardara city; and potential transboundary water quality impacts in the Syr Darya downstream of the reservoir, noting the hydraulic connectivity to the Aydar-Arnasay Lakes System (Ramsar Site No. 1841, Uzbekistan). The magnitude of this impact is assessed as high in consequence, low in probability under normal operating conditions, regional to international in extent if realised, and long-term to permanent in duration for affected biodiversity values. Pre-mitigation significance is assessed as **High** against the IBA/KBA and Critical Habitat receptors.

Mitigation comprises a Hazardous Cargo Incident Response Procedure (HCIRP), prepared as a standalone annex to the Operational Emergency Response Plan (ESMP entry O-BIO-02), addressing: wagon-level dangerous goods inventory and hazard data sheets accessible to response teams at all times; pre-positioned chemical spill containment, absorption and neutralisation equipment at Yerdaut Station, Promezhutochnaya Station and at the southern end of the IBA/KBA embankment; a defined notification chain covering Kazsushar, the Ministry of Emergency Situations, Kazhydromet and the Basin Water Organisation Syr Darya; joint-response exercises with those authorities before commencement of commercial operations and annually thereafter; speed restrictions for trains carrying Class 1–8 dangerous goods through the IBA/KBA section during periods of low visibility or adverse weather; and cross-border notification procedures for the relevant Uzbek downstream authorities, consistent with Kazakhstan's obligations under the Espoo Convention and the 1992 ICWC transboundary water management agreement, in the event of a spill with potential to reach downstream reaches of the Syr Darya below Shardara.

Residual significance following implementation of the HCIRP is assessed as **Medium**. The consequence of a realised event remains severe, but the probability under the committed mitigation regime is substantially reduced and the pre-positioned response capability limits duration and spatial extent of contamination.

Disturbance. Operational train movements, including noise, the sounding of horns, and idling at passing loops on the IBA embankment section, will result in a long-term, low-level disturbance footprint within the IBA. Some trains may remain idle for up to 45 minutes. In contrast to construction, operational disturbance is typically intermittent, limited in spatial extent relative to the total IBA, and at lower absolute noise levels. The acoustic impacts of railways are relatively well studied. Noise attenuates at approximately 3 dB as the distance away from the source doubles with habitat, ground conditions and weather potentially increasing the reductions up to 5–6 dB as the distance doubles. In practical terms, this means that at 200 m from the active trackside, noise levels are typically 10 to 15 dB lower than at the source (including the initial 25 m), which is equal to a reduction of approximately 68–82% or the noise. Visual disturbance from train movements and associated artificial lighting at night follows a similar reduction pattern with ecologically relevant thresholds for most bird species being between 200 and 300 m from the alignment (Reijnen et al., 1995; Lucas et al., 2017). Research on waterbird and raptor responses to railway infrastructure consistently demonstrates that behavioural disturbance, including alert posture, flushing, and habitat avoidance, is concentrated within a relatively narrow corridor adjacent to the alignment. Reijnen et al. (1995) documented significant reductions in breeding bird density within approximately 100 to 300 m of trafficked linear infrastructure, with effects declining sharply beyond this zone. Lucas et al. (2017), similarly evidenced that the majority of documented avoidance responses occur within 200 to 500 m from active railways.

Research on waterbird responses to railway disturbance also suggests that habituation over time is likely for most species (Lucas et al., 2017), although certain sensitive species, particularly the internationally important wintering waterbird assemblage and migratory raptors, may exhibit persistent avoidance of the immediate embankment corridor. If 250 m is taken as an average distance from the Project alignment for disturbance impacts to dissipate, it is reasonable to estimate that c.800 ha of the reservoir will be indirectly impacted by noise, light and movement disturbance (i.e. 250 m either side of the alignment for 16 km).

The magnitude of this impact is therefore assessed as low to moderate, permanent in duration, infrequent to frequent in occurrence depending on the final train timetable, and local to sub-regional in spatial extent. Critically, the available evidence supports the conclusion that operational disturbance impacts, whilst adverse and long-term, will be substantially attenuated beyond approximately 200 to 300 m from the alignment, thereby limiting their effective footprint to a narrow corridor within the wider IBA/KBA.

Mitigation for Shardara Reservoir. Given the international significance of the IBA/KBA and the abundance of birds in and near the Project throughout the year, all mitigation necessary to avoid and reduce impacts to birds, particularly collision and electrocution risks, will be designed and implemented in accordance with Good International Practices (GIP). Relevant GIP includes Preventing Electrocution Risks for Birds on Distributions Lines (IFC and EBRD, 2026), Conservation of Migratory Species Guidelines on How to Avoid or Mitigate Impact of Electricity Power Grids on Migratory Birds, the BirdLife International's guidance (particularly on marking overhead wires and insulating energised infrastructures), and the Post-Construction Bird and Bat Mitigation Monitoring for Onshore Wind Energy Fatalities in Emerging Market Counties. The minimum mitigation will comprise:

- Professional-grade bird flight diverters (BFDs) will be installed on all overhead cables within the IBA/KBA, plus a minimum of one additional 1km to the north and 1 km to the south of the IBA/KBA as a buffer. All BFDs must be approved by the lenders before procurement and installation. The BFDs will be sourced from a reputable manufacturer (e.g. to the standard of Powerline Sentry or equivalent), be designed and built to endure in situ for at least 25 years, be appropriately sized to the wire diameter for permanent retention, and will incorporate high-contrast light- and dark-coloured surfaces, reflective elements, and phosphorescent components for nocturnal visibility. In the IBA/KBA, the BFD's will be spaced every 5 m along the full length of all overhead cables
- All energised pole-top and any gantry infrastructure will be designed to good-practice bird-safe standards. This will comprise a minimum horizontal clearance of 1.5 m and a minimum vertical clearance of 0.6 m between energised parts, all exposed and live parts will be insulated. If any retrofitting is required perch deterrents will be installed
- All operational lighting within the IBA/KBA and a 1 km buffer to the north and south, will comprise directional, downward-facing, warm-spectrum LEDs. All lights must also have full cut-off shielding to minimise the attraction of night-migrant birds and likely disorientation. No upward-facing or open-spectrum floodlighting will be used in or near the IBA/KBA
- Vantage-point monitoring at pre-selected locations along the embankment will continue for a at least three years post-construction and will be repeated every five years for the operational life of the railway. Survey data will be used to improve and refine the BFD specification and spacing and identify emerging mortality hotspots and inform adaptive management
- Post-Construction Fatality Monitoring (PCFM) will be completed in accordance with the EBRD/IFC/KFW 2023 PCFM handbook for at least the first three years post-construction. PCFM will comprise at least four surveys per month along the entire embankment alignment, east and west during the key migratory months (March and April and again in September and October). Survey frequency will reduce to 2 surveys per month in all other months. Searcher efficiency and scavenger removal trials will be applied to derive corrected mortality estimates
- If operational monitoring identifies mortality of a globally threatened species (Endangered or Critically Endangered IUCN status), or collision events persist, adaptive management will be used and additional or amended mitigation measures will be deployed within 90 days. Such measures may include increased BFD density or the use of different specification BFDs
- Within the Shardara IBA/KBA, an appropriate operational speed restriction will be established in consultation with KTZ's operational and railway safety functions, taking account of biodiversity risk and operational safety requirements. The agreed restriction and associated signage and operating procedures will be incorporated into the Operational ESMP.

- The strict prohibition of all activities that could result in the pollution of any open water, including but not limited to, the restriction of any refueling, cleaning, discharge of waste or use of chemicals along the embankment within the reservoir or within 50 m of any river
- Pollution Emergency Response Plan will be developed and implemented throughout the IBA/KBA, with pre-positioned spill response equipment near watercourses

The commitment to BFD also ensures that the Project is legally compliant with national requirements. Article 246 of the Environmental Code of Kazakhstan states that, when locating, designing, constructing, operating, repairing o upgrading electrical power networks, measures must be developed and implemented to prevent the death of birds and other wild animals, and to preserve habitats, breeding conditions, migration and concentration sites. The subsequent, long-term monitoring of the BFDs is also required under Kazak law as operations are required to inspect networks regularly and where necessary take measures to reduce negative effects on birds.

Residual Impact. Despite the implementation of the mitigation measures set out above, there remains a residual collision and mortality risk to the bird assemblages and species for which the IBA/KBA is recognized. Published evidence from Conservation Evidence (conservationevidence.com) and peer-reviewed literature indicates that bird-flight diverters reduce collision rates by 50–70% when correctly installed on overhead lines (Barrientos *et al.* 2012; Jenkins *et al*. 2010; Janss 2000). Despite this reduction, a residual risk therefore remains, particularly for large-bodied, low-flight-altitude species such as ducks, geese, pelicans and vultures. Therefore, despite the mitigation, residual adverse impacts remain and additional, off-site, biodiversity offset commitments are required**.** The offset actions will be designed in consultation with relevant stakeholders and align with existing IBA and KBA management priorities. Indicative actions are introduced in the Project's Preliminary BAP (see Appendices) and include habitat management and restoration, the retrofitting of local distribution and transmission lines with BFD's to further reduce the risk of collision in the wider landscape, and the provision of surveying resources to improve the collection of data and our understanding of IBA/KBA.

The successful implementation of the final BAP must achieve measurable biodiversity gains for the IBA/KBA and its constituent bird species in perpetuity. This will require long-term leadership and support by KTZ, community engagement and enduring and sustainable funding for decades to come. At this stage, it is possible that the residual impacts can be offset and the Project achieves NNL for the Shardara Reservoir IBA/KBA. Further assessment and the development of the full BAP is required.

B. Natural Habitat

Pollution. During the operation of the railway there will be an ongoing risk of low-level pollution from fuel and cargo spillage that could affect the retrained Natural Habitat adjacent to the embankment, including any reinstated wetland and riparian vegetation. The probability of significant pollution events under routine operations is low, but the consequences for Natural Habitat water quality and wetland function could be significant if a major spill event were to coincide with ecologically sensitive conditions. The magnitude is moderate, large in terms of its potential ecological consequences, low in probability, local in its extent, short-term to medium-term duration if promptly remediated.

Mitigation for natural habitat. Mitigation with respect to the potential impacts on Natural Habitat during operation include:

The development and implementation of a Pollution Emergency Response Plan specific to the reservoir, with pre-positioned spill response equipment at strategic locations, designated response protocols, and coordination with the national water management authority.

Residual impacts. Residual impacts are assessed as low significance following implementation of a Pollution Emergency Response Plan, and continued monitoring of habitat condition within the IBA crossing zone.

C. Birds

Dalmatian Pelican

Killing/Injury. Dalmatian pelican, a species for which the reservoir is Critical Habitat, is a large-wingspan species with documented susceptibility to collision with power lines. The two parallel 10 kV OHLs represent a collision risk, particularly at locations where the line crosses the reservoir foreshore and adjacent open water regularly used by pelicans. The magnitude is assessed as high in terms of size (large birds, poor manoeuvrability), long-term duration, and irreversibility, but moderate probability as not all crossing events result in collision.

Disturbance. Long-term, low-level operational disturbance from train movements is expected to result in a persistent low level of avoidance by pelicans from near the embankment and thus reduced use of foraging areas near it. Given the total area of the reservoir available to pelicans and the likelihood of habituation over time, the magnitude is assessed as low.

Mitigation for Dalmatian Pelican. Mitigation for the dalmatian pelican comprises the same measures introduced for the Shardara Reservoir IBA/KBA. Permanent installation of BFDs every 5 m on all OHLs within the IBA/KBA and 1 km buffer (retained for the full operational life of the line), together with Post-Construction Fatality Monitoring (PCFM) for a minimum of the first 3 years, with the BFD specification and spacing reviewed and, if needed, adjusted on the basis of the PCFM findings.

Residual Impact. As referenced above, the use of BFDs will likely reduce collision risk by 50 to 70% when correctly installed and cannot completely eliminate the risk of collision and therefore mortality of this Critical Habitat trigger species. As part of the BAP, the Project commits to retrofitting BFD's to nearby distribution or transmission lines, which will further reduce the risk of collision in the local areas and thus, achieve theoretical NG. It is GIP to retrofit off-site OHLs with the same distance or number of diverters as those associated with the new risks on site, i.e. BFDs every 5 m for at least c.16 km. The installation of BFDs on site achieves a reduction in the risk of the pelican by 50% if using the precautionary lower estimation, thus the equivalent retrofitting of BFDs nearby reduces risks by another 50% creating a theoretical reduction in risks by 100%. The Project complete further assessments and consult with ACBK, KECOG and other informed stakeholders to identify suitable nearby OHLs. In addition to the PCFM committed to for the IBA/KBA, Long-term monitoring of dalmatian pelican population numbers is also required, as party of the Projects commitment to monitor bird diversity and abundance near the embankment.

In conclusion, it is possible that the residual impacts can be offset and the Project achieve the requisite NG for the Critical Habitat triggering dalmatian pelican. Further assessment and the development of the full BAP is required.

C. Wintering Bird Assemblage

The impacts expected on the wintering bird assemblage are very similar to those summarised for the dalmatian pelican above, the killing and injury from the OHLs, particular on large species with poor eye-sight or maneuverability, and disturbance associated with train movements and general operations. The magnitude associated with direct mortality and harm is assessed as high in terms of potential flock-scale collision events, with long-term, irreversible mortality. However, given the size of the reservoir and the documented tolerance of some species to operational railway noise (cf. the February 2026 survey observations), disturbance is less likely to result in significant population level effects but may reduce the attractiveness and value of the local wintering habitat available to the assemblage.

Mitigation for wintering bird assemblage. Mitigation for the winter bird assemblage comprises the same measures introduced for the Shardara Reservoir IBA/KBA and dalmatian pelican, e.g. BFDs every 5 m on all OHLs and PCFM for at least 3 years.

Residual Impact. The use of BFDs and other requisite mitigation cannot eliminate the risk of collision or injury completely and residual impacts remain. Additional conservation actions are thus required and will be developed and implemented through the BAP. At this stage, it is likely that the additional measures introduced for the Shardara Reservoir IBA/KBA and dalmatian pelican will also directly benefit the wintering bird assemblage, and the residual impacts will be sufficiently reduced to avoid any long-term adverse effects. Further assessment and the development of the full BAP is required.

D. Migratory Bird Assemblage

The impacts expected on the migratory bird assemblage are very similar to those summarised above for the wintering bird assemblages and dalmatian pelican. Migratory birds are particularly at risk of collision and injury as large numbers of birds will likely arrive and leave the reservoir at night when visibility is poor and in large flocks. Night-migrating passerines may also be affected by artificial light from the railway infrastructure. Given the internationally important density of migrants using the IBA crossing zone, this is assessed as a high-magnitude impact.

Mitigation for migratory bird assemblage. Mitigation for the migratory bird assemblage comprises the same measures introduced for the Shardara Reservoir IBA/KBA, dalmatian pelican and wintering bird assemblage, e.g. BFDs every 5 m on all OHLs and PCFM for at least 3 years.

Residual Impact. The residual impacts for migratory birds are the same as those summarised for the wintering bird assemblage. Residual risks remain, additional conservation actions are required, and at this stage, it is likely that the measures introduced in the Preliminary BAP will reduce the residual impacts to a level that is not significant. Further assessment and the development of the full BAP is required.

E. Breeding Bird Assemblage

The impacts expected on the breeding bird assemblage, including the pygmy cormorant the Critical habitat triggering species, are very similar to those summarised for the wintering and migratory bird assemblages and dalmatian pelican. Breeding birds flying between colony and foraging areas across the reservoir are susceptible to collison with the new OHLs, particularly the pygmy cormorant, glossy ibis and egret species, which are present in very large numbers and regularly commute over the reservoir and its foreshore. Magnitude is assessed as moderate to high.

Mitigation for breeding bird assemblage. Mitigation for the migratory bird assemblage comprises the same measures introduced for the Shardara Reservoir IBA/KBA, dalmatian pelican and wintering and migratory bird assemblages, e.g. BFDs every 5 m on all OHLs and PCFM for at least 3 years.

Residual Impact. The residual impacts for breeding birds are the same as those summarised for the wintering and migratory bird assemblages. Residual risks remain, additional conservation actions are required, and at this stage, it is likely that the measures introduced in the Preliminary BAP will reduce the residual impacts to a level that is not significant. Further assessment and the development of the full BAP is required.

F. Raptor and Vultures

Raptors are among the species most vulnerable to electrocution on OHLs due to their tendency to perch on elevated structures and their large wingspans which bridge live components. This applies particularly to steppe eagle, white-tailed eagle, and the other large raptors the regularly use Project area. Collision OHLs is also a risk during low-altitude flight, particularly in poor visibility conditions. For an assemblage that includes globally Endangered species, steppe eagle and potentially Critically Endangered species Pallas's Fish-eagle, this is assessed as a high-magnitude, significant operational impact.

Mitigation for raptor and vulture assemblage. Mitigation for the migratory bird assemblage comprises the same measures introduced for the Shardara Reservoir IBA/KBA, dalmatian pelican and wintering

and migratory bird assemblages, e.g. BFDs every 5 m on all OHLs and PCFM for at least 3 years. This mitigation is however, restricted to the reservoir area only but raptors and vultures are highly mobile species and will regularly use habitat along the entire Project alignment. The Project has therefore also committed to PCFM for the entire Project alignment for at least one year. While the 2026 fiueld surveys did not identify any high-risk areas, the PCFM will help determine any high risk collision areas outside the reservoir that may require the retrospective fitting of BFD. If required, The same high-quality specification of BFD's as introduced for the IBA/KBA will be installed. Additionally, all poles and OHL infrastructure will be designed to avoid any risks to birds or installed with insultation to eliminate the risk of electrocution.

Residual Impact. With the commitment to PCFM along the entirety of the Project alignment and the agreement to retrospectively fit BFD's to any high risk areas, the residual risk of collision mortality is reduced to low significance.

G. Other Bird Species (Little Bustard, Yellow-eyed Pigeon)

The main operational impact for little bustard is collision mortality with train infrastructure, specifically the new 10 kV OHL. Although a ground-dwelling species, little bustards undertake low display and dispersal flights that could bring it into contact with the new lines. Noise and movement disturbances from regular train movements may also displace little bustard from suitable steppe/desert habitat adjacent to the track. These potential impacts are assessed as a moderate-magnitude, significant operational impact. Yellow-eyed Pigeons are more agile and as a smaller species less susceptible to collision, or electrocution. No material impacts on yellow-eyed pigeons are likely.

Mitigation for migratory bird assemblage. Mitigation introduced for the other bird receptors, particularly the raptors and vultures is directly relevant for all other bird species. No additional mitigation is recommended.

Residual Impact. With the commitment to PCFM along the entirety of the Project alignment and the agreement to retrospectively fit BFD's to any high risk areas, the residual risk of collision mortality is reduced to low significance.

H. Fish

Railway operations introduce a long-term, low-probability risk of fuel, lubricant, and cargo spillage into the Syr Darya and the Shardara Reservoir. Even low-level chronic pollution from railway operations (track drainage, dust suppression) could affect water quality and benthic habitat in the vicinity of the crossing. For the Syr Dara shovelnose sturgeon, for which the river is Critical Habitat, any risk of pollution requires active management. The magnitude is assessed as moderate to high given the species' conservation status, but the probability is low under standard operational management.

Mitigation for fish. The production and implementation of a Pollution Emergency Response Plan specific to the reservoir crossing, with pre-positioned spill response equipment at strategic locations, designated response protocols, and collaboration with the national water management authority is required.

Residual impacts. Residual impacts are assessed as low significance following implementation of a Pollution Emergency Response Plan.

I. Reptiles

Collision with moving trains is the only risk to Central Asian tortoise and the European Glass Lizard as they are relatively slow moving and may cross the rail tracks. The magnitude is assessed as moderate long-term, irreversible, medium probability (dependent on track crossing rate), and local to regional extent. Conversely however, long-term operational noise and vibration from moving trains may

displace and discourage reptiles from the immediate track alignment, which is consistent with similar observations on road infrastructure. The magnitude is low to moderate, local in extent.

Mitigation for reptiles. No mitigation is recommended.

J. Mammals

Collisions represents the only material risk for mammals as they may attempt to cross the track. However, the majority of the alignment is close to managed agricultural land and settlements, implying that mammals, particularly gazelle are unlikely to be frequently present. The noise, vibrational dn movement disturbances associated with operational trains are also likely to discourage mammals from Project alignment. The likelihood of collision with mammals is therefore low and the associated magnitude also low.

Mitigation for mammals. No mitigation is recommended.

K. Invertebrates

Long-term operational spillage and contaminant risks from the railway (fuel, cargo, and ballast drainage) represents a low-probability, potentially significant risk to aquatic invertebrate communities in the Syr Darya river and the reservoir. The magnitude is assessed as moderate for waved pincertail given the species' water quality sensitivity, but low probability under standard operational management.

Mitigation and residual impacts for invertebrates. The implementation of a Pollution Emergency Response Plan will reduce residual risk to low significance.

L. Flora

Impacts to flora during the operational phase of the Project are restricted to term soil contamination from spillage but such risk are very unlikely at any material scale. The magnitude is therefore low for all flora species, especially given the highly localised nature of such soil contamination events.

Mitigation and residual impacts for flora. The implementation of a Pollution Emergency Response Plan will maintain any slight residual risk as low.

M. Ecosystem Services

Long-term operational spillage risk from the railway corridor within and adjacent to the reservoir represents the largest and most likely threat to ecosystem services. A major fuel or chemical spillage event could affect the fishery, water supply quality, and aquatic biodiversity across a substantial area of the reservoir and the Syr Darya river downstream. The probability of such an event is low under standard operational management, but the consequence for internationally significant ecosystem services would be very high. The magnitude is assessed as high, and long-term but reversibility over time.

Mitigation and residual impacts for ecosystem services. The implementation of a Pollution Emergency Response Plan will ensure any such pollution is adequately dealt with and the provisioning and irrigation functions of the river and reservoir are maintained. Any slight residual risk will be maintained as low.

N. Alien Invasive Species (IAS)

Railway operations are a well-documented long-term pathway for spreading of invasive plant species. Seeds and propagules attach to rolling stock and can be deposited along the ballast corridor, spreading to adjacent habitats.

Disturbed ground along the track corridor is particularly susceptible to colonisation by opportunistic invasive species. These risks are however, during the operational phase of the Project unlikely and remain limited in scale and extent.

KTZ shall as part of a wider initiative on the management of trackside vegetation make managers and staff aware of the risk of IAS and take steps to eradicate at an early stage any AIS observed during routine inspections and trackside vegetation management.

8.4.4.11. Hydrology

The permanent railway embankment intersects natural and engineered drainage pathways along the Project corridor, including ephemeral drainage lines, the Syr Darya floodplain and the extensive irrigation and drainage network in the southern Project area. The national EIA confirms that the railway is constructed predominantly on embankment and identifies shallow groundwater and water-saturated ground in parts of the irrigated and floodplain sections. The principal operational hydrological risks relate to alteration of existing surface and shallow groundwater flow patterns by the permanent embankment and the continuing hydraulic performance of culverts and other cross-drainage structures.

HG001 – Alteration of Surface and Shallow Groundwater Flow Patterns

VER and Sensitivity. The relevant VER comprises existing surface-water and shallow groundwater flow patterns along the Project corridor, together with land potentially affected by changes in drainage, ponding or soil-moisture conditions. Sensitivity is greatest in the irrigated southern corridor and Syr Darya floodplain, where the national EIA identifies a dense irrigation and drainage network and areas where groundwater occurs within approximately 2 m of the ground surface. The receptor is assessed as **Moderate sensitivity**, consistent with the VER register.

Impact. The railway is constructed predominantly on embankment. While this provides elevation of the railway formation in flood-prone areas, the permanent embankment also creates a linear barrier across existing surface-water pathways and may locally influence shallow subsurface flow.

Where adequate hydraulic connectivity is not maintained, the embankment could result in localised upstream ponding, changes in drainage patterns or altered soil-moisture conditions on either side of the railway. In areas of shallow groundwater, interaction between the permanent formation and existing shallow flow conditions could similarly contribute to localised waterlogging or drying.

The national EIA confirms that embankment construction is the predominant formation type and specifically identifies shallow groundwater and water-saturated soils in the irrigated and Syr Darya floodplain sections. The potential for localised changes in surface and shallow groundwater conditions as a consequence of the permanent embankment is assessed further through this Supplementary ESIA.

Effects are expected to be localised rather than representing a material alteration of the regional hydrological regime. Where changes in drainage or shallow groundwater affect irrigation infrastructure, agricultural land or water users, the associated agricultural consequences are addressed under AF008 – Operational Severance and Degradation of Irrigation Network Performance.

Mitigation and management response. Maintenance of hydraulic connectivity through the permanent railway formation is the principal mitigation. Culverts, bridges and other drainage structures will be maintained to allow material surface-water pathways to cross the railway and to minimise unacceptable ponding, erosion or changes in drainage conditions.

During operation, KTZ will monitor locations where the embankment intersects significant drainage pathways and areas where shallow groundwater conditions create an elevated risk of ponding or waterlogging. Monitoring will identify persistent ponding, changes in drainage behaviour, waterlogging or drying of adjacent land, erosion and other evidence of Project-related changes in land condition.

The Project GRM will remain accessible to adjacent land users and farmers to report changes in drainage, waterlogging, drying or land condition potentially associated with the railway.

Where monitoring or stakeholder complaints confirm a Project-attributable adverse effect, KTZ will investigate the cause and implement appropriate corrective measures. These may include clearance or improvement of drainage pathways, local drainage works, modification or provision of additional hydraulic openings, erosion protection or other technically appropriate remedial measures. Where a confirmed Project-related impact on agricultural land or livelihood cannot reasonably be remedied through physical measures, compensation will be provided in accordance with the applicable Project land acquisition and livelihood-restoration framework.

Residual Impact. With maintenance of hydraulic connectivity, operational monitoring and timely corrective intervention where Project-related effects are identified, widespread alteration of surface or shallow groundwater flow is not expected. Localised effects may nevertheless occur where the embankment interacts with shallow groundwater or existing drainage pathways. The operational monitoring and corrective measures described above address the continuing effects associated with **HG001**, with the hydraulic performance of individual culverts and drainage structures assessed separately under HG002.

HG002 – Operational Performance of Culverts and Drainage Structures

VER and Sensitivity. The relevant VER comprises surface-water flow pathways crossed by culverts and other drainage structures, together with adjacent land potentially affected by upstream ponding, downstream erosion or changes in drainage performance. This includes natural and ephemeral drainage pathways as well as their interface with the engineered drainage network. The receptor is assessed as **Moderate sensitivity**, consistent with the VER register.

Impact. Culverts and other cross-drainage structures concentrate flows through defined openings in the railway embankment. During operation, sediment, vegetation, debris or structural deterioration could progressively reduce their hydraulic capacity. Restricted capacity could result in upstream ponding or localised flooding, while concentrated discharge at outlets could increase downstream flow velocities and cause erosion or scour.

These effects are most likely to occur following significant runoff or flood events or where inspection and maintenance are inadequate. Failure to incorporate culvert inspection and cleaning into routine railway maintenance could allow otherwise localised hydraulic problems to become recurrent and affect adjacent land.

The impact is assessed as Moderate magnitude and Medium significance before mitigation, consistent with Table 88. Effects specifically involving the performance of irrigation canals and consequences for irrigation-water users and agricultural production are addressed under **AF008** and are not duplicated here.

Mitigation and management response. KTZ will incorporate culverts, bridge drainage openings and other material cross-drainage structures into its routine operational inspection and maintenance programme. Inspections will identify sediment and debris accumulation, vegetation blockage, structural damage, erosion and scour, upstream ponding and other evidence of impaired hydraulic performance.

Structures will be inspected and cleared at appropriate intervals and additionally following significant flooding or other events with the potential to cause blockage, damage or erosion. Identified obstructions will be removed and damaged structures or erosion-protection measures repaired.

Where monitoring identifies recurrent ponding, erosion, scour or inadequate hydraulic performance that cannot be addressed through routine maintenance, KTZ will undertake an engineering review and implement appropriate corrective measures. Depending on the cause and location, these may include modification of inlet or outlet arrangements, additional erosion or scour protection, increased hydraulic capacity or additional relief drainage.

The Project GRM will provide an additional mechanism for adjacent land users to report flooding, ponding, erosion or other drainage problems potentially associated with Project infrastructure.

Residual Impact. With routine inspection and maintenance of cross-drainage structures, additional inspection following significant flood events and timely corrective intervention where hydraulic-performance problems are identified, significant long-term changes in drainage or flood conditions are unlikely. The residual significance of **HG002 is assessed as Low**, consistent with Table 88.

8.4.4.12. Landscape

The Project passes through a predominantly low-relief landscape characterized by long horizons and extensive views, including open steppe and semi-desert landscapes in the northern and central sections, intensively modified agricultural and settlement landscapes farther south, and the locally distinctive Shardara Reservoir margin. Existing roads, transmission lines, irrigation infrastructure, settlements and other development already introduce engineered elements into parts of the landscape. The permanent railway nevertheless introduces a new continuous linear feature comprising the embankment, track infrastructure, bridges, stations and associated facilities. The principal effects are assessed separately as changes in landscape character and changes in views experienced by people within the Project area.

LV001 – Change in Landscape Character

VER and Sensitivity. The relevant VER comprises the landscape character of the Project corridor. Sensitivity varies along the alignment. The intensively cultivated and settled landscapes of Zhetysay and Maktaaral are assessed as **Low to Medium sensitivity**, reflecting their existing modification by agriculture, irrigation infrastructure, roads, utilities and settlements. The more open steppe landscapes in Saryagash, Keles and Shardara districts are assessed as **Medium sensitivity** because of their openness, long horizons and relatively limited built development in some sections. The Shardara Reservoir margin is assessed as **High sensitivity** because of its locally distinctive combination of open water, wetland and steppe landscapes and its association with the internationally important biodiversity values of the reservoir. For the corridor-wide assessment, the landscape VER is assessed as **Medium sensitivity**, while recognizing the higher sensitivity of the Shardara Reservoir section.

Impact. The permanent embankment, bridges and bridge approaches, stations, sidings and associated railway infrastructure introduce a new continuous engineered feature through the landscape. The effect is less pronounced in the intensively modified agricultural and settlement landscapes in the south, where the railway is experienced alongside existing infrastructure. In the open steppe and reservoir-margin sections, the contrast is greater and the embankment and major structures are more prominent against long and relatively uninterrupted horizons.

The alignment and vertical geometry are now substantially fixed and much of the embankment formation has already been constructed or levelled. The principal change in landscape character is therefore largely a realized and permanent Project effect, rather than one that can now be avoided through further alignment optimization.

Taking account of the permanent and continuous nature of the change, its spatial extent and the sensitivity of the landscapes crossed, the impact is assessed as **Major magnitude and Medium significance before mitigation**, consistent with Table 88.

Mitigation and management response. Opportunities for further mitigation are principally associated with the treatment of stations, sidings, bridge approaches and other concentrated permanent facilities, since the alignment, embankment and major structures are now substantially fixed. Where detailed design remains capable of refinement, architectural finishes and materials will use visually recessive and context-appropriate treatments where practicable.

The national EIA already incorporates landscaping within the permanent design. This includes seeded perennial grass at Yerdaut, Intermediate Station, Maktaaral and passing loops Nos. 2 and 5, together with tree planting at Yerdaut and Maktaaral. These commitments will be implemented as part of the permanent facility landscaping.

Additional planting should be targeted to stations, sidings, bridge approaches and other ancillary facilities where it can assist their integration into the surrounding landscape. Continuous screen planting along the open railway alignment is not proposed because this could itself emphasize the railway as an artificial linear feature.

Where additional planting is proposed by the Supplementary ESIA beyond that already specified in the national design, locally appropriate native species, preferably of local genetic stock, should be used where practicable. This requirement should not be presented as an existing national EIA commitment, since the OVOS specifically identifies lime and pyramidal Chinese poplar within the approved landscaping design.

Residual Impact. The permanent railway will remain a substantial linear feature, particularly across the open steppe and Shardara Reservoir sections. Landscaping and appropriate treatment of concentrated permanent facilities can reduce their local prominence but cannot remove the fundamental change in landscape character. The residual significance of **LV001 is assessed as Medium**.

LV002 – Change in Visual Amenity

VER and Sensitivity. The relevant VER comprises people experiencing views of the permanent railway, including residents of settlements and individual properties close to the alignment, people working on agricultural land, users of roads and other transport routes and recreational users of the Shardara Reservoir margin. Residents with sustained views from their homes are assessed as **High sensitivity**, while recreational users of the Shardara Reservoir margin are also relatively sensitive because landscape forms part of their experience. Agricultural workers and travellers are generally of **Low to Medium sensitivity** because their views are more intermittent. For the corridor-wide assessment, visual receptors are assessed as **Medium sensitivity**, while recognizing that individual residential and recreational receptors may have higher sensitivity.

Impact. The permanent embankment, bridges, stations, sidings and associated infrastructure will be visible from surrounding settlements, properties, agricultural land, roads and other locations. Visual effects will be greatest where sensitive receptors are located close to elevated embankments, bridges, stations or other prominent structures and where there is little intervening screening. Effects generally reduce with distance and are less pronounced where the railway is viewed in the context of existing transport, utility, settlement or agricultural infrastructure.

The principal effects concern changes to the everyday views experienced by local communities. The Shardara Reservoir margin represents a locally more sensitive visual environment because of its open character and recreational use. As the principal alignment, embankment and major structures are now substantially fixed, these visual effects are also largely realized permanent outcomes.

The impact is assessed as **Moderate magnitude and Medium significance before mitigation**.

Mitigation and management response. For permanent facilities where detailed design remains capable of refinement, layout, scale, materials and finishes will avoid unnecessary visual prominence and use context-appropriate treatments where practicable.

The landscaping specified in the national EIA will contribute to the integration of stations and other permanent facilities into their surroundings. Where additional targeted planting would provide effective screening for nearby residential receptors, this should be incorporated around stations and ancillary facilities where space and operational requirements permit. Continuous screen planting along the open alignment is not proposed.

Permanent external lighting will be limited to that required for safe railway operation and facility security and designed to minimize unnecessary light spill towards nearby residential receptors and sensitive environmental areas. The national design includes permanent lighting infrastructure, including floodlight masts at Yerdaut. Lighting at the Shardara Reservoir crossing and other biodiversity-sensitive locations will also comply with the applicable biodiversity mitigation requirements.

Remaining architectural, lighting and landscape-design measures will be finalised and implemented before completion of the relevant permanent facilities.

Residual Impact. Some permanent change in views will remain because the principal railway infrastructure cannot practicably be screened across the open landscape. Targeted landscaping, appropriate architectural treatment and control of external lighting can reduce local visual effects but cannot remove the visibility of the railway itself. The residual significance of **LV002 is assessed as Medium**.

8.4.4.13. Access

The Project alignment between Yerdaut and Maktaaral stations incorporates 33 bridges and overpasses and 130 culverts. Cross-corridor connectivity for people and livestock is provided by a combination of dedicated livestock and agricultural underpasses, bridges and larger box culverts. The structures inventory identifies extensive crossing provision along the corridor, including dedicated agricultural and livestock passages and 43 box culverts of at least 2.0 × 2.0 m that are potentially usable by livestock. A further 19 river and watercourse bridges and five road or railway overpasses provide additional, conditional connectivity, while 87 pipe and small culverts serve drainage only. Dedicated livestock provision includes 4 × 2.5 m passages at KM 22.9, KM 42.8 and KM 55.1, where the location and/or dimensions of the crossings have been informed by consultation with affected communities and local authorities.

The wider agricultural access network also includes nine at-grade level crossings identified in the Project level-crossing register as agricultural crossings on roads of local significance. These crossings provide formal cross-corridor access for agricultural users and vehicles and are therefore relevant to the assessment of agricultural connectivity. Their designation as agricultural crossings does not, however, by itself demonstrate their suitability for livestock movements, and they are not included within the inventory of potential livestock-suitable passages assessed below.

Crossing provision is extensive over most of the alignment and livestock-suitable structures are generally available at relatively frequent intervals. However, the adequacy of cross-corridor access cannot be determined from structure spacing alone and depends on the relationship between individual crossings and established livestock movement routes, settlements, grazing areas and water resources, as well as the practical usability of the structures. The Shardara Reservoir crossing represents a distinct section of the alignment where there is no cross-corridor livestock requirement, while south of approximately KM 86 the alignment passes predominantly through irrigated cropland, where the principal connectivity requirements relate to agricultural land and machinery access and continuity of irrigation infrastructure rather than livestock droving.

For sections already constructed, the adequacy of the as-built crossing provision will be verified against actual agricultural and livestock access requirements, with particular attention to locations where affected communities have raised specific access concerns and to longer-spaced reaches where the availability of suitable alternative crossings may result in material diversions. Where this verification identifies a material connectivity deficiency, KTZ and the EPC Contractor will consult with affected users and implement technically and operationally practicable corrective measures. These may include improving access to an existing crossing, adapting a suitable existing structure or, where necessary and technically feasible, providing additional crossing provision. This verification and any required corrective measures will be completed before the start of operations.

There is no universal numerical standard prescribing the spacing of livestock or agricultural crossings along a railway corridor. The adequacy of crossing provision is therefore assessed on a site-specific basis, taking account of the location of settlements and agricultural holdings, established livestock and agricultural movement routes, access to grazing areas and water resources, the availability and distance of alternative crossings, and the dimensions and practical usability of individual structures.

Consultation with affected communities is particularly important in determining crossing adequacy because livestock and agricultural movement routes may not be identifiable from land-use mapping or engineering drawings alone. Consultation undertaken for the Project has identified locations where substantial numbers of livestock regularly cross the alignment to reach pasture and has informed the location and dimensions of crossing structures, including the 4 × 2.5 m livestock passages at KM 22.9, KM 42.8 and KM 55.1.

The spacing of livestock-suitable structures has therefore been used as a screening tool to identify longer-spaced reaches requiring closer consideration, rather than as a prescribed design criterion. A longer interval between crossings does not in itself represent a connectivity deficiency where there is no established cross-corridor movement requirement or where a suitable alternative crossing remains reasonably accessible. Conversely, relatively close spacing does not necessarily demonstrate adequate access if the available structures are poorly located relative to established routes or are unsuitable for practical livestock or agricultural use.

Structure of the analysis - This section assesses the provision of cross-corridor access for people, livestock and agricultural users. The structures inventory is summarized by access function, distinguishing between dedicated livestock and agricultural passages, larger box culverts potentially capable of supporting livestock movement, other major structures providing conditional access, and structures serving drainage functions only. The assessment considers both the physical characteristics of individual structures and their relationship to established livestock and agricultural movement routes identified through consultation.

Inventory of structures - The structures inventory identifies 163 engineered structures along the alignment: 33 bridges and overpasses and 130 culverts. These are summarized by access function in the table below.

Table 90: Cross-corridor structures by access function (whole alignment)

Structure type	Count	Chainage / role
Dedicated cattle underpass	7	KM 0.62, 8.82, 14.06, 22.9, 42.8, 55.1, 76.38 — structures specifically providing livestock access; KM 42.8 is a dual-function drainage/livestock box structure
Dedicated agricultural underpass	5	km 4.93, 19.57, 25.91, 52.36, 71.98 — purpose-built
Road / railway overpass	5	km 2.85, 5.06, 46.31, 62.86, 96.48 — conditional (cattle if driven along road)
River / watercourse bridge	19	incl. major Syr Darya bridge (km 83.55); passage incidental / seasonal
Box culvert ≥ 2.0 × 2.0 m	40	livestock-usable, distributed along the alignment
Pipe / small culvert (< 2 × 2 m)	87	hydraulic only; no cross-corridor permeability
Total	**163**	**33 bridges/overpasses + 130 culverts**

Note: Table 90 summarizes the bridges, overpasses and culverts included in the Project structures inventory. The nine at-grade level crossings identified as agricultural crossings are additional elements of the agricultural access network and are not included in the 163 structures shown in the table. Their contribution to agricultural connectivity is considered in the assessment above; they are not assumed to provide livestock passage unless their practical suitability for livestock movement is confirmed.

Culvert passability - Of the 130 culverts, the larger rectangular box culverts have dimensions that may allow them to provide cross-corridor access for livestock in addition to their drainage function. The structures inventory identifies 43 rectangular box culverts with clear openings of at least 2.0 × 2.0 m, of which three — at KM 22.9, KM 42.8 and KM 55.1 — have a confirmed livestock-access function. The remaining 40 are treated as potentially livestock-usable structures rather than designated livestock passages. The remaining 87 pipe and smaller box culverts, including 1.0 × 1.5 m structures, are considered drainage structures only and are not relied upon for livestock connectivity.

The dimensions of a box culvert alone do not establish that it provides a suitable livestock crossing. Practical usability also depends on factors including the length and internal conditions of the structure, approach gradients, drainage and standing water, ground conditions at the entrances, visibility through the structure and its location relative to established livestock movement routes. This is consistent with feedback received during community consultation, where livestock owners reported that some smaller drainage structures were too narrow, long or dark to provide practical cattle access. Accordingly, box culverts not specifically designated as livestock passages are treated as **potentially livestock-usable structures**, with their contribution to cross-corridor connectivity dependent on their actual condition, location and use.

Major structures — access classification - In addition to the larger box culverts that may be physically capable of accommodating livestock, the Project design identifies structures with a specific livestock or agricultural access function. This includes livestock passages at KM 22.9 and KM 55.1 identified as skotoprogon in the structures register, and the 4 × 2.5 m structure at KM 42.8 for which the livestock-access function is confirmed through KTZ's design correspondence.

Table 91: Dedicated underpasses and conditional crossings

Structure	km	Access function
Bridge + cattle underpass	0.62	Dedicated cattle underpass (see note on labelling)
Bridge + agricultural underpass	4.93	Dedicated agricultural underpass
Railway overpass + cattle underpass	8.82	Dedicated cattle underpass
Bridge + cattle underpass	14.06	Dedicated cattle underpass
Railway overpass + agricultural underpass	19.57	Dedicated agricultural underpass
4.0 x 2.5 box structure	22.9	Designated livestock passage: location / dimensions informed by community consultation
Bridge + agricultural underpass	25.91	Dedicated agricultural underpass
4.0 x 2.5 box structure	42.8	Dual function drainage and livestock passage; livestock function confirmed by KTZ

Structure	km	Access function
Bridge + agricultural underpass	52.36	Dedicated agricultural underpass
4.0 x 2.5 box structure	55.1	Designated livestock passage: location / dimensions informed by community consultation
Bridge + agricultural underpass	71.98	Dedicated agricultural underpass
Tunnel + cattle underpass	76.38	Dedicated cattle underpass (box tunnel)
Road / railway overpasses	2.85, 5.06, 46.31, 62.86, 96.48	Conditional — pedestrians/vehicles; cattle if driven along road
River / watercourse bridges (19)	various	Incidental — passable at low flow; not sanctioned crossings

Note on labelling. The structure at PK 6+17.32 (km 0.62) is recorded in the inventory as a "Bridge + cattle underpass", but the corresponding design drawing is titled "without cattle underpass" — the structure is a railway bridge over a dry valley whose bed is concrete-lined and designated as a cattle pass, with an agricultural vehicle passage alongside, rather than a separate box underpass. Functionally it provides open, all-weather passage; the labelling is to be confirmed at detailed design.

Distribution of potential livestock-access Structures - The Project includes 12 structures specifically designated for livestock or agricultural access, together with 40 additional box culverts of at least 2.0 × 2.0 m that are potentially capable of supporting livestock movement. Together, these provide up to 52 structures that may contribute to livestock connectivity along the alignment. Their distribution is shown in Table 92.

The distribution of these structures has been reviewed as a screening exercise to identify longer-spaced reaches where closer consideration of livestock and agricultural access may be warranted. The spacing between structures does not in itself determine the adequacy of access, which depends on actual livestock and agricultural movement patterns and the practical usability of the available crossings.

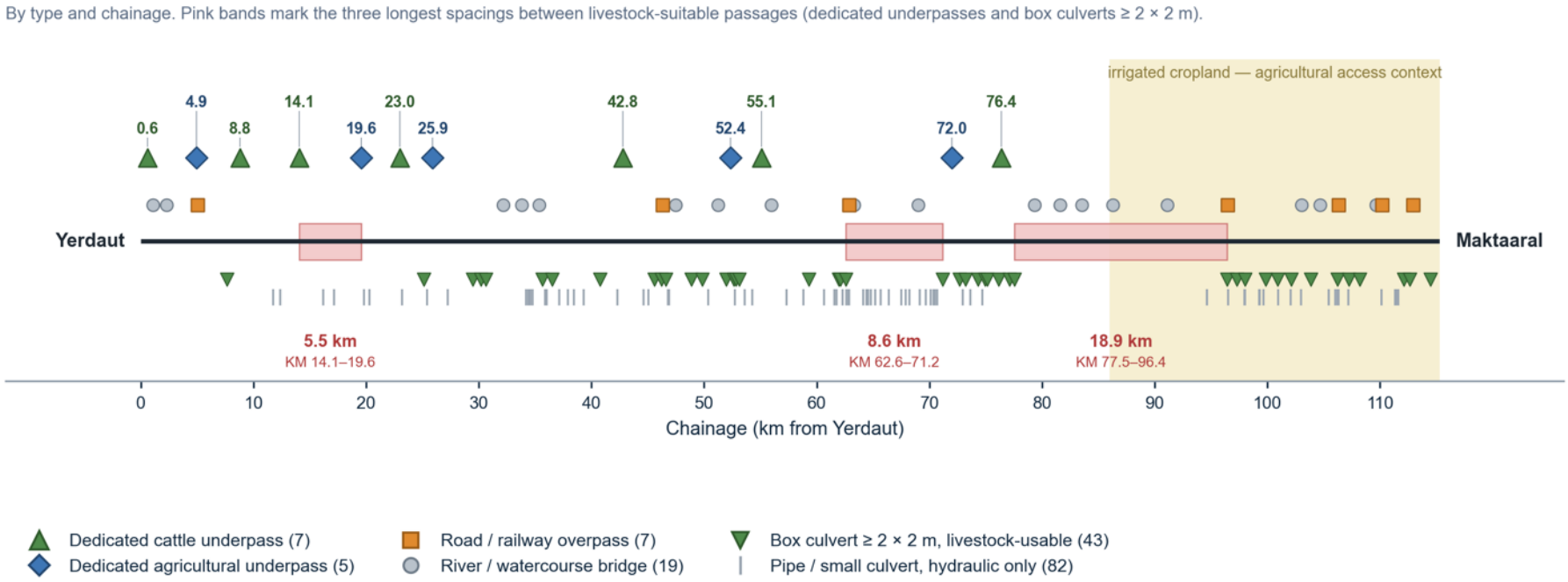
Table 92: Longer-spaced reaches between potential livestock-access structures

Reach (km)	Spacing (km)	Comment
77.5 – 96.5	18.9	Predominantly associated with the Shardara Reservoir crossing and the transition to irrigated agricultural land; not considered indicative in itself of a livestock-access deficiency.
62.6 – 71.2	8.6	Longer-spaced reach requiring verification against actual livestock/agricultural movement requirements and the availability and practical usability of alternative crossings.
14.1 – 19.6	5.5	Bounded by designated livestock and agricultural passages; significance depends on actual cross-corridor movement requirements within the intervening area.

Vista
Environment

Vista Environment

Figure 60: Cross-corridor passage structures along the Darbaza–Maktaaral alignment, by type and chainage. Pink bands mark the largest spacings between livestock-suitable passages.



Vista Environment

Overall assessment

- Cross-corridor provision is extensive, but local adequacy depends on actual access requirements. The Project includes 12 structures specifically designated for livestock or agricultural access, together with 40 additional box culverts of at least 2.0 × 2.0 m that are potentially capable of supporting livestock movement. Together, these provide up to 52 structures that may contribute to livestock connectivity along the alignment. The number and average spacing of structures does not, however, demonstrate that crossings are appropriately located or practically usable relative to established livestock, agricultural and pedestrian movement routes.
- Community consultation has informed crossing provision and identified local access requirements. Consultation with livestock owners, local residents and local authorities identified important livestock routes and access requirements at specific locations and resulted in modifications to crossing provision, including 4 × 2.5 m livestock passages at KM 22.9 and KM 55.1. In the Sattarov/Oshakty area, residents raised concerns regarding the dimensions and practical usability of the culvert at KM 44.6005 for livestock movement. The structures register confirms that this culvert has an opening of only 1.0 × 1.5 m and is therefore not considered suitable for cattle passage. However, the crossing network in this area includes the 4.0 × 2.5 m livestock passage at KM 42.8, approximately 1.80 km from the location raised during consultation, and the railway overpass at KM 46.306, approximately 1.71 km away. The crossing network therefore provides potential alternative cross-corridor access approximately 1.7 – 1.8 km in either direction from the location raised during consultation. Subject to confirmation that the approaches and connecting routes are practically accessible to livestock users, the issue at this location is therefore expected to represent a localised increase in livestock travel distance rather than loss of cross-corridor access.
- A small number of longer-spaced reaches warrant specific consideration. Screening of the distribution of potential crossings identifies longer intervals at approximately KM 14.1–19.6 and KM 62.6–71.2. These intervals do not in themselves constitute access deficiencies; their significance depends on the presence of established cross-corridor livestock or agricultural movement and the availability and practical usability of alternative crossings. The longer interval associated with the Shardara Reservoir and transition to the southern irrigated agricultural area is not considered indicative in itself of a livestock-access deficiency.
- The southern reach is principally an agricultural-access context. South of approximately KM 86, the alignment runs predominantly through irrigated cropland, where the principal connectivity requirements relate to access to agricultural land, movement of agricultural machinery and continuity of irrigation infrastructure rather than livestock droving.
- Physical dimensions alone do not determine whether a culvert provides effective livestock access. Practical usability depends on the dimensions and length of the structure, drainage and internal conditions, approach gradients and ground conditions, visibility through the structure and its location relative to established livestock routes. This is consistent with community feedback that some smaller drainage structures may be too narrow, long or dark for practical cattle movement.
- Small pipe and box culverts do not provide cross-corridor access. The 87 pipe culverts and box culverts below 2.0 × 2.0 m are considered hydraulic structures only and are not relied upon for livestock connectivity.

In the absence of appropriate crossing provision, the railway could restrict access between settlements, agricultural land and pasture, increase livestock and agricultural journey distances and encourage unsafe crossing or trespass onto the railway. The sensitivity of affected pastoral and agricultural communities is considered Medium to High, particularly where households depend upon regular access to grazing and agricultural land. Given the permanent barrier created by the railway and the potentially substantial consequences at locations where established access routes are severed, the unmitigated impact is assessed as **Major adverse**.

Mitigation Measures - To maintain cross-corridor connectivity to good-practice standards, the Project commits to the following measures, set out in the ESMP:

- Verification of cross-corridor access — for sections already constructed, the adequacy of the as-built crossing provision shall be verified against actual agricultural and livestock access requirements, with particular attention to locations where affected communities have raised specific access concerns and to longer-spaced reaches where the availability of suitable alternative crossings may result in material diversions. Where verification identifies a material connectivity deficiency, KTZ and the EPC Contractor shall consult with affected users and implement technically and operationally practicable corrective measures. These may include improving access to an existing crossing, adapting a suitable existing structure or, where necessary and technically feasible, providing additional crossing provision. This verification and any required corrective measures shall be completed before the start of operations. (ESMP C-SEV-01.)
- Livestock-pass usability — structures designated for livestock passage shall be maintained in a condition suitable for their intended use, including appropriate drainage, safe and stable approaches, unobstructed access and adequate visibility through the structure. Where site-specific conditions such as structure length or limited natural light could discourage livestock use, appropriate measures, including lighting where necessary, shall be incorporated. (ESMP D-SEV-02.)
- Agricultural-access and irrigation continuity (southern reach) — in the irrigated-cropland reach south of ~km 86, maintenance of field and machinery access across the corridor and continuity of irrigation canals and aryks at all crossings. (ESMP D-AGR-01 / D-AGR-02.)
- Passage-use monitoring — during the initial operational period, KTZ shall verify the practical effectiveness of designated livestock and agricultural crossings through inspections, review of access-related grievances and, where appropriate, consultation with affected users. Where monitoring identifies a material Project-related access deficiency, appropriate corrective measures shall be implemented, consistent with the approach established under C-SEV-01. (ESMP O-SEV-01.)

Residual Impact. The Project incorporates extensive cross-corridor provision, including designated livestock and agricultural passages, larger box culverts potentially capable of supporting livestock movement, and road, railway and watercourse crossings. Community consultation has informed the design at locations where significant livestock movements and pasture-access requirements have been identified. With verification of the as-built crossing arrangements before operation and implementation of technically practicable corrective measures where a material access deficiency is identified, reasonable agricultural and livestock connectivity is expected to be maintained across the alignment. Some localized increases in journey distance may remain. The residual impact is therefore assessed as Minor adverse, reducing to Negligible in sections where existing crossing provision maintains established access without material diversion.

8.4.4.14. Water Resources

Operational water demand will arise principally at the main staffed Project facilities, particularly Maktaaral Station and the Yerdaut servicing facility. The national EIA provides quantified design demands and identifies existing potable-water networks as the intended principal sources of supply. The feasibility-stage EIA similarly envisaged use of existing water-supply systems at Yerdaut, Maktaaral and Zhetysay, with reinforcement where required. Given the wider water-stress context, the principal issue is therefore not the absence of an identified supply source, but confirmation that the existing networks have sufficient capacity to meet Project demand without materially affecting existing users.

WR001 – Operational Water Demand at Maktaaral

VER and Sensitivity. The relevant VER comprises regional water resources and existing users of the potable-water supply serving Maktaaral. Water is an important resource within the wider Syr Darya basin and the Project will rely on an existing supply system also serving other users. The receptor is assessed as **Moderate sensitivity**, reflecting the regional water-stress context and potential sensitivity of community supply to additional demand.

Impact. Operation of Maktaaral Station, including the cross-border inspection and disinfection facilities, will generate demand for potable and process water.

The national EIA estimates total potable-water demand for Maktaaral Station at approximately 73.4 m^3/day, with a maximum hourly demand of approximately 39.75 m^3/h. When replenishment of fire-water storage is included, maximum demand is approximately 54.8 m^3/h. The design includes potable and fire-water distribution systems, pumping infrastructure and two 400 m^3 fire-water reservoirs. The proposed source for both potable and fire-fighting supply is the existing potable-water network.

The feasibility-stage EIA similarly identified the existing water-supply system as the intended source at Maktaaral, while noting that reinforcement could be required. Neither assessment, however, demonstrates the available capacity and headroom of that network relative to existing demand. The potential impact therefore arises if Project demand reduces the reliability or availability of water supply to existing users, particularly during periods of high demand.

The Project design also incorporates a water-reuse opportunity. The national EIA provides for collection and treatment of stormwater, with an estimated average annual runoff volume of approximately 36,193 m^3/year, followed by storage in a 12,000 m^3 treated-water pond. During the warmer months, treated water is intended to be reused for operational purposes, irrigation of landscaped areas and washing of paved surfaces.

The impact is assessed as **Minor magnitude and Medium significance before mitigation**, consistent with Table 88.

Mitigation and management response. Prior to commissioning, KTZ will confirm that the existing potable-water network has sufficient sustainable capacity to meet the operational demand of Maktaaral Station and the disinfection facilities without materially affecting the reliability or availability of supply to existing users. The assessment will consider the design demand identified in the national EIA, existing network capacity and headroom, seasonal demand conditions and any reinforcement required before operation.

Water-use efficiency will be incorporated into facility operation. Treated water will be reused for suitable non-potable purposes in accordance with the national design, including landscaping, paved-surface washing and other appropriate operational uses. Additional recirculation or reuse of process water will be implemented where technically practicable and compatible with sanitary and biosecurity requirements.

Operational water consumption will be metered and monitored. Where actual demand materially exceeds the design basis, or monitoring identifies pressure on the existing supply network, KTZ will implement additional efficiency, reuse or supply-capacity measures as necessary.

Residual Impact. Subject to confirmation of adequate supply capacity and implementation of the Project's water-efficiency and reuse measures, the additional demand associated with Maktaaral is not expected to materially affect existing water users. The residual significance of **WR001 is assessed as Low**.

WR002 – Operational Water Demand at Yerdaut

VER and Sensitivity. The relevant VER comprises regional water resources and existing users of the potable-water network supplying Yerdaut. As for Maktaaral, the receptor is assessed as **Moderate sensitivity**, taking account of the wider water-stress context and the need to avoid Project demand affecting the reliability or availability of existing supplies.

Impact. Operation of Yerdaut Station and its locomotive servicing and maintenance facilities will require water for worker amenities, station services, maintenance activities and fire protection.

The national EIA provides a station-specific potable-water demand of approximately 48.1 m^3/day, with a maximum hourly demand of approximately 25.75 m^3/h. When replenishment of fire-water storage is included, maximum demand is approximately 57.12 m^3/h. The design incorporates separate potable and fire-water networks, pumping infrastructure and two 800 m^3 fire-water reservoirs.

The national EIA identifies the existing potable-water network as the source for domestic and fire-fighting water supply. This is consistent with the feasibility-stage EIA, which envisaged use of the existing water-supply system at Yerdaut, with reinforcement where necessary.

The principal uncertainty is again the available capacity and headroom of the existing network relative to existing users. The impact would arise if Project water demand contributed to reduced supply reliability or availability, rather than simply from the absolute volume of Project consumption.

The impact is assessed as **Minor magnitude and Medium significance before mitigation**, consistent with Table 88.

Mitigation and management response. Prior to operation, KTZ will confirm that the existing water-supply network has sufficient sustainable capacity to meet Yerdaut's operational demand without materially affecting the reliability or availability of supply to existing users. Where the assessment identifies insufficient capacity, the necessary network reinforcement or alternative supply arrangements will be implemented before the relevant facilities become operational.

Water-efficiency measures will be incorporated into servicing and station activities, including controlled use of water for maintenance and washdown, leak detection and repair, and reuse of treated water where technically appropriate.

Operational consumption will be metered and reviewed against the national EIA design demand. Where actual use materially exceeds the design basis, or monitoring identifies pressure on local supply capacity, KTZ will investigate the cause and implement additional water-efficiency, reuse or supply measures.

Residual Impact. Subject to confirmation of adequate network capacity and implementation of appropriate water-efficiency measures, Yerdaut's operational demand is not expected to materially affect existing water users. The residual significance of **WR002 is assessed as Low**.

8.4.5 Greenhouse Gas Assessment

The National EIA (OVOs) looks at air emissions from construction equipment and from the operating railway, and it gives useful design information for the greenhouse gas work. This includes the use of TE33A diesel locomotives, an operating level of 23 train pairs per day over the approximately 115 km

section between Yerdaut and Maktaaral (at a design speed of 54.8 km/h), and the electricity supply arrangements for the permanent facilities. However, the OVOs does not add these up into a greenhouse gas total measured in CO_2e. The greenhouse gas totals below have therefore been prepared as part of the Supplementary ESIA to meet the lenders' requirements, using the national design figures where they exist and recognized international emission factors and methods for everything else.

The assessment is measured against three lender standards. The IFC Performance Standard 3 (paragraphs 7 and 8) says that where a project's emissions are above 25,000 tonnes of CO_2e per year, the client must measure them each year and identify ways to reduce them. The ADB Safeguard Requirement 1 (Principle 9) requires emissions to be controlled in line with the World Bank Group's environmental guidelines and good practice. The AIIB Standard 1 requires reporting for projects with significant emissions. The assessment also reflects Kazakhstan's commitments under the Paris Agreement, its 2060 carbon-neutrality strategy, and the national emissions trading scheme, under which KTZ already reports its emissions.

Emissions built into materials such as cement, steel and ballast (Scope 3 emissions) are not required by these lender rules and are not included here.

Electricity emission factor - To work out the emissions from the electricity the project buys, the assessment needs to know how much CO_2 is released to make each unit of electricity in Kazakhstan. It uses the International Energy Agency figure of 0.75 tonnes of CO_2 per megawatt-hour (from the IEA 2025 dataset, for the year 2023). This is high because about 70% of Kazakhstan's electricity is made from coal. This is an international dataset figure, not a figure from the OVV, and it should be re-checked against the latest IEA data at the detailed-design stage.

Construction emissions (Scope 1) - During construction, emissions come from the diesel burned by the heavy machines on site, such as excavators, bulldozers, dump trucks, graders, rollers, piling rigs, cranes and concrete plant. The assessment assumes about 350 machines[24] on site.

Using standard international diesel factors and assuming an average engine size of 150 kW, working at half power for six hours a day, the estimated construction emissions are about 38,500 tCO_2e/year (central estimate; the range is 15,800 to 102,400 tCO_2e/year depending on how many machines are used and how hard). This is above the 25,000 tonne level. This is the Supplementary ESIA's own indicative estimate.[25]

These emissions are temporary and stop when construction finishes, expected in December 2026. The Construction Environmental and Social Management Plan requires the contractor to keep machines well maintained, use cleaner equipment where available, stop machines idling, and record fuel use.

Operating emissions from the trains (Scope 1) - The line is not electrified, so the trains run on diesel. The OVV says the Yerdaut to Maktaaral section uses TE33A diesel locomotives, with five main-line locomotives needed for the first stage, based at the Yerdaut depot. The design level of service is 23 train pairs per day (46 train movements), matching the OVV (which, for the 2031 design year, sets out 21 goods trains and 2 local passenger trains in each direction). The emissions are built up as follows.

Distance and journey time. The section is 119.8 km long. The OVV gives running times of 89 minutes from Yerdaut to Maktaaral and 83 minutes on the way back, then adds an allowance for the single-track sections where trains have to wait for each other to pass. With that allowance the journey takes about 2.2 hours each way (an average speed of 54.8 km/h).

[24] Source: ESIA Section 2.8.2 (heavy plant and construction vehicles currently mobilised on site).

[25] The OVV looks at construction plant for ordinary air pollution and requires machinery to be tuned to keep exhaust emissions down, but it does not work out a greenhouse gas figure. This construction estimate is therefore the Supplementary ESIA's own rough calculation, based on an assumed number of machines and how hard they are used.

Locomotive power. One TE33A locomotive produces about 2,462 kW. The calculation assumes each goods train is pulled by two of these joined together (a 2TE33A), giving 4,924 kW. The OVV confirms the TE33A type and that five locomotives are needed, but it does not confirm whether trains use one locomotive or two joined together, so the two-locomotive figure is the Supplementary ESIA's assumption (see the box on the first page).

Fuel per trip. Working at about half power on the loaded run and lower on the empty return, each train burns roughly 1,130 kg of diesel on the way out and 680 kg on the way back. The fuel-use rate used is 210 grams of diesel for each kilowatt-hour of power.[26]

Daily and yearly totals. The 23 train pairs burn about 39,600 kg of diesel a day, or about 14,440 tonnes a year. Each tonne of diesel gives 3.186 tonnes of CO_2, so the operating train emissions are about 46,000 tCO_2e/year (central estimate; range 35,700 to 57,100). All cases are above the 25,000 tonne level, so the review of emission-cutting options is required under IFC Performance Standard 3, paragraph 8.

Operating emissions from electricity (Scope 2)

These emissions come from the electricity the project buys from the regional grid (supplied at 10 kV) to run the signalling and to power the stations, buildings and lighting along the line. Two overhead supply lines serve these needs: an 85.3 km signalling supply line and a 224.1 km line serving the stations and other facilities. Energy-efficient LED lighting is used throughout.

The average electricity demand is estimated at about 1,860 kW[27], or about 16,300 megawatt-hours a year. At the 0.75 factor above, this gives electricity emissions of about 12,200 tCO_2e/year (central estimate; range 9,100 to 16,400).

Electricity use will be metered at each of the three substations, and the real metered figures will replace these estimates in the yearly reports from the first year of operation.

Table 93: Estimated greenhouse gas emissions, Darbaza to Maktaaral Railway

Emissions source	Low	Central	High	Notes
Construction, from diesel machines (per year)	15,800	38,500	102,400	Temporary; stops when construction finishes (about Dec 2026). Shown separately, not added to the operating total (see note below).
Operating trains, from diesel	35,700	46,000	57,100	23 train pairs a day over 119.8 km at 54.8 km/h. Assumes two joined locomotives per goods train (see box, page 1).
Operating electricity, from the grid	9,100	12,200	16,400	About 1,860 kW average demand; about 16,300 MWh a year; grid factor 0.75.

[26]The 210 grams of diesel per kilowatt-hour figure is the mid-point of the published fuel-use range (195 to 220 g/kWh) for the GE 7FDL16 engine fitted to the TE33A locomotive. It is an engine-specification value, not a figure from the OVV.

[27]The 1,860 kW figure is worked out by the Supplementary ESIA; it is not a single number taken from the OVV. It adds the estimated average power used by the signalling supply line (about 850 kW, from 85.3 km of line at roughly 10 kW per km) to the estimated average power used by the stations and other lineside buildings (about 1,010 kW: Yerdaut 350 kW, Maktaaral 400 kW, Promezhutochnaya 120 kW, passing loops 40 kW, and other lineside equipment 100 kW). The OVV confirms this electrical equipment exists but does not give a combined demand figure.

Emissions source	Low	Central	High	Notes
Operating total (trains + electricity)	44,800	58,200	73,500	This is the figure reported against the 25,000 tonne level. Above it in every case, so the review of cutting options is required.

Construction and operating emissions are kept separate and are not added together. Construction emissions are temporary: they happen only while the line is being built and stop when construction finishes. The operating emissions are permanent, because the trains run for the life of the railway. The "operating total" is therefore the figure that matters for the project's long-term reporting against the 25,000 tonne level. Construction is shown because it is also above that level on its own, which is why the building contractor has to manage and report it separately under the Construction Environmental and Social Management Plan.

Options for cutting emissions

Because the operating total of about 58,200 tCO_2e/year is above the 25,000 tonne level, a review of the ways to cut emissions is required. The four main options are:

- Keep locomotives well maintained. KTZ overhauls its engines regularly, which keeps them running efficiently. Well-maintained locomotives use an estimated 3 to 8% less fuel than poorly maintained ones.
- Run trains more efficiently. Cutting out unnecessary movements, long waits at passing loops and engine idling saves fuel. A better timetable and no-idling rules at stops, both committed to in the Operational Environmental and Social Management Plan, help here.
- Replace older locomotives over time. KTZ renews its fleet roughly every 25 to 30 years. Newer engines could use 10 to 20% less fuel than the current ones when the time comes to replace them.
- Electrify the line. Switching from diesel to electric trains would remove the train emissions completely and is the only option that would make a big difference. A design for electrification has been prepared and kept for the future (brochure 747605/2022/1-Э). The problem now is that the regional electricity supplier has said it cannot provide the extra power that electrification would need (letter No. 06-692, 24 February 2023). KTZ has committed to review the case for electrification every five years as the regional network grows.

Comparing rail with road

The railway carries freight that would otherwise travel by road. This section compares the emissions of moving the same freight by rail and by road, to show where the project sits in the wider picture. This is background context prepared by the Supplementary ESIA. It is not an OVV finding, and these figures cannot be subtracted from the project's own emissions total for the lender rules.

The trains give off real CO_2 on every trip. The comparison does not mean the project saves emissions in any absolute sense, and it does not reduce the project's own reported total. It simply shows that rail is a much lower-emission way to move this freight than road.

Each loaded train carries about 4,814 tonnes of freight. Moving the same amount by truck (about 25 tonnes each) would need roughly 2,540 truck-loads a day. Allowing for the fact that some of this freight already moves by rail on the existing Saryagash route rather than by road, about 1,525 loaded truck trips a day are counted. At about 130 km by road, plus the empty return trips, road transport would give off about 334,700 tCO_2e a year. These are the Supplementary ESIA's own comparison figures.

Applying the same share to the updated goods-train emissions gives about 26,500 tCO_2e a year for the freight moved from road. These are real emissions from burning diesel.

Moving this freight by rail gives off about 26,500 tCO_2e a year, against about 334,700 tCO_2e a year by road. For each tonne of freight carried one kilometre, rail gives off about 9 grams of CO_2 against about 85 grams by road, so rail is close to nine times cleaner for this freight on this route.

Table 94: Rail compared with road

	Low	Central	High	Notes
If the same freight went by road	194,700	334,700	553,200	Loaded trucks plus empty returns. Supplementary ESIA comparison figure.
The same freight by rail	13,700	26,500	44,000	Goods-train emissions for the share moved from road. Real diesel emissions.
Difference (road minus rail)	181,000	308,200	509,200	How much more road would give off. Not a saving that can be subtracted from the project total.
Rail emissions per tonne carried 1 km (grams CO2)	~8	~9	~10	Road is about 85 grams, so rail is roughly nine times cleaner.

Overall finding and reporting

The project's operating emissions are assessed as Medium significance under the lender rules. The 25,000 tonne level is clearly passed: the central operating estimate of about 58,200 tCO_2e/year is more than twice the level, and the review of cutting options has been done. Electrification is the only option that would make a big difference, and KTZ has committed to review it every five years. Construction emissions (about 38,500 tCO_2e/year while building work goes on) are also assessed as Medium and drop to zero when construction finishes in December 2026.

The road comparison shows that rail carries this freight at roughly one-ninth the emissions of road, which is a real benefit for the region. It supports the case for the project and is relevant to the ADB and AIIB view of the project's benefits, but it does not change the finding against the 25,000 tonne level or reduce the project's own reported emissions.

KTZ will report the project's emissions every year under the Operational Environmental and Social Management Plan, as part of the six-monthly monitoring report sent to the lenders. Each report will cover: the actual electricity use metered at the three substations; the locomotive fuel use from KTZ's records; the resulting yearly train and electricity totals compared with the estimates here; and progress on the emission-cutting options, including the five-yearly electrification review.

8.4.6 Cumulative Impacts

The Project's environmental and social impacts have been assessed in combination with other existing, planned and reasonably foreseeable future developments in the Turkistan corridor and beyond, in accordance with IFC Performance Standard 1 paragraph 8, AIIB ESS1 paragraph 27, and SPS SR1 Principle 2. The methodology applied is the IFC Good Practice Handbook on Cumulative Impact Assessment and Management (2013), which prescribes a six-step framework: VEC selection, spatial and temporal boundaries, baseline characterization, cumulative-impact prediction, cumulative-impact management, and monitoring.

VEC selection. Five Valued Environmental and Social Components have been selected for cumulative impact assessment on the basis of their sensitivity, their dependence on the affected resources, and their potential to be cumulatively affected (per Section 7 update Cumulative Impact baseline): (a) the Shardara IBA/KBA waterbird assemblage; (b) the Syr Darya hydrological regime; (c) ambient air quality in the Project corridor; (d) community health and safety in the affected districts; and (e) agricultural livelihoods.

Spatial and temporal boundaries. The cumulative AoI is the Turkistan rail corridor (Saryagash–Maktaaral–Tashkent) plus the wider Shardara IBA/KBA plus the Mirzachoel cotton-producing zone extending into Uzbekistan. The temporal AoI is the operational life of the Project (120 years for civil works) with the cumulative assessment focused on the next 20–30 years during which the principal foreseeable future actions are most likely to materialise.

Where baseline data permits, the VEC characterization for each of the five VECs above takes into account the historical trajectory of impact from existing actions (e.g. long-term waterbird count trends at the Shardara Reservoir, historical irrigation development in the Mirzachoel) rather than treating the current baseline as a static, unimpacted reference condition.

Other actions assessed in combination (Table 95 below sets out the status and physical scope of each).

Table 95: Cumulative actions considered (status and physical scope)

Category	Action	Status	Physical scope / interaction
Existing	Arys-Saryagash-Tashkent rail corridor	Operational	Shared corridor; cumulative rail-borne air quality, noise, vibration, biosecurity
Existing	M-32 and regional road network	Operational	Construction traffic, dust, noise, community safety
Existing	Saryagash and Maktaaral border-crossing facilities	Operational	Community health and security
Existing	Shardara HPP and reservoir water-management infrastructure	Operational	Syr Darya hydrological regime; IBA/KBA bird assemblages
Existing	Mirzachoel irrigation network	Operational	Agricultural land take; water resources
Existing	Irrigated cotton production	Ongoing	Agrochemical residues, water quality, soil salinisation
Planned	M-32 and regional road upgrades	Planned, timing tbc	Traffic, air quality
Planned	Saryagash Bypass road project	Planned, timing tbc	Community safety, land take
Planned	Shymkent-Tashkent transport corridor upgrades	Planned, timing tbc	Regional transport emissions
Planned	Kazakhstan irrigation modernization programmes	Planned, timing tbc	Water resources, agricultural livelihoods
Planned	Rail-network expansion (Trans-Caspian Middle Corridor)	Planned, timing tbc	Regional rail traffic and emissions

Future Option	KTZ electrification option	Future option; subject to network capacity and future business-case review	Potential reduction in operational locomotive GHG emissions
Reasonably foreseeable	Darbaza-Maktaaral programme Stages 2 and 3	Not yet committed; see Section 4.6	Potential additional environmental and social effects requiring cumulative consideration with Stage 1
Reasonably foreseeable	Continued urbanization of the Saryagash-Shymkent-Tashkent corridor	Ongoing trend	Community health and safety, land take
Reasonably foreseeable	Continued intensification of irrigated agriculture in the Mirzachoel	Ongoing trend	Water resources, agricultural livelihoods

VEC-by-VEC cumulative impact prediction

a) For the Shardara IBA/KBA waterbird assemblage, the cumulative impact arises from the Project's permanent footprint (approximately 150 ha = 0.15% of the IBA), the existing reservoir-margin disturbance (reservoir operation, fishery, recreational use, Shardara HPP), and any future Stage 2/3 footprint within or adjacent to the IBA. The Project's marginal contribution to cumulative habitat loss within the IBA is small in proportion to the total IBA area but is concentrated in habitats of particular sensitivity (reedbed roosting and feeding areas, mudflat foraging areas). The cumulative impact on Critical Habitat-triggering species (Dalmatian Pelican, Pygmy Cormorant, Syr-Darya Shovelnose Sturgeon) is addressed through the BAP-anchored Net Gain framework with the Project's offset commitments designed to deliver Net Gain at the BAP-defined offset locations and not solely within the Project footprint. Residual cumulative impact on the Shardara IBA/KBA waterbird assemblage is assessed as Medium prior to demonstration of the required biodiversity outcomes. Achievement of No Net Loss for the IBA/KBA and Net Gain for Critical Habitat remains dependent on implementation and long-term verification of the Final BAP and associated offset measures.

b) For the Syr Darya hydrological regime, the cumulative impact arises from the permanent railway embankment and associated bridge and cross-drainage structures within the Shardara/Syr Darya floodplain, in combination with existing reservoir releases and upstream Naryn – Syr Darya Cascade regulation, basin-wide irrigation abstraction across the Mirzachoel, and projected climate-related changes in flow. The Project's marginal contribution is small relative to the existing regulated regime and projected climate-driven flow alteration. Basin-scale cumulative water management is undertaken through the BWO Syr Darya / ICWC framework, while Project-specific hydrological effects are managed through the design, inspection and maintenance measures identified in the hydrology assessment. Residual cumulative impact is Low.

c) For ambient air quality, the cumulative impact arises from construction-phase Project emissions (NOx, PM, CO from plant and HGV traffic), existing road and rail emissions on the M-32 and Arys–Saryagash–Tashkent corridor, agricultural fugitive dust during cotton harvest, and domestic heating emissions in winter. The Project's marginal contribution is concentrated at the six sensitive receptor locations (Maktaaral, Erdaulet, Aktas/Algabas, Küriş/Ushagash, Sarıžylga–Bereke, Şyrıldak–Jabaytöbe) during construction and is mitigated by the IAQM-

aligned Air Quality Management Plan. Residual cumulative impact on ambient air quality at the sensitive receptor locations during construction is Medium; operational cumulative impact is Low.

d) The Project's marginal contribution to construction traffic risk is managed through the Traffic Management Plan. Operational hazardous-cargo risk is managed through the Pollution Emergency Response Plan, applicable KTZ dangerous-goods requirements and Project emergency-response arrangements. Residual cumulative impact is Medium during construction, reflecting concurrent corridor construction and workforce activity, and Low to Medium during operation.

e) For agricultural livelihoods, the cumulative impact arises from Project land take, changes in access and severance, and potential effects on irrigation and drainage infrastructure, in combination with other corridor land requirements, irrigation-modernization programmes, labour-market interactions and projected climate-related drought and water-scarcity pressures. The Project's contribution comprises permanent land take addressed through the LARP and access, irrigation and drainage effects addressed through Project design, construction management, maintenance, monitoring and grievance mechanisms. Wider cumulative effects require coordination with relevant authorities and other infrastructure programmes. Residual cumulative impact is Medium.

Cumulative management measures. (i) Coordination with corridor-level Government and Akimat planning to ensure cross-project alignment on construction-phase traffic, workforce, and biodiversity monitoring; (ii) engagement with the BWO Syr Darya / ICWC transboundary water management regime; (iii) forward-planning conditions for future Stage 2/3 ESIA preparation that take account of Stage 1 baseline and offset frameworks; (iv) inclusion of cumulative impact monitoring metrics in the semi-annual E&S monitoring report to lenders.

8.4.7 Residual Impacts

Residual impacts are those effects expected to remain following implementation of the mitigation and management measures committed through this ESIA. Where the effectiveness or final specification of mitigation remains subject to further assessment, verification or the Final BAP, the residual conclusion is identified as conditional or TBC rather than assuming that the anticipated mitigation outcome has already been achieved. The identified residual significant effects are shown in Table 96.

Table 96: Summary of Material and Conditional Residual Effects

Stage	Impact ID	Residual impact	Residual significance
Design	PG001	Permanent interaction with Shardara IBA/KBA and Critical Habitat	**High**
Design	LV001	Permanent change in landscape character	**Medium**
Design	LV002	Permanent change in visual amenity	**Medium**
Design	CS007	Residual community-safety design risk associated with the public/rail interface	**Medium**
Land Take	TE001	Permanent loss of habitat within the Shardara IBA/KBA	**High**
Land Take	TE006	Permanent loss of habitat used by Dalmatian Pelican within the IBA/KBA	**High**

Stage	Impact ID	Residual impact	Residual significance
Land Take	TE018	Permanent loss of habitat used by the migratory bird assemblage within the IBA/KBA	**High**
Land Take	AF004	Permanent loss of residential, commercial and productive agricultural land	**Medium**
Land Take	TE024, TE028, TE032, TE036, TE040, TE058	Permanent habitat loss affecting other threatened birds, wintering and breeding bird assemblages, other birds of conservation significance and Natural Habitat	**Medium**
Construction	TE002	Temporary habitat loss within the IBA/KBA	**Medium**
Construction	TE003	Residual construction disturbance to wildlife within and adjacent to the IBA/KBA	**Medium**
Construction	TE005	Temporary hydrological fragmentation within the IBA/KBA	**Medium**
Construction	TE008	Temporary hydrological fragmentation affecting habitat used by Dalmatian Pelican	**Medium**
Construction	TE052	Residual disturbance to IUCN-listed fish from bridge and in-channel construction	**High / conditional**
Construction	TE053	Residual water-quality effects on IUCN-listed fish	**Potentially High / conditional**
Construction	TE054	Residual risk of direct injury or mortality to IUCN-listed fish during in-channel works	**Potentially High / conditional**
Construction	TE060	Introduction and spread of invasive alien species	**Medium**
Construction	GHG001	Construction-phase GHG emissions	**Medium**
Construction	NO002	Construction noise at the identified sensitive station-area receptors	**Medium***
Construction	TE080	Residual direct injury/mortality risk to IUCN-listed reptiles	**TBC – Final BAP / mortality verification**
Operations	TE083	Residual Dalmatian Pelican collision risk associated with railway electrical infrastructure	**Potentially High / BAP dependent**
Operations	NO001	Operational railway noise at sensitive receptors	**Medium**
Operations	GHG002	Operational GHG emissions	**Medium**
Operations	CC001	Residual physical climate risk	**Medium**
Operations	HC001	Residual hazardous-cargo accident risk	**Medium**

Stage	Impact ID	Residual impact	Residual significance
Operations	LV001	Permanent landscape-character effect	**Medium**
Operations	LV002	Permanent visual effect	**Medium**

Stage	Impact ID	Residual impact	Residual significance
Design	PG001	Permanent interaction with Shardara IBA/KBA and Critical Habitat	**High**
Design	AF007	Potential embankment effects on shallow groundwater and agricultural drainage	**Medium**
Design	LV001	Permanent change in landscape character	**Medium**
Design	LV002	Permanent change in visual amenity	**Medium**
Design	CS007	Residual community-safety design risk associated with the public/rail interface	**Medium**
Land Take	TE001	Permanent loss of habitat within the Shardara IBA/KBA	**High**
Land Take	TE006	Permanent loss of habitat used by Dalmatian Pelican within the IBA/KBA	**High**
Land Take	TE018	Permanent loss of habitat used by the migratory bird assemblage within the IBA/KBA	**High**
Land Take	AF004	Permanent loss of residential, commercial and productive agricultural land	**Medium**
Land Take	TE024, TE028, TE032, TE036, TE040, TE058	Permanent habitat loss affecting other threatened birds, wintering and breeding bird assemblages, other birds of conservation significance and Natural Habitat	**Medium**
Construction	TE002	Temporary habitat loss within the IBA/KBA	**Medium**
Construction	TE003	Residual construction disturbance to wildlife within and adjacent to the IBA/KBA	**Medium**
Construction	TE005	Temporary hydrological fragmentation within the IBA/KBA	**Medium**
Construction	TE008	Temporary hydrological fragmentation affecting habitat used by Dalmatian Pelican	**Medium**
Construction	TE052	Residual disturbance to IUCN-listed fish from bridge and in-channel construction	**High / conditional**
Construction	TE053	Residual water-quality effects on IUCN-listed fish	**Potentially High / conditional**

Stage	Impact ID	Residual impact	Residual significance
Construction	TE054	Residual risk of direct injury or mortality to IUCN-listed fish during in-channel works	**Potentially High / conditional**
Construction	TE060	Introduction and spread of invasive alien species	**Moderate**
Construction	GHG001	Construction-phase GHG emissions	**Medium**
Construction	NO002	Construction noise at the identified sensitive station-area receptors	**Medium***
Construction	TE080	Residual direct injury/mortality risk to IUCN-listed reptiles	**TBC – Final BAP / mortality verification**
Operations	TE083	Residual Dalmatian Pelican collision risk associated with railway electrical infrastructure	**Potentially High / BAP dependent**
Operations	NO001	Operational railway noise at sensitive receptors	**Medium**
Operations	GHG002	Operational GHG emissions	**Medium**
Operations	CC001	Residual physical climate risk	**Moderate**
Operations	HC001	Residual hazardous-cargo accident risk	**Medium**
Operations	LV001	Permanent landscape-character effect	**Medium**
Operations	LV002	Permanent visual effect	**Medium**

* **NO002:** Medium residual significance applies specifically at the identified Maktaaral/Erdaulet station-area receptors; the general corridor residual is NS.

9. Stakeholder Engagement & Grievance Mechanism

9.1 Public Consultation Requirements & Objectives

ADB, IFC and AIIB all have specific requirements for stakeholder engagement as part of their policies and standards. The requirements are broadly similar and are summarized in the following table.

Table 97: Lender Requirements for Stakeholder Engagement

Aspect	IFC (Performance Standard 1)	ADB (Safeguard Policy Statement, 2009)	AIIB (Environmental and Social Framework, 2020)
Purpose	Identify & manage environmental & social risks; ensure stakeholder input	Ensure project affected people can participate and voice concerns; identify risks	Promote early and ongoing stakeholder engagement; integrate community feedback into project design
Timing	Early, before project decisions	Early, during project preparation; before approval	Early, during project planning; continue throughout lifecycle
Scope of Consultation	All potentially affected communities, especially vulnerable groups	Affected people and key stakeholders, with attention to vulnerable groups	All affected parties, including vulnerable and marginalized populations
Disclosure of Information	Accessible, timely, relevant, in local language	Provide project info in understandable form; timely disclosure	Timely and accessible info; culturally appropriate formats
Inclusiveness	Must consider marginalized, vulnerable groups, gender, cultural norms	Inclusive participation; special measures for vulnerable groups	Inclusive and culturally appropriate; attention to vulnerable groups
Two-Way Communication	Stakeholders can express concerns; responses provided	Encourage feedback and dialogue; integrate into project design	Interactive engagement; two-way feedback loops required
Documentation	Record consultations, concerns, and responses	Document consultation process and outcomes	Record engagement process, concerns raised, and actions taken
Ongoing Engagement	Throughout project lifecycle	Continuous as impacts evolve	Continuous, throughout project lifecycle and adaptive to changes
Grievance Mechanism	Required; fair, transparent, timely	Required; accessible and responsive	Required; transparent, accessible, and timely

Accordingly, the following are the main objectives of the consultations process carried put for the Darbaza–Maktaaral Railway Expansion Project:

- To inform affected communities and other stakeholders about the project — its scope, components, schedule and benefits — in an accessible form and language.
- To explain the project's potential environmental, social, health and safety impacts, both temporary and permanent, together with the proposed mitigation and compensation measures.
- To ascertain the views of affected communities and stakeholders on the project and its impacts, and to obtain their feedback on the proposed design, mitigation and compensation measures.
- To provide a two-way dialogue through which concerns can be raised and responded to, and to ensure that feedback is taken into account in project design and implementation where feasible.
- To raise awareness of the Grievance Redress Mechanism and how it can be accessed.
- To inform affected communities and stakeholders of the next steps and implementation schedule, and of the arrangements for continued consultation and participation.
- To build effective coordination among all stakeholders in support of successful project implementation.

9.2 Public Consultation Completed to Date

9.2.1 Consultation through the National EIA Process

Stakeholder consultation and public disclosure have been undertaken at successive stages of the national EIA process. The process commenced with submission by KTZ of the Application for Planned Activity (No. KZ34RYS00298131) on 10 October 2022. In accordance with the national EIA procedure, the Application for Planned Activity was subject to statutory disclosure and an opportunity for interested government bodies and the public to submit comments and proposals. Such comments and proposals are required to be compiled by the competent environmental authority and taken into account in determining the scope of the EIA.

The Conclusion on Determining the Scope of the Environmental Impact Assessment (No. KZ53VWF00080975) was subsequently issued by the Committee for Environmental Regulation and Control on 18 November 2022. The documentation available for review confirms completion of these procedural stages but does not include the associated protocol of comments and proposals and therefore does not provide information on the number, source or substance of comments received at this stage.

Following determination of the EIA scope, the Report on Possible Impacts was prepared as part of the Project Feasibility Study and progressed through the public-hearing stage of the national EIA process. Following selection of Variant B as the strategic route direction, the proposed alignment was considered through these hearings and subsequently refined in response to the issues raised.

At the public hearing held on 14 April 2023 at Abay village (Keles District), residents of Abay and adjacent settlements raised categorical objections to the proposed alignment, which passed through the Keles River valley close to settlement areas. The Akimat of Keles District tabled an alternative route running approximately north-west of the proposed alignment and roughly 15 km longer overall.

Because the Project's TEO had already been confirmed by Government Resolution and a First Deputy Prime Minister direction, the hearing outcome was escalated by KTZ to national level. At a working meeting chaired by First Deputy Prime Minister R.V. Sklyar, a protocol decision was taken to dispatch officials from the Apparatus of the Government to Keles District to investigate the issue in the field.

A Working Group on the alignment convened on site on 22 April 2023, chaired by Mr E.K. Uskenbayev of the Apparatus of the Government and attended by KTZ, the Oblast Maslikhat and Executive Body, and the designer (Transproekt-K). In response to the concerns raised regarding the proposed alignment, the Working Group instructed Transproekt-K to develop a revised alignment for the affected section in agreement with the Keles District Akimat and instructed KTZ to amend the Project technical assignment accordingly.

The revised alignment was prepared by Transproekt-K and agreed with the Akim of Turkistan Region, the Akimats of Keles and Saryagash districts, and KTZ. It bypasses the Keles River valley between Abay and Kyzylasker villages, with the main route running westwards along the Kuryukkeles River valley. The corrected alignment retained the Project staging structure but increased the total alignment length within Kazakhstan.

Confirmatory public hearings were subsequently held on 20 and 21 July 2023 in four districts of Turkistan Region (Saryagash, Keles, Shardara/Zhetysay and Maktaaral). These hearings formed part of the continuing national EIA process and considered the Project on the basis of the revised alignment. The hearings confirmed the corrected final alignment.

The documentation available for preparation of this Supplementary ESIA identifies the principal issues and outcomes of the 2023 consultation process, including the resulting change to the Project alignment. However, the underlying public-hearing protocols, attendance lists, photographs and detailed information on the composition of participants and accessibility of the consultation venues were not available for review.

9.2.2 Access Specific Design Consultations

As the Project design was further developed, targeted consultation was undertaken with affected communities and rural Akimats regarding livestock and agricultural access across the railway alignment. The documentary record reviewed for this Supplementary ESIA includes meeting minutes, community requests, correspondence from the relevant rural Akimats and formal written responses from KTZ. These consultations formed part of the ongoing Project design and stakeholder-engagement process and are distinguished from the statutory national EIA consultations described above.

On 6 March 2026, an on-site consultation was undertaken in the Shyrildak/Zhabaitobe area with approximately 50 local residents and representatives of the local authorities, KTZ, EPC Contractor, works contractor and Project designer. Residents explained that communal pasture was located on the opposite side of the railway and identified an established livestock route around KM 22.9. The consultation records refer to approximately 800-1,000 cattle and 4,000 smaller livestock and indicate that the smaller crossing then proposed was considered inadequate for the volume of livestock movement. The request was subsequently transmitted formally through the Birtilek rural Akimat, and KTZ confirmed provision of a 4.0 x 2.5 m livestock crossing at KM 22.9.

Consultation and correspondence in the Oshakty/Sattarov area similarly resulted in consideration of additional livestock crossing requirements. A community request for a crossing around KM 43.0 was accommodated through provision of a 4.0 x 2.5 m livestock crossing at KM 42.8. A further request for an additional crossing at KM 44.8 was not accepted on design grounds, with KTZ identifying the KM 42.8 crossing, approximately 2.0 km away, as the alternative crossing point. The practical adequacy and accessibility of this arrangement will be confirmed through the as-built access verification required under Section 8.4.1.

A further on-site consultation was held on 6 March 2026 in relation to the livestock route around KM 55.0-KM 55.1. Residents identified this as an established route to pasture on the opposite side of the railway and reported approximately 800-1,000 cattle using the surrounding grazing area. The design register records a 4 × 2.5 m livestock passage at KM 55.1. However, the signed consultation minutes

of 6 March 2026 indicate that technical constraints may limit the effective clear height to approximately 2 m. The final as-built dimensions and practical suitability of the structure for the livestock movements identified during consultation will therefore be verified before operation.

These records demonstrate that consultation on agricultural and livestock access resulted in specific design responses at several locations. They also demonstrate that crossing adequacy depends on location, dimensions, accessibility and practical usability relative to established livestock and agricultural movement routes. The remaining commitment is therefore to verify the practical adequacy of the completed crossing network before operation and to implement technically and operationally practicable corrective measures where a material connectivity deficiency is identified.

9.2.3 Supplementary ESIA and LARP Consultations

In addition to the national EIA consultations, the ESIA Team completed six community consultation sessions between 19 and 21 May 2026 at locations within the Saryagash, Keles, Zhetysai and Maktaaral districts along the alignment. The aim of the consultations was to present the preliminary findings of this ESIA, the corresponding findings of the LARP, and the grievance redress mechanism applicable to the project, and to invite community feedback. All participants were provided with copies of an environmental project information brochure (ePIB) and the LARP information brochure. The consultations were facilitated by the ESIA and LARP specialist team, with representatives of KTZ and the Lenders (ADB, AIIB and IFC) in attendance where applicable. The schedule, venues and rationale for selection are set out in the table below, followed by a summary of attendance and a detailed account of each consultation event. The consolidated feedback and corresponding responses are recorded in Table 99.

Community feedback gathered through the consultation program has been taken into account in the project design and in this ESIA/ESMP. The principal instances where input has been accommodated, or a specific response committed, are summarized below and cross-referenced to the relevant part of the report; the full record of issues and responses is in Table Table 99.

- *Alignment and livestock movement (Keles district).* Input from the July 2023 alignment-confirmation consultations on movement between and within pasture lands informed adjustments to the alignment in Keles district (Section 4.4).
- *Cross-corridor passage and livestock/agricultural access.* Community concerns have informed the Project crossing design, including provision or modification of livestock passages at KM22.9, KM42.8 and KM55.1. A further request at KM44.8 was declined on design grounds, with the KM42.8 crossing identified as the alternative crossing point. At KM55.1, the design register records a 4.0 x 2.5 m structure, while the signed consultation minutes indicate that technical constraints may limit the effective clear height to approximately 2 m. The adequacy, as-built dimensions and practical accessibility of the completed crossing arrangements will therefore be verified before operation, with technically and operationally practicable corrective measures implemented where a material connectivity deficiency is identified (Section 8.4.1, Agriculture / AF001; ESMP).
- *Construction noise and vibration.* Targeted construction noise and vibration management is committed at the six community locations identified through the technical assessment, including the pre-condition surveys and vibration monitoring sought by residents at Ushagash (Section 8.4.3; ESMP).
- *Air quality.* Operational air quality monitoring at Akuy village has been included in response to community input (Section 8.4.4; Operational ESMP).
- *Irrigation supply and agricultural infrastructure.* Subsequent KTZ records demonstrate that irrigation and drainage structures were systematically identified through the design process and document corrective works at PK259+03.00, where a water-conveyance pipe supplying

agricultural fields was restored and access for irrigation operation and maintenance equipment was reinstated. The remaining requirements are to verify the as-built functionality of relevant irrigation and drainage structures, rectify any Project-related deficiency identified through commissioning, supervision or the GRM, and address any substantiated crop, production or income losses through the applicable LARP provisions. Separate unresolved site-specific matters, including the Atakent LOTOK relocation and any other irrigation grievance not demonstrated to correspond to KM25.9, remain subject to their specific follow-up actions (Section 8.4.1, AF002; LARP; ESMP).

- *Land-area verification.* The request by PAPs at Birlik (Shablan Dildabekov, Zhetysai) for re-survey of the 31 affected irrigated plots has been committed, with written results to PAPs and the local akimat (LARP; Section 8.4.2).
- *Grievance mechanism.* Feedback at Erdauit on the effectiveness of grievance channels has informed strengthening of the GRM, including reinforced awareness measures and a review of response and closure times (Section 9.5).

Where issues require further investigation or detailed design, the specific commitment and the route to resolution are recorded in Table 99 and logged in the Grievance Redress Mechanism for tracking to closure.

Table 98: Schedule and Venues of Community Consultations, 19–21 May 2026

#	Date	District	Time and Venue	Rationale for Venue Selection
1	19 May 2026	Saryagash	14:00 Primary school, Erdauit village, Darbaza rural okrug; 16:30 House of Culture, Ak Ui village, Kurkeles rural okrug	Erdauit is the location of the train station to be constructed and the focus of the most significant LARP and ESIA impacts. Ak Ui is the most populous settlement in Saryagash located close to the railway at a reasonable distance from Erdauit, allowing residents of other Saryagash settlements an opportunity to participate.
2	20 May 2026	Keles	10:00 Local Akimat, Oshaqty settlement, Oshaqty rural okrug; 14:00 Local Akimat, Birlik settlement, Birlik rural okrug	Oshaqty and Birlik are the administrative centres of rural okrugs comprising 13 and 7 settlements respectively, most of which are located near the construction works. Pre-consultation socio-economic surveys indicated that the majority of unresolved issues originated from PAPs in these settlements. The administrative centres also provided the most accessible locations for transport within the affected areas.
3	21 May 2026	Zhetysai and Maktaaral	10:00 Local Akimat, Birlik settlement, Shablan Dildabekov rural okrug (Zhetysai); 14:00 Local Akimat, Atakent town, Atakent and Maktaaral rural okrug	Birlik is the administrative centre of the Shablan Dildabekov rural okrug, which comprises 13 settlements. Atakent is the location of the existing train station to be reconstructed under the project, with associated acquisition of private land. At the time of consultation, only preparatory works were underway in Atakent and the land acquisition process was ongoing.

The schedule was agreed with KTZ, the local authorities and the Lenders approximately two weeks in advance of the consultations. Announcements were made by the local akimats on notice boards in the akimat halls and entrance areas, and through internal WhatsApp group channels used by the rural okrug administrations to communicate with their residents. In addition, the ESIA team contacted previously surveyed PAPs directly through social media and telephone. The akimats and KTZ advised that attendance was likely to be limited because residents were engaged in seasonal field work, women were typically engaged in bazaar activities, and the working-age population commuted daily to Shymkent and other nearby cities. Attendance therefore comprised predominantly PAPs with unresolved issues and elderly retired residents.

Total attendance across the six events was 90 participants: 14 at Erdauit and 18 at Ak Ui (subtotal 32 in Saryagash district, including PAPs principally from Erdauit); 21 at Oshaqty and 18 at Birlik in Keles district (subtotal 39); 16 at Birlik settlement in Zhetysai district; and at least 19 at Atakent in Maktaaral district. Some late arrivals did not record their names and contact details on the attendance sheets. From a gender perspective, there was a pronounced disparity at most events: only one female participant attended at Erdauit and at Ak Ui, three at Birlik (Zhetysai) and five at Atakent. The female E&S specialist of the ESIA team made additional efforts to engage women who declined to attend the public meetings, briefing them separately on the consultation process and seeking their views on E&S impacts and on opportunities for the empowerment of women in the affected areas and in Turkestan oblast more broadly. As a result, three women in Oshaqty, approximately ten women in Zhetysai (a number of whom declined to provide names and contact details) and nine women in Atakent were engaged through this informal channel. The Turkestan oblast is generally considered the most traditional and patriarchal region of Kazakhstan, and it is customary in rural areas for women (other than the elderly or those with specific concerns) to avoid mixed-gender gatherings, including at major community events; this pattern is less pronounced in urban areas, where women appear more empowered in decision-making and other facets of community life.

At each consultation event, the meeting was opened by the local akimat official, who welcomed the audience and introduced the ESIA specialist team and any Lender representatives in attendance. The ESIA team then presented the main purpose of the meeting – namely, the disclosure of the substantially finalized LARP and ESIA documents in accordance with the Lenders' E&S policies, as a precondition for KTZ to access the project loan – followed by an interactive session on the principal E&S impacts and the proposed mitigation measures. Comments, concerns and questions raised during the consultation events were recorded and reviewed by the ESIA and LARP teams. Where relevant, these have informed revisions to the ESIA and associated mitigation measures, the LARP and stakeholder engagement measures; issues requiring individual follow-up are recorded and managed through the applicable grievance mechanism. The detailed accounts of each event, including the principal issues raised and responses provided, are presented below.

Erdauit village, Saryagash district, 19 May 2026. A consultation event was held at the village primary school, attended by 14 residents including project-affected persons from Erdauit and the wider Darbaza rural okrug. Erdauit is the location of the proposed train station and is therefore the focus of the most significant LARP and ESIA impacts within Saryagash district. The principal issues raised by participants related to: (i) construction nuisance from subcontractor activity, with residents reporting dust, noise and concerns over child safety arising from 24-hour working with limited on-site supervision and inadequate enforcement of safety controls; (ii) the effectiveness of the existing grievance redress channels, which residents considered insufficient to secure timely resolution of urgent issues; and (iii) specific unresolved cases requiring individual follow-up, including a PAP who has disputed the valuation of his acquired land and is pursuing the matter through the courts, and a PAP who identified from the Erdauit development masterplan that approximately half of the territory and facilities of her kindergarten would be expropriated under the railway sanitary protection zone, raising concerns over the future viability of the facility.

Akuy village, Saryagash district, 19 May 2026. A consultation event was held at the village house of culture, attended by 18 residents and opened by the Deputy Akim of the village okrug. The event covered the LARP findings, the grievance redress mechanism, and the principal ESIA findings on noise, dust, safety and biodiversity (including the Shardara Reservoir crossing). No project-affected persons were present at this event and participants stated that no significant environmental or social impacts had been observed at the current progress stage of the project. Following a structured prompt to elicit issues of community interest, the following questions and concerns were raised:

- the type of motive power proposed for the railway and, specifically, whether the line could be operated using electric rather than diesel locomotives, with associated questions on the scale and health implications of diesel exhaust emissions;
- the monitoring arrangements for air pollution given the projected throughput of up to 46 trains per day passing populated areas;
- the provision of stock-proof fencing along the alignment to prevent livestock entering the railway corridor and the associated risk of loss of livestock and liability for owners;
- the status of a third station, reported to have been mentioned at earlier consultations, distinct from any onward extension of the line towards Zhetisay; and
- the arrangements for waste segregation during construction and operations and the prevention of soil and water pollution from project waste streams.

Responses to each question were provided at the event by the specialist team. Responses, and the corresponding ESIA references where the issue is addressed in the technical assessment, are recorded in Table 99**Oshakty village okrug and Birlik village, Saryagash district, 20 May 2026.** A site-based consultation was held with residents of settlements within Oshakty village okrug and, separately, with residents of Birlik village. Approximately 20 participants attended each event. In contrast to the Akuy event, residents at both Oshakty and Birlik raised a number of unresolved concerns of which the most prominent were:

- the dimensions and number of agricultural underpasses provided in the current design across Oshakty village okrug. Residents reported that several of the underpasses currently incorporated in the design are sized for drainage purposes (typically 2 × 2 m or smaller) rather than for cattle movement, and are too narrow, too long, and too dark to be used by livestock in practice. Residents reported widespread livestock grazing across the alignment, with common underpasses shared by multiple settlements and used by livestock several times per day. Specific design proposals were tabled by residents, including:
    - a cattle underpass of 4 × 2.5 m at approximately PK 365+09 to serve approximately 400 households in Bereke settlement, in place of the 2 × 2 m structure currently in the design;
    - two cattle underpasses of 4 × 2.5 m at approximately PK 408+09 and at a location between PK 448+00 and PK 449+00 to serve three settlements in the Sattarov area, with an alternative option referred to by residents at PK 428+00 that requires further verification;
- the status of correspondence between local authorities and KTZ on the underpass dimensions, in particular a letter from the local Akimat dated 6 April 2026 to which residents reported a same-day response from KTZ stating that the proposed underpass dimensions could not be accommodated, without supporting reasoning; and
- verbal commitments reportedly made by representatives of KTZ and Turkestan regional authorities ahead of a recent regional summit indicating that design rearrangements would be considered after construction milestones had been met. Residents expressed a clear

preference for written confirmation of design changes prior to the relevant construction activity.

At Birlik village, separate concerns were raised by project-affected persons whose land has been acquired for the project. The principal issues raised were:

- damage to the irrigation network resulting from the project, which has rendered land donated to the project unproductive for two cultivation seasons while rental obligations have continued, with consequent loss of agricultural income;
- the status of a water pipeline previously committed as part of the project mitigation package, which had not been installed at the time of the consultation;
- the height of the embankment in the vicinity of approximately PK 606+00 in relation to the proposed overcrossing for agricultural vehicles and an associated crossing for livestock; and
- a broken concrete (LOTOK) irrigation pipeline in Ushagash settlement, approximately 12 km from Birlik, which has prevented agricultural cultivation, together with reports of vibration-related cracking at one or two houses in Ushagash potentially associated with the project.

Birlik village, Shablan Dildabekov rural okrug, Zhetysai district, 21 May 2026. A consultation event was held at the local akimat, attended by 16 residents from settlements within the Shablan Dildabekov rural okrug (which comprises 13 settlements). The principal issue raised, by both residents and the local authorities, was a lack of confidence among PAPs that the areas of land acquired correspond to the areas stated in the akimat decrees. PAPs requested that geodesists from the contractor or subcontractor attend site and undertake survey measurements on 31 affected irrigated plots located within the Shablan Dildabekov rural okrug boundaries, to verify the acquired areas against the decreed areas. This concern has been logged in the project Grievance Redress Mechanism and will be addressed through a re-survey of the affected plots and a written response to PAPs and the local akimat setting out the survey results.

Atakent town, Maktaaral district, 21 May 2026. A consultation event was held at the local akimat, attended by at least 19 residents from Atakent town and the Atakent and Maktaaral rural okrugs. Atakent is the location of the existing train station to be reconstructed under the project. At the time of the consultation, only preparatory works had commenced and the land acquisition process was ongoing; the land acquisition arrangements are also expected to be revised in connection with the required relocation of the existing concrete (LOTOK) irrigation water channel. Consequently, the number of issues raised was limited and related primarily to land acquisition and compensation arrangements. The issues raised have been logged in the project Grievance Redress Mechanism and will be addressed through the LARP process and the project Community Liaison Officer.

Following the May 2026 consultations, KTZ provided additional design and construction records relevant to the access and irrigation concerns. For agricultural and livestock access, the records include design information, meeting minutes, Akimat correspondence and formal KTZ responses documenting location-specific design responses at KM22.9, KM42.8 and KM55.1 and the decision regarding the additional request at KM44.8. For irrigation, the design register dated 6 April 2026 identifies 79 structures serving irrigation ditches, canals and drainage channels within the first construction phase. Project records also document corrective works at KM25.9, where a water-conveyance pipe supplying agricultural fields was restored and the associated access road was levelled to allow access by irrigation operation and maintenance equipment; completion was reported by the works contractor on 9 September 2026. These records demonstrate that irrigation infrastructure was systematically considered in the design and that at least one construction-related irrigation issue was subject to corrective action. They do not, however, establish the functional status of every irrigation structure or resolve all individual livelihood-loss allegations raised during consultation. Remaining verification requirements are addressed under AF001 and AF002 in Section 8.4.1, while any substantiated crop, production or income losses are addressed through the LARP and Project GRM.

The concerns raised at Erdauit, Oshakty, Birlik (Keles), Ushagash, Birlik (Zhetysai) and Atakent will be addressed as follows. The construction nuisance, child safety and supervisory concerns raised at Erdauit will be addressed through reinforced contractor oversight, dedicated community liaison cover during 24-hour working periods, and a review of the effectiveness of the existing GRM channels in the affected settlements; the individual cases will be progressed through separate investigations under the GRM. The livestock and agricultural access concerns raised in Oshakty village okrug were subsequently reviewed by KTZ and the design team against the crossing provision along this section of the alignment. The final design includes a 4.0 × 2.5 m livestock passage at KM 42.8 in the Sattarov/Oshakty area. The smaller structure at approximately KM 44.6 raised during consultation is not considered suitable for cattle passage; however, alternative cross-corridor access is available through the livestock passage at KM 42.8 and the railway overpass at approximately KM 46.3. The adequacy and practical accessibility of these as-built crossing arrangements will be verified before operations in accordance with the commitments in Section 8.4.1 and the ESMP.

Subsequent clarification provided by KTZ confirms that the irrigation issue raised by participants at Berlik relates to the LOTOK channel located at Ushagash, approximately 12 km from Berlik, and is therefore not a separate irrigation asset or impact. Restoration of the Ushagash channel is underway, with the principal foundation works completed and installation of the channel remaining. At Atakent, relocation of the LOTOK channel has commenced and the associated land-acquisition process is underway. KTZ has confirmed that no formal written irrigation-related complaints have been received. The irrigation concerns recorded during the May 2026 consultations are nevertheless retained in the consultation record and have informed the irrigation-continuity and infrastructure-verification measures incorporated into Section 8.4.1 and the ESMP.

The reported vibration damage at Ushagash will be investigated through the vibration monitoring programme committed under Section 8.4.3, with pre-condition surveys of the affected structures undertaken prior to any further vibration-generating works in proximity. The land-area verification request raised at Birlik (Zhetysai) will be addressed through a geodetic re-survey of the 31 affected irrigated plots, with results communicated in writing to PAPs and the local akimat. The land acquisition and compensation concerns raised at Atakent will be addressed through the ongoing LARP process and reflected in the revised land acquisition arrangements associated with the LOTOK irrigation channel relocation. All concerns recorded in this section have been logged in the project Grievance Redress Mechanism and will be tracked to closure under the GRM procedures described in Section 9. The feedback is summarized as follows:

Table 99: Consultation Summary

#	Location and Date	Comment / Concern Raised	Response and Action	ESIA Reference
1	Akui, Saryagash, 19 May 2026	Type of motive power; possibility of electrifying the line; health effects of diesel emissions	Project uses diesel traction; electrification is not within current project scope but is technically feasible. Operational air quality monitoring committed at representative receptors.	Section 8.4.4 (Air Quality, Noise); Section 2 (Project Description)
2	Akui, Saryagash, 19 May 2026	Monitoring of air pollution given throughput of up to 43 trains per day	Air quality monitoring at representative sensitive receptors committed throughout construction; operational monitoring under the Operational ESMP.	Section 8.4.3 (Air Quality); Section 9.2.11

#	Location and Date	Comment / Concern Raised	Response and Action	ESIA Reference
3	Akui, Saryagash, 19 May 2026	Provision of stock-proof fencing along the alignment to prevent livestock incursion	Stock-proof fencing along the full Right of Way committed; agricultural underpasses to be provided to maintain livestock movement; inspection and maintenance regime to be established by KTZ.	Section 8.4.4 (Agriculture, AF006)
4	Akui, Saryagash, 19 May 2026	Third station within Darbaza–Maktaaral project (as distinct from any onward extension)	To be confirmed against the current project definition; response to be provided to participants.	Section 2 (Project Description)
5	Akui, Saryagash, 19 May 2026	Waste segregation during construction and operations and prevention of soil and water pollution from waste	Construction Waste Management Plan to be prepared by the EPC contractor; waste hierarchy applied; licensed disposal facilities to be used.	Section 8.4.3 (Waste Management, Soils and Geology)
6	Oshakty village okrug, 20 May 2026	Agricultural underpass at KM 36.5 (Bereke): existing 2 × 2 m structure requested to be enlarged to 4 × 2.5 m to allow livestock movement for ~400 households	The request is retained as part of the consultation record. Subsequent KTZ design and consultation records demonstrate that crossing requirements in the wider Oshakty/Sattarov area were reviewed through the design process. The adequacy of the completed/as-built crossing network against actual livestock and agricultural access requirements will be verified before operation; where a material connectivity deficiency is identified, technically and operationally practicable corrective measures will be implemented.	Section 8.4.1 (Agriculture, AF001); Section 9 (GRM)
7	Oshakty village okrug, 20 May 2026	Agricultural underpasses at KM 40.8 and between KM 44.8 and KM 44.9 (Sattarov area): structures of 4 × 2.5 m requested to serve three settlements; alternative at KM 42.8 referenced and to be verified	Subsequent KTZ records confirm that a 4.0 x 2.5 m livestock crossing was provided in the design at KM42.8 following consultation. The request for an additional crossing at KM44.8 was not accepted on design grounds, with KM42.8 identified as the alternative crossing point. The practical	Section 8.4.1 (Agriculture, AF001); Section 9 (GRM)

#	Location and Date	Comment / Concern Raised	Response and Action	ESIA Reference
			accessibility and adequacy of the KM42.8 alternative, together with the wider as-built crossing network, will be verified before operation and corrective measures implemented where a material connectivity deficiency is identified.	
8	Oshakty village okrug, 20 May 2026	Correspondence with local Akimat (letter dated 6 April 2026) on underpass dimensions and concern over the supporting reasoning provided in KTZ's response	The subsequent documentary record includes the relevant Akimat correspondence and formal KTZ responses and confirms the location-specific design decisions adopted following consultation. These outcomes are reflected in the updated AF001 assessment in Section 8.4.1. Remaining action is limited to verification of the practical adequacy of the completed/as-built crossing arrangements and correction of any material connectivity deficiency.	Section 9 (GRM)
9	Birlik village, 20 May 2026	Damage to the irrigation network reportedly resulting in affected agricultural land being unproductive for two cultivation seasons while rental obligations continued, with associated alleged loss of agricultural income.	Subsequent clarification provided by KTZ confirms that the irrigation issue raised at Birlik relates to the LOTOK irrigation channel located at Ushagash, approximately 12 km from Birlik, and does not represent a separate irrigation infrastructure impact. Restoration of the Ushagash channel is underway, with the principal foundation works completed and installation of the channel remaining. KTZ has confirmed that no formal written irrigation-related complaint has been received. Any reported crop, production, income or other economic loss associated with the disruption will be investigated on an asset- and claimant-specific basis through the GRM/LARP process and, where Project-related loss is	LARP; Section 8.4.2 (Land Take)

#	Location and Date	Comment / Concern Raised	Response and Action	ESIA Reference
			substantiated, addressed in accordance with the applicable LARP provisions.	
10	Birlik village, 20 May 2026	Status of a previously-committed water pipeline	The status and location of the water pipeline referred to by participants will be confirmed through the Project CLO/GRM process and checked against the relevant design and construction records. Any outstanding Project commitment will be completed and its functionality verified, with the outcome communicated to the affected users.	LARP
11	Birlik village, 20 May 2026	Embankment height and the overcrossing/livestock crossing arrangement near PK 606+00	Detailed design to be reviewed; written response to be provided to residents.	Section 8.4.1 (Design); Section 9 (GRM)
12	Ushagash settlement, 20 May 2026	Broken concrete (LOTOK) irrigation pipeline; reported vibration-related cracking at 1–2 dwellings	Subsequent clarification provided by KTZ confirms that this LOTOK channel is the same irrigation asset referred to by participants at Birlik and does not represent a separate irrigation impact. Restoration of the Ushagash LOTOK channel is underway, with the principal foundation works completed and installation of the channel remaining. Following completion, irrigation functionality and access required for operation and maintenance will be verified, and any Project-related deficiency identified during completion or commissioning will be rectified. The reported vibration-related cracking at one or two dwellings will be addressed separately through the vibration investigation and monitoring measures committed under Section 8.4.3.	Section 8.4.3 (Noise and Vibration, NO004); Section 8.4.2 (Land Take, AF002)

#	Location and Date	Comment / Concern Raised	Response and Action	ESIA Reference
13	Erdauit, Saryagash, 19 May 2026	Construction nuisance from subcontractor activity (dust, noise) and child safety concerns associated with 24-hour working with limited on-site supervision and enforcement of safety controls	Reinforced contractor oversight committed; community liaison cover during 24-hour working periods; review of subcontractor compliance with the Construction ESMP including dust suppression, noise controls and traffic/safety management at populated areas.	Section 8.4.3 (Air Quality; Noise and Vibration); Section 8.4.4 (Community Health and Safety); Section 9 (ESMP, GRM)
14	Erdauit, Saryagash, 19 May 2026	Effectiveness of existing GRM channels considered insufficient by residents for timely resolution of urgent construction-phase issues	KTZ will provide sufficient resources for effective implementation of the Project GRM, including additional Community Liaison Officer (CLO) capacity where required. CLOs will maintain regular engagement with affected communities, ensure grievances are promptly recorded and investigated, coordinate responses with KTZ and the EPC Contractor, and track grievances through to resolution. Grievances will be acknowledged and responded to within the timeframes established by the Project GRM, with overdue or unresolved cases escalated in accordance with the GRM procedure. GRM performance, including numbers of grievances received, response and resolution times, outstanding cases and recurring issues, will be monitored and reported through the Project E&S monitoring framework.	Section 9 (GRM)
15	Erdauit, Saryagash, 19 May 2026	Individual PAP case (Mr Perneshev): disagreement with land valuation; matter pursued through the courts	Case logged in the GRM for separate investigation; case progressed in parallel with the judicial process; outcome to be reflected in the LARP monitoring framework.	LARP; Section 9 (GRM)

#	Location and Date	Comment / Concern Raised	Response and Action	ESIA Reference
16	Erdauit, Saryagash, 19 May 2026	Individual PAP case: approximately half of the territory and facilities of an existing kindergarten to be expropriated under the railway sanitary protection zone per the Erdauit development masterplan; concern over future viability of the facility	Case logged in the GRM; sanitary protection zone footprint and impacts on the kindergarten to be confirmed against the Erdauit masterplan; reinstatement or relocation options to be considered under the LARP.	LARP; Section 8.4.4 (Community Services and Infrastructure); Section 9 (GRM)
17	Birlik (Shablan Dildabekov), Zhetysai, 21 May 2026	Lack of confidence among PAPs that acquired land areas match the akimat decrees; request that contractor/subcontractor geodesists undertake survey measurements on 31 affected irrigated plots within the Shablan Dildabekov rural okrug	Geodetic re-survey of the 31 affected irrigated plots committed; written response to PAPs and the local akimat setting out the survey results and any required adjustments to the LARP entitlements.	LARP; Section 8.4.2 (Land Take); Section 9 (GRM)
18	Atakent, Maktaaral, 21 May 2026	Land acquisition and compensation arrangements at the existing Atakent train station, including the implications of the required relocation of the existing concrete (LOTOK) irrigation channel	KTZ has confirmed that relocation of the LOTOK irrigation channel associated with the Maktaaral Station works has commenced and is ongoing, with approximately 300 m of excavation remaining. The associated land-acquisition process has also commenced and the relevant regional resolution is pending. The relocation will be completed while maintaining irrigation functionality during the remaining works. Following completion, the functionality of the relocated channel and access required for operation and maintenance will be verified. Associated land-acquisition requirements will be completed in accordance with the LARP and applicable national requirements.	LARP; Section 8.4.2 (Land Take); Section 9 (GRM)

9.2.4 Biodiversity and Critical Habitat Consultations

Biodiversity consultation has been undertaken with conservation organizations, government authorities, academic and scientific institutions, and recognized species specialists. Details are presented in Table 100.

Table 100: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process.

Ref	Organisation / Expert	Type	Date	Purpose
1	Shardara Reservoir Management Authority	Email correspondence and formal letter request - no response	February/March 2026	Reservoir operations, water hydrology aquatic habitat
2	Aral–Syrdarya Basin Inspection (Committee for Water Resources)	Email correspondence and formal letter request - no response	February/March 2026	Water management, basin ecology, fisheries regulation
3	Committee of Forestry and Wildlife (Ministry of Ecology and Natural Resources)	Email and meeting correspondence with Mr Musaliev - Regional Head	March 2026	Protected areas, wildlife regulation, habitat oversight
4	Kazakhstan Fisheries Research and Production Center (KazNIIRKh)	Email correspondence and formal letter request - no response	February/March 2026	Fisheries, aquatic ecology, reservoir fish and Sturgeon
5	RSE Kazhydromet	Email correspondence and formal letter request - no response	February/March 2026	Hydrology, water levels, climate and meteorological data
6	Institute of Geography and Water Security	Email correspondence and formal letter request - no response	February/March 2026	Hydrology, water balance, climate–water interactions
7	Al-Farabi Kazakh National University – Department of Zoology	Email correspondence - no response	February/March 2026	Herpetology, specifically desert reptiles
8	Auezov South Kazakhstan University – Ecology Department	Email correspondence - no response	February/March 2026	Regional reptile knowledge
9	Ministry of Water Resources and Irrigation	Email correspondence and formal letter request - no response	March 2026	Water governance, basin management
10	ACBK	Emails, meetings, site surveys and data sharing	2025 and 2026 ongoing	Biodiversity data, particularly birds

Ref	Organisation / Expert	Type	Date	Purpose
11	Victoria Kovshar – professional ornithologist	Email and meeting correspondence and sharing of data.	2025 and 2026 ongoing	Bird data
12	Eurasian Regional Association of Zoos and Aquariums	Email and meeting correspondence and sharing of data.	March 2026	Syr Dara Shovelnose sturgeon
13	Tennessee Aquarium Conservation Institute (Bernie Kuhajda)	Email and meeting correspondence and sharing of data.	March and April 2026	As above

It is noted that the Project's biodiversity focused consultation to date has largely focused on gathering data and informing the Critical Habitat Assessment and the Impact Assessment with its associated mitigation. While consultation relating to the offsets and ACAs has started and work to date has informed the potential offsets and ACAs presented in this Preliminary-BAP, the speed of construction and the retrospective nature of the ESIA have constrained early engagement, including consultation with KTZ on biodiversity commitments and offset budgets. This ESIA acknowledges that more consultation is required as part of developing the Final BAP.

9.3 Future Consultation Strategy

9.3.1 General Strategy

Stakeholder engagement will continue throughout the remainder of construction, commissioning and operation of the Project. Engagement will distinguish between (i) disclosure and consultation associated with the Supplementary ESIA, LARP and other lender environmental and social instruments; and (ii) ongoing Project stakeholder engagement required to manage construction, land acquisition, community health and safety, access, livelihood and operational issues.

KTZ will have overall responsibility for Project stakeholder engagement, supported during construction by the EPC Contractor. Engagement methods will be selected according to the stakeholder group and issue concerned and may include community meetings, targeted meetings with affected households and land users, site-based consultation, individual meetings and household visits, and engagement through the relevant Akimats. Advance notice will be provided in locally appropriate languages and through channels reasonably accessible to affected stakeholders, with particular attention to affected persons and vulnerable groups.

Consultation and engagement will also be used to identify and address concerns and implementation issues. Where an issue raised during consultation constitutes a grievance or requires individual corrective action, it will be entered into the Project grievance register and managed through the applicable GRM irrespective of whether it was initially raised orally during a meeting, through an Akimat, in writing or through another engagement channel. Consultation records and the grievance register will be cross-referenced where appropriate to ensure that issues are not lost or duplicated.

Supplementary ESIA disclosure consultation. Consultation associated with disclosure of the Supplementary ESIA will include the communities at the six locations identified through the operational noise assessment, together with any additional sensitive receptor locations identified through subsequent noise and vibration assessment. The consultation will explain the predicted

impacts, proposed mitigation and monitoring arrangements and the mechanisms available for communities to raise concerns during construction and operation.

Agricultural and livestock access. Prior to operational handover, KTZ and the EPC Contractor will undertake targeted site-based verification with affected farmers, livestock owners, pasture users and relevant rural Akimats to confirm the practical adequacy of the completed crossing network. This engagement will build on, rather than repeat, the design-stage consultation already undertaken and will focus on as-built dimensions, accessibility, established movement routes, practical usability and any material diversion created by the railway. Particular attention will be given to locations where concerns were previously raised or where an alternative crossing was relied upon, including KM42.8/KM44.8 and KM55.1. Where a material connectivity deficiency is identified, affected users will be consulted on technically and operationally practicable corrective measures before operational handover.

Agricultural infrastructure and livelihoods. Follow-up engagement with affected land users will focus on the functionality and restoration of irrigation and drainage infrastructure, field access roads and other agricultural infrastructure affected by construction; confirmation of completion and effectiveness of any corrective works; and resolution of outstanding grievances or substantiated livelihood losses. This engagement will be coordinated with the ESMP commissioning/verification process and implementation of the LARP, including follow-up with households and land users with unresolved compensation, livelihood-restoration, access or irrigation issues. Design-stage identification of irrigation/drainage crossings will not be repeated unless new information indicates a previously unidentified Project-related issue.

The Project GRM will be actively socialized through future engagement. Information provided to communities will include available grievance channels, Project contact details, arrangements for confidential or anonymous complaints and applicable response procedures.

9.3.2 Biodiversity Strategy

In terms of biodiversity KTZ commits to a structured consultation programme as part of developing the Final BAP. The programme will prioritize engagement with ACBK and KECOG on bird offset design and monitoring; community consultation with the Shardara fishing and herder communities on reservoir-based habitat actions; land tenure and permissions for all indicative offset sites; and coordination with Kazakhstani environmental authorities, international experts and the Uzbekistan sturgeon hatchery on the sturgeon ACA. Table 101 sets out the minimum consultation that KTZ commits to as part of the Final BAP development.

Table 101: Committed Biodiversity Stakeholder Consultation Programme

Ref	Organisation / Expert	Biodiversity Focus
1	ACBK (Association for Conservation of Biodiversity of Kazakhstan)	Identify priority bird monitoring sites; identify and assess candidate existing OHL for retrofit (B1 – B5) co-design bird monitoring protocols
2	KECOG (Kazakhstan Electricity Grid Operating Company)	Identify ownership, condition, and access to priority OHLs for BFD retrofit (B1) and pole insulation (B2)
3	Shardara District Administration / Akimat	Confirm land tenure and permissions for all indicative offset sites (H1–H5), explore community management models

Ref	Organisation / Expert	Biodiversity Focus
4	Shardara fishing communities and herder associations	Community-level consultation on reservoir-based habitat actions, identify co-benefit and co-management opportunities
5	Kazakhstani Ministry of Ecology & Natural Resources	Sturgeon survey permits (S1); captive breeding collaboration (S3); Species Action Plan (S4)
6	Uzbekistan Institute of Gene Pool of Plants & Animals/sturgeon hatchery	Explore captive breeding collaboration for shovelnose sturgeon (S3)
7	Tennessee Aquarium Conservation Institute (Bernie Kuhajda)	International experts on shovelnose sturgeon (S1, 2 & 3)
8	ADB, IFC and AIIB	Review and approval of Final BAP prior to loan disbursement

9.4 Disclosure

KTZ, will continue the disclosure process during project implementation by providing relevant information in a timely manner, in an accessible place, and in a form and language understandable to affected persons and other stakeholders. The draft ESIA will be made available in corporate and regional offices of KTZ and at the project site office of Integra. The summary ESIA in Kazakh language will also be made available to the project affected people through KTZ offices, website and on request. The draft and final ESIA will be disclosed in English on the websites of ADB, IFC, AIIB and KTZ and implemented by KTZ. The monitoring reports on implementation to be prepared by KTZ and submitted to Lenders, will also be posted on the Lender's website.

9.5 Grievance Mechanism

This section presents the Project-level Grievance Redress Mechanism (GRM) for environmental and social concerns and grievances raised by affected communities, other stakeholders and members of the public. The GRM provides a structured process through which Project-related concerns can be received, registered, investigated, resolved and monitored, with escalation where a grievance cannot be satisfactorily resolved at the initial level.

The Project GRM is intended particularly to facilitate prompt resolution of community-level issues arising from construction and operation, including dust and air quality, noise and vibration, construction traffic, community health and safety, temporary or permanent access constraints, agricultural and livestock access, irrigation and drainage, damage to community or agricultural infrastructure and other Project-related environmental and social impacts.

Land acquisition and resettlement grievances are managed through the grievance mechanism established under the LARP. Where a grievance received through the Project GRM concerns land acquisition, valuation, compensation, displacement, livelihood restoration or another matter falling within the scope of the LARP, it will be registered and referred to the LARP grievance process. Where a grievance contains both LARP-related and wider Project environmental or social issues, KTZ will coordinate the two processes so that the complainant is not required to submit separate grievances.

Worker grievances are addressed separately through the Worker GRM described in Section 9.7.

The Project GRM complements, but does not replace, public administrative complaint and judicial mechanisms available under the laws of the Republic of Kazakhstan, including E-Otinish. Complainants may use these mechanisms or seek redress through the courts at any stage.

9.5.1 Objectives of the Grievance Procedure

The GRM is accessible to individuals living or working in areas affected by the project's activities. Anyone impacted by or having concerns about the project has the right to engage with the GRM, should find it easily accessible, and is encouraged to utilize it. The proposed GRM does not replace the public complaint and conflict resolution mechanisms established by the legal system of the Republic of Kazakhstan (RoK), such as E-Otinish28, but it aims to be more project specific and minimize reliance on other systems which are not project specific as much as possible.

The specific objectives of the GRM include:

- To provide stakeholders with a structured process to voice complaints and concerns.
- To ensure grievances are addressed promptly and transparently.
- To document and analyse grievances to inform project improvements.
- To prevent escalation of issues through proactive conflict resolution.
- To uphold the rights of complainants and prevent retaliation.

9.5.2 Guidelines on the Procedure for Grievance Redress

The GRM operates as set out below. These elements are in place during construction and continue into operation:

Step 1 – Procedures:

Clear procedures for submitting and recording grievances are in place, identifying the personnel responsible for receiving and managing grievances at both Corporate level (Chief Grievance Officer) and Site level (Community Liaison Officer). The procedures cover assessment methods, the determination of suitable resolution processes, decision-making on proposed settlements, the timelines for each stage of resolution, and the protocols for notifying complainants of eligibility, assessment outcomes, proposed resolutions and other relevant matters.

Step 2 – Resolution Options and Response:

The GRM applies a range of formal and informal resolution options, adapted from those already in use by KTZ and the Akimats. Common approaches include proposing solutions, reaching agreement through discussion or negotiation, using a third party for mediation, as appropriate to the nature of the grievance.

Step 3 – Documenting Grievances:

Receipt of every grievance is acknowledged while the complainant's identity is kept confidential. The CLO checks the grievance boxes weekly, records and registers each grievance in the standard format, and tracks it through to resolution. A grievance log/database is maintained by the designated CLO at site level and is used to analyse patterns in grievances, community issues and project operations, enabling proactive measures to prevent future conflict. grievance boxes are sited to be easily accessible and are distributed along the alignment, located preferably at village/District Akimat level.

Step 4 – Appeal:

Where a complainant is not satisfied with the resolution, they may appeal. the circumstances and route for appeal are defined and communicated as part of the GRM, to maintain accountability and transparency at every stage. Appeals are escalated through the GRM levels, and complainants retain the right to seek redress through the national courts at any stage. KTZ may, at its discretion, convene an independent review panel (including governmental and civil -society representation) to provide oversight and to verify the effectiveness of the mechanism through monitoring and data tracking.

[28] https://eotinish.kz/ru

Step 5 – Resolution and Follow-Up:

Once corrective action is agreed, the implemented actions are documented — through photographs, records and the complainant's confirmation — and filed in the case record. the agreed resolution is monitored and followed up to confirm closure of the case. KTZ provides quarterly reports to the public and workers detailing the number of grievances received, resolved, unresolved and referred to a third party, and provides these quarterly reports to the Lenders to support early identification of potential risks.

9.5.3 Availability for Vulnerable and Disadvantaged Groups

The GRM is designed so that vulnerable and disadvantaged persons — including women, the elderly, persons with disabilities, low-income and severely affected households, ethnic-minority (including Uzbek-speaking) households, and seasonal labour migrants — can learn about and use it on an equal basis:

- Information is provided in Kazakh, Russian and Uzbek and in plain language, using verbal and pictorial formats where literacy is a barrier, and disseminated through women-only and small-group sessions as well as open meetings.
- Multiple confidential intake routes are available (grievance boxes, hotline, general email, in person, and trusted intermediaries such as village elders and female focal points), so complainants need not raise sensitive matters in public or through male intermediaries.
- Awareness activities are timed around the agricultural calendar and male out-migration season to reach women and absent household members.
- GBVH concerns are handled through the separate confidential, survivor-centred channel (Section 9.5.9) with female focal points available for intake.

The CLO records complainant vulnerability status (where known and consented) so that uptake by vulnerable groups is monitored and barriers addressed.

9.5.4 Levels and Procedure for Grievance Redress

Overall responsibility for implementation of the Project GRM rests with KTZ, supported by the EPC Contractor during construction and by the relevant Project environmental and social personnel. The Project GRM provides three levels of resolution: Level 0 – Project Site/CLO; Level 1 – District GRC; and Level 2 – Regional (Oblast) GRC. Relevant Akimats and other competent authorities will participate where the subject matter of a grievance falls within their respective responsibilities.

This escalation structure applies to the Project community GRM described in this ESIA. Land acquisition and resettlement grievances follow the separate LARP grievance mechanism.

9.5.5 GRM: Project Site Level

At the first stage, the resolution of the grievance will be attempted by the CLO on site. The CLO will be required to follow the process of response and documentation of all grievances received. Receipt of every grievance will be acknowledged within one week. The CLO will then have up to two weeks from receipt to contact and, where possible, meet the complainant and resolve the issue at site level; only if the grievance remains unresolved at the end of that two-week period will it be escalated to Level 1.

Receiving and Registering the Grievance

- Secure grievance boxes will be placed at various key designated locations along the alignment area (Erdaut, Maktaaral and intermediary train stations), and at Akimats offices at village/district level.

- Receipt of grievances lodged in person, via phone, through a letter or e-mail or fax will be acknowledged. together with the full contact details for the Community Liaison Officer and the Grievance Redress Committees at District and Regional level, are set out in the GRC Contact Details 9.6. section below.
- Complainants may choose to remain anonymous by writing down their grievances and submitting them in the available complaint boxes.
- Upon receiving a complaint, it will be logged in the grievance register or data system, and an acknowledgment slip will be issued to the complainant within one week of receipt.
- Grievances will be recorded in a standard format.

Assessment and Addressing the Grievance

- The designated CLO at Level 0 will check the complaint boxes once every week.
- The grievance will be reviewed to determine if the issues raised fall within the scope of the grievance mechanism.
- During the assessment, the CLO will collect information on the key issues and concerns to evaluate potential resolutions.
- The CLO will attempt to resolve the grievance on site within two weeks of receipt.
- If the CLO is unable to resolve the grievance within two weeks of receipt, the issue will be escalated to the GRC at District Akimat level 1 for further screening and assessment. If intervention is necessary, it will be considered for further action; otherwise, the grievance will be deemed invalid, and the CLO at site level will inform the complainant of that outcome within the same two-week period.
- The GRC at District Akimat level will address grievances at Level 1 within a further two weeks after receipt from the CLO at Level 0.
- If the grievance is resolved at the CLO Level 0, the complainant will be notified of the outcome. If the grievance remains unresolved and is escalated to the Grievance Redress Committee (GRC) at the District Akimat level 1 for further consideration, the complainant will receive pertinent information, including the date the case was forwarded to the central GRC and the anticipated date for the resolution.
- In cases of anonymous complaints, the written response will be displayed on the information board of the KTZ or the relevant District Akimat where the complaint was lodged, allowing the complainant to view and assess the feedback.

9.5.6 GRM: District (Akimat) Level

At this stage, the resolution of grievance will be attempted through GRC at the District Akimat level. The GRC at District Akimat level is composed of the following stakeholders:

- Darbaza-Maktaaral KTZ Project Manager, including CLO
- Designated Project Technical Supervisors, if relevant
- Akims of District Akimat of Saryagash, Keles, Zhetysay and Maktaaral, or designated representative(s)
- Representative of Women's, Vulnerable Groups, and Farm Worker's / Commercial Agriculture's Association where applicable.

Akimats of the affected Districts located in the project area will be informed on the GRM process and will be involved in considering the grievances and can attend the GRC meeting in case the issue is

related to their community. In addition, professional mediators or representatives of NGOs may be involved in resolution of grievance cases, as needed.

A representative from the regional branch of KTZ, or the CLO will chair the GRC at the District Akimat level and be responsible for the overall operation of GRM and its efficient and timely implementation. Coordinator of the GRC at the District Akimat level will be nominated by the management of the regional branch of KTZ and be responsible for involving the relevant parties and coordinating the works of GRC at District Akimat level.

Assessment and Addressing of Complaints

- If the grievance is resolved at the CLO Level 0, the complainant will be notified of the outcome. If the grievance remains unresolved and is escalated to the Grievance Redress Committee (GRC) at the District Akimat level 1 for further consideration, the complainant will receive pertinent information, including the date the case was forwarded to the central GRC and the anticipated date for the resolution.
- In cases of anonymous complaints, the written response will be displayed on the information board of the KTZ or the relevant District Akimat where the complaint was lodged, allowing the complainant to view and assess the feedback.
- At the GRC District Akimat Level 1, the CLO and KTZ Darbaza-Maktaaral PM will attempt to resolve the grievance within two weeks of the escalation (in other words, within approximately four weeks of the original receipt of the grievance from the complainant).

9.5.7 GRM: Regional (Oblast) Level

Following unsuccessful consideration of grievance by GRC at the Akimat level 1, the complaint resolution will be attempted at the Regional (Oblast) level. The GRC at Turkistan Regional (Oblast) level is composed of the following parties:

- KTZ (Headquarters - Astana) Project Manager and Darbaza-Maktaaral KTZ Project Manager, including the CLO
- KTZ Chief Grievance Officer (Corporate level)
- Akim of Turkistan Oblast or designated representative
- Akims of District Akimat of Saryagash, Keles, Zhetysay and Maktaaral, or designated representative(s)

For grievances related to the project, the representatives of the KTZ Project Manager will be invited to take part in the meeting of the GRC at the Oblast level. The complaining party, as well as representatives of relevant state stakeholders, village / district / oblast Akimats, designated Project Technical Supervisors (as needed) will also be invited to attend the GRC meeting.

Assessment and Addressing of Complaints

- If the grievance is resolved at the District Akimat level 1, the complainant will be notified of the outcome. If the grievance remains unresolved and is escalated to the Grievance Redress Committee (GRC) at the Regional (Oblast) level 2 for further consideration, the complainant will receive pertinent information, including the date the case was forwarded to the central GRC and the anticipated date for the resolution.
- At Level 2, the KTZ Chief Grievance Officer (Corporate level) will collaborate with the Corporate-level Director of Human Resources & Administration and the Director of Operations to address the grievance. The Chief Grievance Officer will facilitate decision-making, and if necessary, meetings will be held with the complainant to examine evidence. The grievance will be resolved within one month following the referral. In total, a grievance

escalated through to Level 2 will be resolved within approximately two months (about eight weeks) of its original receipt at Level 0.

- Complainants will have the opportunity to participate in committee meetings and discuss their grievances at both levels. If the issue remains unresolved after both levels, the complainant may approach an appropriate court for redress.
- Anonymous complaints will be registered at the site level, discussed by the GRC committee, and appropriate actions will be taken if the complaints are found to be valid.

9.5.8 GRM: Legal System

If after the intervention and assistance from the GRCs at both District Akimat level and Regional (Oblast) level, no solution has been reached, and if the grievance redress system fails to satisfy the complaining parties, the case will be referred to the court for resolution in accordance with the RoK legislation.

It should also be emphasized that, at any time, the complaining party has the right to submit the case to the court of law in the first stage of grievance process, and does not have to follow the two levels of grievance resolution envisaged by the GRM.

9.5.9 GBVH-specific GRM channels

The Project applies the IFC Good Practice Note on Addressing GBVH in Investments Involving Major Civil Works (2020) framework and the requirements of IFC PS2 22 and ILO Convention 190 to ensure that workers and community members affected by gender-based violence and harassment have access to confidential, survivor-centred reporting channels that are distinct from — but interoperable with — the general project Grievance Redress Mechanism. The principal elements are:

Women-only contact points: Female-only contact points are designated at each work front, at the Project Site office, and at the KTZ regional office in Turkistan, with named female staff trained in GBVH-sensitive complaint receipt and survivor referral. The female E&S specialist who supported the May 2026 consultations is the principal female contact at Project level pending the establishment of permanent female focal points by the EPC contractor.

Confidential GBVH reporting: GBVH cases are reported through a dedicated channel separate from the general GRM register, with restricted access limited to designated GBVH responders. Anonymous reporting permitted. Submission channels include direct telephone to the female focal point, dedicated email address, in-person submission to the designated female focal point or the female E&S specialist, and submission through trusted intermediaries (community elders, religious leaders, female community representatives) where the survivor prefers indirect contact.

External support and referral pathways: Partnership arrangements with the Union of Crisis Centres of Kazakhstan and the Shymkent regional crisis centre for survivor support; the national 150 helpline operated by the Ministry of Internal Affairs; the local Department of Internal Affairs (police) for criminal aspects; the Akimat social-services department in each district; and primary healthcare facilities (FAPs and District hospitals) for medical care, with explicit referral consent from the survivor. The female focal point coordinates the referral pathway as requested by the survivor.

Designated GBVH focal points: Named GBVH focal points at each work front, at KTZ Project Manager level, and at KTZ Corporate level, all trained in GBVH-sensitive complaint receipt, survivor support, and the referral framework. Refresher training at 6-month intervals. Contractor-side GBVH focal points required at each subcontractor with workforce in the project area.

Anti-retaliation protections: Explicit prohibition of retaliation against complainants or witnesses in the Project Code of Conduct, with disciplinary measures including immediate dismissal for confirmed retaliation. The Workers' GRM (Section 9.7 below) includes specific anti-retaliation provisions covering both general and GBVH-related complaints.

Confidentiality: GBVH case records are held in a restricted-access register accessible only to designated GBVH responders. Aggregate statistics (case count by category, response time, resolution outcome) are reported to KTZ E&S team and to lenders in the semi-annual E&S monitoring report; identifying details are not disclosed. The survivor controls the level of identifying information shared at each stage.

Interoperability with general GRM: Where a complaint received through the general GRM contains GBVH content, the receiving CLO refers the case to the designated GBVH responder using a defined transfer protocol that preserves confidentiality and re-establishes survivor consent for any further engagement.

Operational-phase continuation: Post-commissioning, the GBVH framework continues under KTZ corporate code of conduct application with the operational workforce at Yerdaut depot and Maktaaral disinfection complex, supported by the operational CLO function and the continued partnership with regional crisis centres.

9.5.10 Operational-phase GRM

The construction-phase GRM established under the EPC contractor and KTZ Project E&S team transitions to KTZ operational management at commissioning, with continuity of access channels, focal points, and reporting arrangements over the operational life of the railway (track 25–40 years, bridges 100 years, civil works 120 years).

Transition: The transition from construction-phase to operational-phase GRM occurs at the commissioning milestone, with a 12-month overlap period during which the EPC contractor CLO and the KTZ operational E&S team jointly operate the GRM. After this overlap, KTZ operational E&S team assumes sole responsibility, with EPC contractor support available for any commissioning-related residual issues.

Operational-phase access channels: Grievance boxes maintained at the operational stations (Maktaaral, Yerdaut/Erdaulet, intermediate stations) and at the District Akimat offices in the five affected districts. Telephone and email access to the KTZ operational CLO function at the Turkistan regional KTZ office. Dedicated project website maintained by KTZ with online grievance submission, FAQ, and disclosure of operational monitoring reports. Mobile platforms (WhatsApp / Telegram channels operated by the rural okrug administrations) continue to be a community access channel, coordinated through the District Akimat focal points.

Operational-phase focal points: KTZ operational CLO function based at the Turkistan regional office, with named operational CLO at appointment. KTZ Chief Grievance Officer (Corporate level, Astana) retained for Level 2 escalation. District Akimat focal points (Saryagash, Keles, Zhetysay, Maktaaral) retained as Level 1 escalation. The 3-level GRM structure (CLO Level 0 - District GRC Level 1 -Regional Oblast GRC Level 2 - court) continues to apply at operations with the same timescales (acknowledgement within 1 week; Level 0 resolution within 2 weeks; Level 1 within a further 2 weeks; Level 2 within a further 4 weeks).

Operational engagement cadence: Annual community meetings in each of the five affected districts during the first three operational years, reducing to triennial thereafter subject to satisfactory issue

closure rates and absence of unresolved Material concerns. Specific operational-engagement triggers (additional community meeting required) include: confirmation of any vibration/noise exceedance at a sensitive receptor location; any hazardous-cargo incident with potential community impact; any biodiversity adaptive management trigger event (e.g., confirmed mortality of a globally threatened species). Operational community engagement includes specific outreach to vulnerable groups and to women-only contact points.

Operational-phase reporting and review: Quarterly GRM aggregate reports to KTZ corporate management and to the Akimats; annual report to lenders aligned with the operational E&S monitoring report; IESC review at semi-annual or annual operational monitoring missions (subject to lender requirements); 5-yearly comprehensive GRM review aligned with the 5-yearly climate-resilience and operational-performance review committed in the Operational ESMP.

9.5.11 Protection Against Reprisals

The Project treats protection of complainants and witnesses as a core requirement of the GRM. The following measures apply at all levels:

- Complainant identity is kept confidential, and anonymous grievances are accepted through the grievance boxes, the project grievance hotline and email, and trusted intermediaries (including community elders and, for sensitive matters, female focal points), so that no complainant is obliged to raise an issue in person or through a named individual.
- Retaliation against any person who raises a grievance, supports a complainant, or acts as a witness is expressly prohibited under the Project Code of Conduct and worker contracts, with disciplinary consequences up to and including immediate dismissal for confirmed retaliation.
- Any allegation of retaliation is treated as a priority grievance and is escalated to the KTZ Project E&S team for independent investigation, outside the line of management against which the allegation is made.
- Complainants retain the right to take any matter to the national courts at any stage, without first exhausting the GRM.
- GBVH-related cases are handled exclusively through the confidential, survivor-centred channel (Section 9.5), with access restricted to designated responders.

Consultations to date did not identify a specific reprisal risk in the Project corridor; nonetheless, these safeguards are applied as standard so that the GRM remains accessible to women, vulnerable and minority complainants and to workers concerned about employment consequences.

9.5.12 Implementation Experience and Adjustments to Date

Construction commenced ahead of lender-aligned due diligence, and the parallel ESCA found that the project-level GRM was not yet consistently embedded across contractors and that awareness among workers and some communities was variable (ESCA findings SE-2, SE-3, LWC-3). During the May 2026 consultations, residents at Erdauit considered the existing channels insufficient for the timely resolution of urgent construction-phase issues. In response, the following adjustments have been made or committed: (i) reinforced CLO-led awareness measures in the affected settlements; (ii) a review of GRM uptake, response times and closure rates; (iii) introduction of institutional, role-based contact channels (a grievance hotline and a general project email) in place of personal contacts; (iv) the revised, more realistic resolution timescales set out above; and (v) inclusion of GRM-procedures training for contractors in the induction and training programme. These adjustments continue to be informed by the quarterly GRM data and the semi-annual monitoring reports.

9.5.13 Complaints Received during the ESIA and other Consultation Process

Concerns and complaints raised during the ESIA consultations (or any other engagement) are captured into the GRM in the same way as directly lodged grievances: each is recorded in the grievance register with a unique reference, acknowledged, triaged to the appropriate level, assigned a responsible person and a target resolution date, and tracked to closure, with the outcome communicated to the complainant (or displayed on the relevant information board where the complainant is anonymous). The concerns recorded at the May 06, 2026 community consultations have been logged on this basis and are reflected in the consultation feedback table (Section 9); their resolution will be reported in the quarterly GRM reports and the semi-annual E&S monitoring report.

9.6 Grievance Focal Points

Project Affected Entities or other concerned individuals may visit, call or send an email, letter or fax to GRC at the District Akimat levels of Saryagash, Keles, Zhetysay and Maktaaral or the Turkistan Oblast.

9.6.1 GRC Contact Details at District Level

- Darbaza-Maktaaral KTZ Project Manager
  (to be added)
- Community Liaison Officer
  Laura Isaeva, Project contact for social issues
  Phone: +7 778 616 0179
  E-mail: laura0479@mail.ru
- Designated Project Technical Supervisors
  (to be added)
- Saryagash District Akimat
  Kuanish Askarovich Kanseitov, Leading Specialist, Land Relations Department
  Phone: +7 702 369 8385
- Keles District Akimat
  Talgat Tontayevich Yesenbekov, Chief Specialist, Land Relations Department
  Phone: +7 705 772 7664
- Zhetysay District Akimat
  Azamat Bolatuly Serikbay, Chief Specialist, Land Relations Department
  Phone: +7 771 695 3354
- Maktaaral District Akimat
  Sabit Bekmyrzauly Absattarov, Chief Specialist, Land Relations Department
  Phone: +7 708 007 9707
- Representative of Women's, Vulnerable Groups, and Farm Worker's / Commercial Agriculture's Association where applicable
  (to be added)

9.6.2 GRC Contact Details at Regional Level

- KTZ (Headquarters - Astana) Project Manager and Darbaza-Maktaaral KTZ Project Manager
  (to be added)
- KTZ Chief Grievance Officer (Corporate level)
  (to be added)
- Community Liaison Officer
  (to be added)

- Akimat of Turkistan Oblast
  (to be added)

9.7 Worker GRM

The Project establishes a Workers' GRM distinct from the community GRM, in accordance with IFC PS2 20 and applicable AIIB ESS2 and SPS SR2 provisions. The Workers' GRM is accessible to all categories of Project worker including KTZ direct staff, EPC contractor workforce, subcontractor workforce, and migrant labour, with provisions appropriate to the multi-employer construction context.

Access: The Workers' GRM is communicated to all workers during induction in a language they understand (Kazakh, Russian, Uzbek as required by workforce composition), and is supported by written materials (printed grievance forms, contact details, procedure overview) prominently displayed at worker accommodation, canteen, and work-front locations.

Submission channels: (a) In-person to the EPC contractor HR or E&S representative at the work front; (b) in writing through grievance boxes at worker accommodation and canteen locations checked weekly; (c) by telephone or email to the named CLO and to the EPC contractor HR; (d) anonymously through the grievance boxes or through trusted intermediaries; (e) directly to the KTZ Project E&S team for cases the worker prefers to escalate outside the EPC contractor; (f) for GBVH cases, through the dedicated GBVH channel (Section 9.5 above).

Independent review: Workers' GRM operation is subject to independent review by the KTZ Project E&S team on a quarterly basis, with aggregate statistics (case count by category, response time, resolution outcome, escalation rate) reported in the semi-annual E&S monitoring report to lenders. The Independent E&S Consultant (IESC) for the Project reviews Workers' GRM performance during semi-annual monitoring missions, with explicit focus on accessibility for subcontracted and migrant labour.

Anti-retaliation:. Explicit anti-retaliation provisions in worker contracts and the Project Code of Conduct, with disciplinary measures including dismissal for confirmed retaliation against complainants or witnesses. Workers' GRM cases involving retaliation allegations are escalated to KTZ Project E&S team for independent investigation.

Categories and timescales: Categories: (i) wages, hours and terms of employment; (ii) accommodation and welfare; (iii) OHS and safe working conditions; (iv) discrimination and harassment (with GBVH cases referred to the dedicated channel); (v) freedom of association and workplace representation; (vi) employment termination; (vii) other. Timescales: acknowledgement within 3 working days; resolution at first level within 10 working days; escalation to KTZ Project E&S level if not resolved at first level, with resolution within a further 10 working days; final escalation to KTZ Corporate level if not resolved at second level. Workers retain right to take any case to applicable courts at any stage.

Operational-phase continuation: Post-commissioning, the Workers' GRM continues under KTZ corporate framework for operational workforce at Yerdaut depot, Maktaaral disinfection complex, and operational maintenance teams along the alignment, with the same access channels, anti-retaliation provisions, and independent review applicable.

9.8 Disclosure of the Grievance Process

Project information and GRM contact details will be displayed on notice boards at construction camps and active work fronts and, in consultation with local authorities, at appropriate publicly accessible locations within affected communities. Information displayed will include relevant construction notifications, contact details for the CLO/GRM, available grievance submission channels and

applicable response timeframes. Information will be provided in locally appropriate languages and updated throughout construction.

The grievance redress mechanism will also be outlined during public consultations and informal meetings within the Project area during the preparation of the ESIA, its implementation, and throughout the subsequent civil works. Additionally, summaries of grievance resolutions will be included in the progress reports from KTZ that will be submitted to the Lenders.

10. Environmental and Social Management Plan

10.1 Preamble

The ESMP provides summary information on the types of impacts and risks anticipated to arise from the Project, and detailed information on the required mitigation and monitoring measures with respect to the following stages of the Project: (i) design and pre-construction; (ii) construction; and (iii) operations and maintenance, together with implementation arrangements and reporting requirements. The ESMP, set out in tabular format for all phases, is presented in Annex A. These phase-specific management plans are collectively referred to as the ESMP (or ESMPs) in this chapter.

This ESMP is prepared in support of a Project on which construction has already commenced. Construction began in 2024, prior to the effectiveness of this ESMP, with approximately 100 km of the alignment levelled and approximately 4 km of track laid at the date of this Supplementary ESIA. The Design and Pre-Construction Phase ESMP is therefore principally a verification framework: it requires the EPC Contractor to confirm that the as-built design reflects the mitigation commitments set out in the ESIA, to identify and report any departures from those commitments, and to identify and address any unanticipated impacts. The Construction Phase ESMP is the live operational document from the date this ESMP is effective. The Operations and Maintenance Phase ESMP applies from the commissioning of each section of the alignment.

The pre-ESMP-effective period operated under: the environmental, health, safety and labour regulations of the Republic of Kazakhstan; the applicable mitigation commitments arising from the national EIA documentation in force at the relevant stage of Project development; KTZ corporate environmental and social management policies; the general environmental and social clauses of the EPC Contract; and the in-house management systems of the EPC Contractor and its subcontractors. The parallel Environmental and Social Compliance Audit (ESCA) — a separate deliverable prepared under the same overall assignment — has audited compliance during this pre-ESMP-effective period and identified non-compliances and corrective actions in the ESCA Corrective Action Plan (CAP). Material findings from the ESCA CAP are reflected in: the Construction Phase ESMP commitments where the CAP identified gaps; the Operations and Maintenance Phase ESMP commitments where the CAP identified gaps requiring carry-through to operations; the Biodiversity Action Plan framework where the CAP identified biodiversity-specific gaps; and the gender-based violence and harassment framework where the CAP identified workforce-management gaps.

The ESMP is dynamic and may be updated as appropriate during Project implementation, subject to prior clearance from the Lenders. The EPC Contractor is responsible for implementing all relevant measures for the works under its contract, supervised by KTZ. Any updates to the ESMP, including in response to unanticipated impacts, will be incorporated into the contract document. In addition, for any corrective action required due to non-compliance, appropriate action will be agreed with the Lenders and implemented by KTZ and its EPC Contractor to improve Project performance. The EPC Contractor will cover the costs where corrective action is required due to non-compliance on the part of the EPC Contractor, its subcontractors, or third parties with the ESMP.

Transition framework

The transition from pre-ESMP-effective to ESMP-effective operation is structured as follows:

(a) CESMP submission by Integra to KTZ within 30 days of ESMP effectiveness, with interim operation against the ESIA mitigation measures and monthly compliance reporting during the gap period;

(b) ESCA CAP implementation tracked alongside the ESMP, with closure of CAP items reported in the semi-annual Environmental and Social Monitoring Report (EMR) to the Lenders;

(c) post-construction-start verification by Integra and KTZ of as-built design compliance with the mitigation commitments in this ESIA, in accordance with the Design and Pre-Construction Phase ESMP verification framework;

(d) any past non-compliances identified through the ESCA, this ESIA, tracked through the Corrective Action framework, with cost responsibility allocated in accordance with the EPC Contract.

Land acquisition and resettlement are managed principally through the Land Acquisition and Resettlement Plan (LARP), while stakeholder engagement and the Project GRM are implemented through the arrangements set out in Chapter 9 and the Stakeholder Engagement Plan. These instruments operate alongside, and are coordinated with, the ESMP and CESMP; see Section 10.3.

10.2 Environmental and Social Monitoring

Three types of monitoring are undertaken on the Project:

- Observational — involving routine site inspections in the field by both the EPC Contractor and KTZ. The Construction Phase ESMP at Annex A sets out the requirements for observational monitoring for each mitigation measure.
- Review and Approval — a desk-based exercise ensuring that all management plans, method statements, permits and design verification documents are reviewed and approved by KTZ before, and during, works. The Design and Pre-Construction Phase ESMP and the Construction Phase ESMP at Annex A set out the requirements for this activity.
- Instrumental — quantitative measurement using calibrated equipment. Instrumental monitoring is committed for construction vibration at sensitive receptors (as set out in Section 8.4.3 of the ESIA), for air quality at representative sensitive receptors during construction (Section 8.4.3), for operational noise at the locations identified in the Preliminary Operational Noise Modelling (Section 8.4.4), and for water quality in the vicinity of the Shardara Reservoir crossing during the bridge works. Additional instrumental monitoring will be undertaken where reasonably required to investigate a community grievance, environmental incident, observed exceedance or other indication that mitigation measures may not be performing as intended.

10.3 Construction Environmental and Social Management Plan (CESMP)

The CESMP is the document that the EPC Contractor prepares setting out how it intends to implement the project-level ESMP during the construction phase, and to ensure that all the mitigation and monitoring is completed according to the implementation arrangements specified in the ESMP and the ESIA.

The CESMP will describe the precise implementation details and locations of the required mitigation and monitoring activities, the persons at the EPC Contractor responsible for the mitigation and monitoring and other persons with roles or responsibilities related to ESMP implementation, the schedule, the budget, training and induction arrangements, and record-keeping and reporting arrangements. The CESMP and all its topic and site-specific sub-plans will be submitted to KTZ for approval within 30 days of the effective date of this ESMP, given that construction has already commenced. From the date this ESMP is effective until the CESMP is approved by KTZ, the EPC Contractor will operate against the committed mitigation measures in the ESIA, with monthly reporting to KTZ on compliance status. Once approved, the CESMP becomes the controlling operational document for environmental and social management during construction.

The CESMP may provide more detailed or site-specific implementation measures but shall not reduce or materially alter the environmental and social commitments established in the ESIA and ESMP without prior approval by KTZ and, where required, the Lenders.

The CESMP shall also incorporate the construction-phase corrective actions arising from the ESCA CAP that remain open or require continuing implementation. Closure of an ESCA CAP action will not remove any corresponding ongoing management or monitoring requirement established under the ESMP.

The CESMP will include the following topic-specific plans:

Table 102: CESMP Topic-Specific Plans

Plan	KTZ Approval
CESMP-01 Pollution Prevention Plan, covering: Air Quality; Noise & Vibration; Waste Management; Water Management and Drainage; Soils and Hazardous Materials	Yes
CESMP-02 Occupational Health and Safety Plan	Yes
CESMP-03 Labour Management Plan and Code of Conduct	Yes
CESMP-04 Community Health and Safety Plan	Yes
CESMP-05 Emergency Preparedness and Response Plan	Yes
CESMP-06 Traffic Management Plan, including traffic management plans for road, agricultural and livestock crossings	Yes
CESMP-07 Biodiversity Management Plan, including site protection plans for the Shardara Reservoir IBA/KBA crossing and Critical Habitat	Yes
CESMP-08 Archaeological Chance Finds Procedure	Yes
CESMP-09 Worker Accommodation and Camp Management Plan	Yes
CESMP-10 Construction Noise Management Plan	Yes
CESMP-11 Irrigation Network Management Plan (for the irrigated southern corridor)	Yes
CESMP-17 GBVH and Gender Action Plan	Yes
CESMP-18 Climate Resilience Adaptation Plan	Yes
CESMP-19 Cumulative Impact and Biodiversity Coordination Plan	Yes
CESMP-20 Ecosystem Services Management Plan	Yes
CESMP-21 Vulnerable Groups and Inclusion Plan	Yes

In addition to the contractor-level CESMP sub-plans listed above, several of the Project's social impacts are managed through two project-level management plans that sit alongside — rather than within — the CESMP, and for which KTZ retains lead responsibility:

- **Stakeholder Engagement Plan (SEP).** The SEP governs stakeholder identification, information disclosure, and ongoing consultation throughout construction and operation, and it houses

the project-level Grievance Redress Mechanism. It is the principal instrument for managing community-relations impacts, disclosure and grievance handling, and for ensuring the inclusive engagement of women, vulnerable and minority groups.

- **Land Acquisition and Resettlement Plan (LARP).** The LARP manages the social impacts associated with land acquisition and involuntary resettlement — replacement-cost compensation, livelihood restoration, physical and economic displacement, severance, and dedicated assistance for vulnerable and severely affected households — together with land-related grievances and internal and external monitoring. Land-take impacts are assessed in Section 8.4.2 (and Section 4, Table 34); the LARP is the controlling document for their mitigation.

Together with this ESMP and the CESMP, the SEP and the LARP form the suite of management instruments through which the Project's environmental and social impacts are managed. The interfaces between them — in particular the shared Grievance Redress Mechanism (Section 9) and the management of vulnerable groups — are coordinated by KTZ to avoid gaps or duplication.

This ESIA includes framework CESMPs Topic Specific Plans to be adopted and updated by the EPC Contractor. The plans can be found in Annex D.

The following method statements will be required for work zones:

Table 103: Method Statements

Method Statement	KTZ Approval
CESMP-12 Access Road Management	Yes
CESMP-13 Reinstatement and Restoration	Yes
CESMP-14 Borrow Pit Management (for each licensed pit)	Yes
CESMP-15 Shardara Reservoir Crossing Method Statement (in-river works)	Yes
CESMP-16 Bridge and Major Structure Construction Method Statements	Yes

The Biodiversity Action Plan (BAP) and the Biodiversity Offset Management Plan referenced in Section 8.4 of the ESIA are separate documents that sit alongside the CESMP and are subject to approval by both KTZ and Lenders.

10.4 Overarching Implementation Arrangements

KTZ is responsible for ensuring correct implementation of the ESMP, for approving the CESMP, and for compliance with Lenders E&S requirements and the environmental, health, safety and labour regulations of the Republic of Kazakhstan. This responsibility extends to the E&S performance and compliance of the EPC Contractor, subcontractors and other parties undertaking Project activities on KTZ's behalf. KTZ acts both as the Project owner and as the supervision body for the EPC Contractor.

If any material change in design, or unanticipated environmental or social impacts, become apparent during Project implementation, the EPC Contractor is required to inform KTZ, who in turn is required to immediately inform Lenders and to: (i) assess the significance of such unanticipated impacts; (ii) evaluate the options available to address them; and (iii) update the ESIA and ESMP, taking appropriate corrective action where necessary, before commencing or recommencing the related works.

The following sections set out the specific implementation requirements for KTZ and for the EPC Contractor and its subcontractors.

10.5 KTZ – Owner and Supervision

KTZ is responsible for supervising the EPC Contractor and for ensuring implementation of the ESMP and the other Project-level environmental and social management instruments for which KTZ has lead responsibility. KTZ provides safeguards oversight, including verification that ESMP requirements are being met, review of the EPC Contractor's monthly reports, preparation of Environmental and Social Monitoring Reports for submission to the Lenders, and oversight of the Project GRM. KTZ executive management is ultimately accountable to the Lenders for the environmental and social performance and compliance of the Project, including activities undertaken by the EPC Contractor and subcontractors on KTZ's behalf.

10.5.1 Primary Responsibilities

KTZ's responsibilities include the following, but are not limited to:

- Ensuring adherence to all applicable national environmental, social, health, safety, and labour laws and regulations of the Republic of Kazakhstan in force at the time, including the Environmental Code, the Water Code, the Land Code, the Labour Code, and the supporting subordinate regulation.
- Ensuring adherence to Lenders E&S policies and to the related IFC EHS General Guidelines and IFC EHS Guidelines for Railways.
- Ensuring that adequate management support, budget, staff and other resources are allocated to satisfactorily implement, supervise and monitor implementation of the ESMP during all phases.
- Appointing suitably qualified and experienced environmental, health and safety, and social safeguards officers to support ESMP implementation throughout all phases.
- Approving the EPC Contractor's CESMP and each of its topic-specific sub-plans and method statements before the relevant works commence (or, where works are already underway, within 30 days of ESMP effectiveness).
- Supervising and verifying the EPC Contractor's implementation of the CESMP through routine site inspections, review of monthly reports, and quarterly internal audits.
- Operating the Project GRM for community and other stakeholder grievances in accordance with Chapter 9 and the SEP, including the CLO/site-level initial resolution stage and escalation through the applicable District and Regional GRCs. Land acquisition and resettlement grievances will be managed through the separate grievance arrangements established under the LARP, with coordination between the two mechanisms where a grievance includes both land-related and wider Project environmental or social issues.
- Conducting ongoing community engagement and stakeholder consultation in accordance with the Stakeholder Engagement Plan, including the regular community meetings.
- Preparing and submitting all reports to Lenders on the schedule set out in the table below.
- Coordinating with the relevant Akimats and national authorities on permits, approvals and compliance matters.
- In the event of a major incident — including fatality, serious injury, major spill, or significant biodiversity incident — notifying Lenders within 48 hours with a preliminary report, and ensuring the EPC Contractor takes immediate corrective action.
- In the event of any non-compliance with the ESMP, preparing a Corrective Action Plan for clearance by Lenders and ensuring that the EPC Contractor implements the corrective action within the required timeframe.

10.5.2 Reporting

KTZ is responsible for the following documents and reports:

Table 104: KTZ Reporting Responsibilities

Document	Destination	Design / Pre-Construction	Construction	Operations
Updated ESIA / ESMP	Lenders	X (when finalized)	X (when changes are made)	X (when changes are made)
Training and Induction Plan	KTZ / EPC Contractor	X	X (ESCA commitment to provide GRM training for contractors)	X (for operations)
Stakeholder Engagement Plan	KTZ / EPC Contractor	X	X (updated as needed)	X (updated as needed)
GRM Quarterly Report (consultation, grievances received and closed)	Lenders / Public		X (Quarterly)	X (Quarterly)
Incident Reports	Lenders		X (Quarterly summary; major within 48 hr)	X (Quarterly summary; major within 48 hr)
Quarterly Progress Reports (QPR)	Lenders	X (Quarterly)	X (Quarterly)	X (Quarterly)
Unanticipated Impact, Major Incident and Chance Find Reports	Lenders		X (within 48 hours)	X (within 48 hours)
Environmental & Social Monitoring Reports (ESMR)	Lenders	X (semi-annual)	X (semi-annual)	X (annual until Lender PCR)

10.5.3 Environmental and Social Monitoring Report (ESMR) Process

ESMRs will be submitted to Lenders on a semi-annual basis by KTZ up to the completion of construction, reverting to an annual basis during operations up to the Project Completion Report (PCR). If recommended within the PCR, annual operational monitoring reporting will continue until all issues are closed out to the satisfaction of Lenders. ESMRs are due for submission to Lenders within 15 days of the month following period end (mid-July and mid-January each year). The ESMRs describe Project implementation progress, any scope or design changes, compliance against safeguard requirements covenanted in the legal agreements, progress with ESMP implementation, and grievances received and resolved.

Draft ESMRs submitted by KTZ during Project implementation are first reviewed by Lenders with comments on quality and acceptability provided. Once resubmitted to Lenders they are disclosed

locally in the same places as the ESIA was originally disclosed, and on the Lenders website upon receipt. Any outstanding comments are flagged to KTZ for ongoing action.

10.5.4 KTZ Department of Ecology, Social and Land Relations

KTZ maintains an internal department, the Department of Ecology, Social and Land Relations, with responsibility for environmental and social compliance across KTZ's portfolio. For the purposes of this Project, the Department shall provide the safeguards oversight function described above. A capacity development programme, described in Section 10, is implemented in support of effective ESMP delivery. The corresponding structure and responsibilities for the Operations and Maintenance phase, including all of the operational mitigation measures, are set out in the O&M Staffing sub-section below.

For Project implementation, KTZ shall assign the following key safeguards roles:

- Environmental and Social Officer (ESO). The ESO is the day-to-day supervision counterpart to the EPC Contractor. The ESO shall have experience of managing environmental and social aspects of large-scale infrastructure projects and familiarity with lender safeguards policies.
- Health and Safety Officer (HSO). The HSO is the day-to-day supervision counterpart to the EPC Contractor.
- Community Liaison Officer (CLO) as the Level 0 grievance redress contact and the standing point of community engagement.
- Chief Grievance Officer at Corporate level within KTZ, with responsibility for the Level 2 Grievance Redress Committee.

10.5.5 KTZ Safeguards Oversight at Site Level

In addition to the office-based safeguards function described above, KTZ shall deploy safeguards personnel at site level for routine supervision of the EPC Contractor. Site-level supervision includes routine inspection of active work fronts, verification of CESMP implementation, witnessing of significant works (in particular the in-river works at the Syr Darya bridge and the embankment construction within the Shardara IBA/KBA), and ad-hoc inspections in response to community concerns received through the GRM. Site-level safeguards personnel report to the ESO and contribute to the monthly reporting process.

10.6 EPC Contractor & Sub-contractors

Through the EPC Contract, KTZ has delegated to Integra the responsibility for implementing all relevant measures during design verification, construction, and the defects liability period. Integra is required to comply with the ESMP during all phases of its contract, closely supervised by KTZ. Integra is responsible for reporting environmental, social, health and safety progress and performance at least monthly to KTZ, including providing the necessary inputs to the Quarterly Progress Reports and Environmental Monitoring Reports for the duration of the EPC Contract. The requirement to undertake mitigation and monitoring actions as set out in this ESMP applies to the construction site, off-site roads used for access, operational facilities, and any temporary or permanent worker accommodation provided for workers during the construction phase.

Integra has ultimate responsibility under the EPC Contract for ESMP implementation. Integra is required to ensure that the ESMP requirements are cascaded down to all subcontractors and workers undertaking works on the Project — whether formally or informally employed — and to supervise and monitor subcontractor performance. Workers engaged on the Project, whether by Integra directly or by its subcontractors, are required to abide by directives issued by their employer with regard to environmental, social, health, safety and labour management. KTZ does not separately contract with or supervise subcontractors; the chain of responsibility runs from KTZ to Integra to subcontractors.

Integra is responsible for the preparation of the CESMP for the construction phase. The CESMP must be fully compliant with this project-level ESMP and the ESIA.

10.6.1 Specific Responsibilities

In addition to the above, Integra is responsible for:

- Implementing all measures and responsibilities allocated to the EPC Contractor under the ESMP for the full duration of the EPC Contract.
- Ensuring adherence to all applicable national environmental, health, safety and labour laws and regulations of the Republic of Kazakhstan in force at the time.
- Verifying that the as-built design reflects the mitigation commitments set out in the ESIA; identifying and reporting to KTZ any departures and any unanticipated impacts; supporting KTZ in any required update to the ESIA / ESMP.
- Undertaking and documenting a facilitated environmental, health, safety and social risk assessment covering all phases of the works.
- Ensuring adequate budget, staff and other resources are allocated to comply with and implement Integra's responsibilities under the ESMP and to supervise and monitor active construction sites and worker accommodation.
- Ensuring suitably qualified and experienced safeguards officers have been appointed, in accordance with the ESMP requirements, to undertake on-site supervision and monitoring activities before the commencement of works at each section.
- Adopting a zero-tolerance approach to OHS on the Project; enforcing compliance with the OHS requirements of the ESMP including the wearing of appropriate PPE at all times on construction sites.
- Obtaining all necessary licenses and permissions before commencement of related works; sharing copies of all clearances, permits, licenses and insurances with KTZ.
- Providing — with support from KTZ where appropriate — environmental, social, health and safety training and induction for all workers and other personnel as required.
- Cascading the ESMP requirements to subcontractors through subcontract documentation, and supervising and monitoring subcontractor performance.
- Supporting KTZ in undertaking ongoing consultation and the operation of the project Grievance Redress Mechanism; in particular, the EPC Contractor's GRM Focal will thoroughly document details of any complaints received directly by the Contractor and convey these promptly to the KTZ CLO; the EPC Contractor will assist in resolving complaints at site level.
- Submitting monthly environmental and social management reports to KTZ documenting the work undertaken over the reporting period, the environmental and social measures implemented, monitoring data collected, near-misses and incidents recorded, grievances received and conveyed to the KTZ CLO, and follow-up actions taken or proposed.
- Informing KTZ immediately in the event of any approved material design changes or any unanticipated environmental or social impacts during implementation; providing any information needed by KTZ to enable a prompt update of the ESIA / ESMP for clearance by Lenders before any changes are implemented.
- Informing KTZ within 24 hours of any chance find or major incident (including fatality) on site and providing within 48 hours an incident report with corrective action detailing how recurrence will be prevented.

- Informing KTZ immediately of any non-compliance and assisting in the preparation of a Corrective Action Plan for clearance by Lenders implementing all necessary corrective action requested by KTZ.

10.6.2 EPC Contractor Reporting

Integra will establish its own internal systems for monitoring and reporting ESMP implementation. Integra will formally submit monthly environmental and social management reports to KTZ per an agreed template. Complete photographic records will be kept by Integra covering all activities on site, including key locations such as construction work fronts, off-site access roads, batching plants, borrow pits, storage areas, sanitation and welfare facilities, and worker accommodation. Photographs of key areas will be taken prior to site establishment and construction activities beginning to provide the environmental baseline. Copies of all geo-referenced photographs will be submitted to KTZ along with the monthly report.

Specifically, Integra is responsible for the following documents and reports:

Table 105: EPC Contractor Reporting Responsibilities

Document	Responsible Person	Destination	Design Verification	Construction
Health and Safety Risk Assessment	EPC H&S Specialist	KTZ	X	X (updated annually and after major incident)
Design verification documentation	EPC Environmental and Social Manager	KTZ	X	
CESMP and all sub-plans for approval	EPC ESM	KTZ	X (within 30 days of ESMP effectiveness)	X (updated as needed)
Environmental, health, safety and social inspection checklists	EPC ESM / H&S	KTZ		X (daily; reported weekly)
Monthly environmental and social management reports, including monitoring records	EPC ESM	KTZ	X (monthly)	X (monthly)
Vibration and noise monitoring records (instrumental)	EPC ESM	KTZ		X (real-time during relevant works; monthly summary)
Air quality monitoring records	EPC ESM	KTZ		X (continuous at fixed locations; monthly summary)
Water quality monitoring (Shardara crossing)	EPC ESM	KTZ		X (during in-river works; monthly summary)

Document	Responsible Person	Destination	Design Verification	Construction
Incident reports	EPC H&S	KTZ		X (major within 24 hr; all in monthly report)
Chance Find reports	EPC ESM	KTZ		X (within 24 hours of any find)

10.6.3 EPC Contractor Staff

To prepare and implement the CESMP, Integra is required to maintain a dedicated team of environmental, social, health, safety and labour specialists, including the following roles. The CESMP confirms the specific personnel filling each role.

- Project Manager — overall accountability for ESMP and CESMP delivery
- Environmental and Social Manager (ESM) — the lead environmental specialist, with primary responsibility for CESMP preparation, implementation and reporting
- Health and Safety Specialist — supported by Health and Safety Supervisors at each active work front
- Labour Officer — responsible for compliance with the Labour Management Plan, the Code of Conduct, and worker welfare arrangements
- GRM Focal — point of contact within the Contractor for any grievances received directly by the Contractor; transmits all grievances to the KTZ CLO

10.6.4 EPC Contractor Management Systems

Integra is required to maintain certified environmental and health and safety management systems for the duration of the EPC Contract. Acceptable certifications include ISO 14001 (Environmental Management Systems) or equivalent, and ISO 45001 (Occupational Health and Safety Management Systems) or equivalent.

10.6.5 EPC Contractor Control of Records

Integra is required to maintain controlled records of all ESMP-related activities, including but not limited to: induction and training records; permit and license registers; subcontractor approval registers; incident registers; grievance registers (forwarded to the KTZ CLO); monitoring records; method statements and risk assessments; non-conformance and corrective action records; and photographic baselines. Records are retained for the duration of the EPC Contract plus a minimum of seven years thereafter. KTZ has unfettered access to all records on request, and the lenders' Independent Environmental and Social Consultant has access to records through KTZ.

10.7 Independent E&S Monitoring

In addition to KTZ's internal monitoring and supervision arrangements, KTZ will appoint a suitably qualified independent environmental and social consultant to periodically monitor implementation of the Project ESMP, ESAP and associated management plans. The independent monitor will review compliance with Project E&S commitments, implementation and effectiveness of mitigation measures, outstanding corrective actions and material E&S incidents and grievances, and will identify any additional corrective actions required. Monitoring reports will be provided to KTZ and the Lenders. The frequency and duration of independent monitoring will be defined in the ESAP, with

monitoring continuing through construction and for an appropriate period following commencement of operation.

10.8 Training, Competency and Capacity Development

Training, competency and capacity development will be implemented throughout the Project to ensure that personnel responsible for environmental and social management have the knowledge, skills and qualifications necessary to fulfil their assigned responsibilities. Requirements will be appropriate to the relevant Project phase and the roles undertaken. During construction, the EPC Contractor is responsible for training and competency of its personnel and subcontractors, subject to KTZ oversight. KTZ is responsible for developing and maintaining the institutional and specialist capacity required for Project oversight and for the transition to operation.

10.8.1 Construction Phase Training and Induction

The EPC Contractor will provide environmental, social, health and safety training and induction to all personnel engaged in construction, including subcontractor personnel. Training will be appropriate to the individual's role and exposure to Project risks and will be provided in a language understood by the worker.

All workers will complete mandatory induction before commencing work on the Project. Personnel already mobilised at the time these requirements become effective will receive the applicable training as soon as practicable.

In addition to the topic-specific E&S training summarised in the table below, the EPC Contractor is required to ensure that all workers hold the role-specific training, certifications and qualifications applicable to their trade (for example, welding, and plant/heavy-vehicle operation), as part of its standard human-resources and OHS management procedures, with training and certification records maintained as part of the EPC Contractor's control of records described below.

Table 106: Training and Induction Requirements

Training Category	Requirements	When It Must Be Done	Frequency / Records
Mandatory induction	All EPC Contractor and subcontractor workers complete mandatory E&S induction. Training will cover, as applicable: Project E&S requirements; OHS	Before commencing work on the Project; as soon as practicable for personnel already mobilised.	Completion recorded. New workers may not commence site work without induction.

Training Category	Requirements	When It Must Be Done	Frequency / Records
	rules and PPE; Code of Conduct, including prohibition of GBVH; pollution prevention and waste management; biodiversity protection measures; chance finds; worker and community grievance mechanisms; emergency response; and requirements applicable to the worker's activities or work location.		
GBVH prevention and response	Workers will receive GBVH awareness and prevention training, including the Code of Conduct,	At induction and before personnel assume relevant supervisory or focal-point responsibilities.	Refresher training at least every six months for workers; designated focal-point training refreshed as appropriate.

Training Category	Requirements	When It Must Be Done	Frequency / Records
	prohibited behaviour, reporting channels and confidentiality. Supervisors, managers and designated focal points will receive additional role-appropriate training on recognition, reporting, response and referral arrangements.		
Task and work-front-specific E&S training	Training will be provided on the environmental and social requirements relevant to particular activities and locations. This will include, as applicable, pollution prevention, waste and	Before undertaking the relevant activity or entering a work area requiring specialist controls.	Refresher training where required by the CESMP, following material changes in procedures or where monitoring identifies inadequate implementation.

Training Category	Requirements	When It Must Be Done	Frequency / Records
	hazardous-material management, biosecurity, archaeological chance finds, noise and vibration controls, biodiversity protection, heat-stress management, emergency response and other requirements established through the CESMP and its topic-specific plans.		
Refresher training	Refresher training will reinforce general E&S and OHS requirements and topic-specific requirements relevant to the worker's	Throughout construction.	General E&S/OHS refresher training at least every six months, supplemented by risk- and task-specific refreshers as required.

Training Category	Requirements	When It Must Be Done	Frequency / Records
	activities. Additional training will be provided where incidents, non-compliances, grievances, monitoring results or changes in work methods indicate a need.		
GRM – contractor procedures	EPC Contractor and subcontractor personnel, particularly the Contractor's GRM Focal, site supervisors and community-facing staff, will be trained in receiving and recording grievances, prompt referral to the KTZ CLO, response	Before commencing relevant duties; as soon as practicable for personnel already mobilised.	Refresher at least every six months and following material changes to the grievance procedures. Training and awareness records maintained.

Training Category	Requirements	When It Must Be Done	Frequency / Records
	and escalation procedures, confidentiality and non-retaliation. Workers will also be informed of the separate Worker GRM. This training implements the relevant ESCA Corrective Action Plan requirements relating to contractor GRM procedures and worker awareness.		
Training records and reporting	Training records will identify the personnel trained, date, subject matter and, where applicable, competency or certification achieved.	Throughout construction.	Records maintained by the EPC Contractor and made available to KTZ for verification. Training performance will be included in routine E&S reporting.

Training Category	Requirements	When It Must Be Done	Frequency / Records
Mandatory induction	All EPC Contractor and subcontractor workers complete mandatory E&S induction. Training will cover, as applicable: Project E&S requirements; OHS rules and PPE; Code of Conduct, including prohibition of GBVH; pollution prevention and waste management; biodiversity protection measures; chance finds; worker and community grievance mechanisms; emergency response; and requirements applicable to the worker's activities or work location.	Before commencing work on the Project; as soon as practicable for personnel already mobilised.	Completion recorded. New workers may not commence site work without induction.
GBVH prevention and response	Workers will receive GBVH awareness and prevention training, including the Code of Conduct, prohibited behaviour, reporting channels and confidentiality. Supervisors, managers and designated focal points will receive additional role-appropriate training on recognition, reporting, response and referral arrangements.	At induction and before personnel assume relevant supervisory or focal-point responsibilities.	Refresher training at least every six months for workers; designated focal-point training refreshed as appropriate.
Task and work-front-specific E&S training	Training will be provided on the environmental and social requirements relevant to particular activities and locations. This will include, as applicable, pollution prevention, waste and hazardous-material management, biosecurity, archaeological chance finds, noise and vibration controls, biodiversity protection, heat-stress management, emergency response and other requirements established through the CESMP and its topic-specific plans.	Before undertaking the relevant activity or entering a work area requiring specialist controls.	Refresher training where required by the CESMP, following material changes in procedures or where monitoring identifies inadequate implementation.
Refresher training	Refresher training will reinforce general E&S and OHS requirements and topic-specific requirements relevant to the worker's activities. Additional training will be provided where incidents, non-compliances, grievances, monitoring results or changes in work methods indicate a need.	Throughout construction.	General E&S/OHS refresher training at least every six months, supplemented by risk- and task-specific refreshers as required.

Training Category	Requirements	When It Must Be Done	Frequency / Records
GRM – contractor procedures	EPC Contractor and subcontractor personnel, particularly the Contractor's GRM Focal, site supervisors and community-facing staff, will be trained in receiving and recording grievances, prompt referral to the KTZ CLO, response and escalation procedures, confidentiality and non-retaliation. Workers will also be informed of the separate Worker GRM. This training implements the relevant ESCA Corrective Action Plan requirements relating to contractor GRM procedures and worker awareness.	Before commencing relevant duties; as soon as practicable for personnel already mobilised.	Refresher at least every six months and following material changes to the grievance procedures. Training and awareness records maintained.
Training records and reporting	Training records will identify the personnel trained, date, subject matter and, where applicable, competency or certification achieved.	Throughout construction.	Records maintained by the EPC Contractor and made available to KTZ for verification. Training performance will be included in routine E&S reporting.

10.8.2 Role Specific Competency and Training

In addition to the topic-specific E&S training requirements identified above, the EPC Contractor will maintain a process to ensure that all personnel undertaking roles requiring specific competencies, qualifications, licences or certifications are appropriately trained, qualified and, where applicable, certified before undertaking those activities. This will include, as applicable, operators of heavy goods vehicles and construction machinery, lifting equipment operators and riggers, welders, electricians, personnel working at height or in confined spaces, and other safety-critical roles. Competency and certification records will be maintained and subject to verification by KTZ. Subcontractors will be subject to the same requirements.

10.8.3 KTZ Capacity Development

In parallel with construction-phase training, KTZ will implement a capacity development programme to support effective oversight of ESMP implementation and establish the environmental and social capability required for operation of the Project.

The programme will be coordinated with the corporate ESMS development programme and associated Corporate ESMS Audit Corrective Action Plan, including the development of capacity in areas identified through that process such as biodiversity management, stakeholder engagement, resettlement oversight, contractor management and cross-functional E&S coordination.

Capacity development for personnel responsible for Project E&S oversight will include, as relevant to their roles:

- applicable Lender E&S requirements and WBG EHS Guidelines;
- ESIA, ESMP and CESMP implementation and monitoring;
- contractor and subcontractor E&S oversight;
- stakeholder engagement and grievance management;
- biodiversity management, including development and implementation of the BAP and achievement and verification of applicable biodiversity objectives;
- noise and vibration management;
- occupational and community health and safety;
- pollution prevention and hazardous-material management;
- GBVH prevention and response;
- climate resilience and emergency preparedness; and
- environmental and social monitoring and Lender reporting.

Training may be delivered through KTZ's internal training systems, Lender-supported capacity development and external specialist providers.

Where specialist expertise is not available within KTZ, external technical assistance will be retained as necessary during construction and the transition to operation. This may include specialist support for biodiversity and BAP development and implementation, operational noise and vibration assessment and mitigation design, hazardous-cargo and emergency-response planning, and other specialist matters identified through implementation of the ESMP or ESCA Corrective Action Plan.

10.8.4 Operational Rediness and Continuous Training

Prior to commissioning of each section of the railway, KTZ will identify the environmental and social roles, competencies and training required for operation of that section and ensure that relevant operational personnel have received the necessary training before assuming their responsibilities.

Operational training will be aligned with the OESMP and associated operational procedures and management plans and will include, as applicable:

- operational environmental and social management and monitoring;
- occupational health and safety;
- emergency preparedness and response, including hazardous-cargo incidents;
- hazardous-material and pollution-prevention requirements;
- biodiversity management and monitoring, particularly for personnel with responsibilities within or adjacent to the Shardara IBA/KBA;
- implementation of relevant BAP requirements;
- stakeholder engagement and the Project GRM;
- climate resilience and response to extreme weather events; and
- role-specific competencies and certifications required for safe railway operation and maintenance.

Routine operational E&S training will be incorporated into KTZ's existing operational training and management systems rather than maintained as a separate parallel system. Refresher training will be provided at intervals appropriate to the relevant risk and role and following material changes to operational procedures, significant incidents, monitoring findings or identified deficiencies in implementation.

Specialist external support may continue during operation where specialist expertise or independent review is required, including for biodiversity monitoring and verification, periodic climate-resilience review and other specialist commitments established through the OESMP, BAP or Lender requirements.

10.9 CESMP Review and Update

The CESMP is a living document. Integra is required to review the CESMP at least annually and to update it in response to:

- changes in the scope or method of the works;
- the identification of unanticipated impacts;
- the findings of internal audits or external audits by the lenders' Independent Environmental and Social Consultant;
- corrective actions arising from non-compliance;
- changes in applicable national law or in lender requirements;
- changes in the EPC Contractor's organisation or key personnel;
- material grievances received through the GRM that indicate inadequacy of existing measures; and
- any other matter that materially affects the implementation of the ESMP.

Updates to the CESMP are submitted to KTZ for approval. Material updates are also notified to lenders; updates to the underlying ESMP itself require prior lender clearance.

10.10 Corrective Actions

Where any non-compliance with the ESMP is identified — whether by Integra's internal audits, by KTZ's supervision, by the lenders' Independent Environmental and Social Consultant, or through the GRM — a Corrective Action Plan is prepared by Integra in consultation with KTZ. The Corrective Action Plan identifies the non-compliance, its root cause, the immediate corrective measure to bring the situation back into compliance, and the longer-term preventive measure to ensure non-recurrence. The Corrective Action Plan is submitted to KTZ for review and onward submission to Lenders for clearance. Implementation of the corrective action is tracked through to closure and verified by KTZ. Where the non-compliance is attributable to Integra or its subcontractors, the cost of corrective action is borne by Integra.

10.11 Meetings and Site Visits

Routine meetings between KTZ and Integra are held on a regular basis to review ESMP implementation. The standing schedule comprises:

- Weekly site walkdowns by the KTZ ESO and the Integra ESM at each active work front, with documented findings.
- Monthly ESMP performance review meetings between the KTZ and the Integra senior management team, covering the monthly report, outstanding items, and forward look.

Records of all meetings and site visits are maintained and form part of the Project record.

10.12 EPC Contractor & Sub-contractor Management

The Project's subcontractor compliance management framework operationalizes the requirements of IFC PS2 ¶27 and the IFC Good Practice Note on Managing Contractor and Subcontractor Risk, and addresses the specific GBVH pre-screening commitments from Section 8 update. The Project operates with approximately ten subcontractors of varying scale and specialization; the framework applies to all subcontractors regardless of contract value.

Pre-screening. Subcontractors are pre-screened by Integra against E&S performance criteria including: organizational E&S policies and procedures; past E&S performance record (incidents, fines, non-compliances over the previous 3 years); training capacity (in-house training; partnership with training providers); GBVH performance specifically — past-record disclosure on harassment/abuse cases, organisational anti-harassment policy, training capacity for GBVH prevention; OHS performance and certification; labour conditions compliance; capacity to deliver the relevant scope of CESMP requirements. Pre-screening outcomes documented in the subcontractor approval register; KTZ Project E&S team retains audit access to the register. Subcontractors falling below threshold standards are either rejected or admitted only on condition of capacity-building delivered by Integra.

Cascading of ESMP requirements. ESMP requirements are cascaded through subcontract documentation, with specific clauses on: compliance with the project ESMP and CESMP; cascading to second-tier subcontractors; specific OHS, environmental, labour, and GBVH commitments; reporting to Integra on monthly cadence; cooperation with Integra and KTZ inspections; cooperation with IESC and lender requests; cost responsibility for non-compliance corrective actions; right of Integra to terminate the subcontract for material breach. Subcontract documentation reviewed by Integra's legal and E&S teams before signature.

Subcontractor compliance monitoring. Integra monitors subcontractor E&S compliance through: weekly site walkdowns at active subcontractor work fronts; review of subcontractor monthly E&S reports; verification of subcontractor records (induction, training, monitoring, incident, grievance); investigation of complaints received against subcontractors. Subcontractor non-compliances are recorded in the non-conformance register with corrective actions tracked through to closure. Material non-compliances are escalated to KTZ for awareness and, where required, to lenders for clearance of corrective action plan.

Independent subcontractor audits. KTZ Project E&S team conducts independent quarterly audits of subcontractor compliance, sampling subcontractors by risk profile (higher-risk subcontractors audited more frequently) and topic category (higher-risk topic categories audited more frequently). The IESC reviews subcontractor compliance during semi-annual site visits with explicit attention to accessibility of the workers' GRM for subcontracted labour, vulnerable groups access, and migrant labour conditions. Findings reported in the IESC report.

Removal of non-compliant subcontractors. Where material non-compliance cannot be remedied within a reasonable corrective action timeframe, or where serious incidents (fatality, serious injury, confirmed GBVH cases, major environmental incident) are attributable to a subcontractor, Integra is required to remove the subcontractor from the Project. The right to terminate the subcontract for material breach is included in subcontract documentation. Subcontractor removal does not relieve Integra of obligations to complete the work; replacement subcontractors must be pre-screened to the same standard.

Workers' GRM accessibility for subcontracted labour. Per Section 9.6, the Workers' GRM is accessible to all categories of Project worker including subcontracted and migrant labour, with provisions appropriate to the multi-employer construction context. Subcontracted workers receive GRM induction in their language of preference. KTZ Project E&S team conducts dedicated GRM-accessibility verification with subcontracted labour during quarterly audits.

10.13 Independent E&S Consultant (IESC)

The lenders appoint an Independent Environmental and Social Consultant (IESC) to provide independent monitoring of Project E&S performance against the ESMP, the BAP framework, and the lenders' safeguards. The IESC is funded by KTZ but reports independently to lenders, with KTZ providing facilitation, document access, site access, and stakeholder access as required.

Appointment timing. The IESC is appointed prior to lender Board approval and remains in continuous engagement through construction and into operations. The IESC mandate covers: pre-construction (review of the ESMP, BAP framework, key plans and method statements); construction (site visits with comprehensive review of CESMP implementation, GRM operation, GBVH framework, BAP development, stakeholder engagement, monitoring outcomes); operations (annual site visits with review of OESMP implementation, BAP delivery and Net Gain progress, operational monitoring, GRM continuation); through to Project Completion Report (PCR) closure.

IESC site visit. Semi-annual site visits during construction with each visit comprising: ESMP and CESMP review against current implementation; field verification of mitigation delivery at active work fronts; GRM register review with explicit focus on accessibility, responsiveness, vulnerable groups, GBVH cases, and closure rates; stakeholder interviews including with affected communities, vulnerable groups, and workers; monitoring data review; biodiversity progress review including BAP development milestones. Annual site visits during operations with similar scope adjusted for operational context. IESC engages with the KTZ Biodiversity Working Group quarterly during F-BAP development and at annual review thereafter.

IESC reporting. IESC site visit reports submitted to lenders within 30 days of site visit conclusion, with copy to KTZ. Reports include: findings against ESMP and lender safeguards; specific Action Items with named ownership and target dates; status update on previously-identified Action Items; closure verification of resolved items. IESC reports are made available in lender disclosure consistent with the EMR disclosure framework.

Specific IESC roles (to be elaborated in a formal ToR). (a) Critical Habitat Net Gain verification — the principal lender-sensitive role for this Project. The IESC reviews BAP development, offset programme delivery, monitoring outcomes against Net Gain baseline, and adaptive management trigger response. (b) GRM and GBVH framework review — explicit focus on accessibility for vulnerable groups, women, ethnic minorities, distance-located stakeholders, subcontracted/migrant workers; cross-validation with field observations and stakeholder interviews; effectiveness for high-priority case categories. (c) Cross-border engagement participation — the IESC observes cross-border coordination as part of the Section 9.11 framework. (d) Vulnerable groups engagement verification — gender-disaggregated employment, women's participation, ethnic minority access. (e) ESCA Corrective Action Plan closure verification — coordinating with the parallel ESCA closure framework.

10.14 Operation and Maintenance Phase

The Operations and Maintenance Phase ESMP (OESMP) applies from the commissioning of each section of the alignment and operates for the duration of the asset's operational life. The OESMP transitions ESMP responsibility from the EPC Contractor (Integra) to KTZ operational management, with continuity of E&S performance, monitoring, GRM, and reporting frameworks. The OESMP is prepared by KTZ, submitted to lenders for clearance, and disclosed alongside the operational commissioning of each section.

10.14.1 O&M Topic Specific Plans

The OESMP comprises the following operational topic-specific plans, each prepared by KTZ and approved at the operational handover milestone for each section:

Table 107: O&M Topic Specific Plans

Operational Plan	Scope
OESMP-01 Operational Air Quality Monitoring Plan	Continuous and periodic ambient air quality monitoring at the six sensitive receptor locations identified in Section 8.4.4. Annual reporting to lenders; trigger-based intervention for exceedances of WHO 2021 AQG annual values.
OESMP-02 Operational Noise and Vibration Monitoring Plan	Pre-commissioning baseline, post-commissioning verification, 5-yearly periodic monitoring at the six sensitive receptor locations. Maktaaral and Ushagash trackform mitigation performance verification with annual monitoring in years 1-3 then 5-yearly. Trigger-based intervention for exceedances of IFC 55/45 dB(A) (noise) or FRA TNVIM 72 VdB Occasional Events (vibration).
OESMP-03 Operational Biodiversity Monitoring Plan	Carcass searches with searcher-efficiency/scavenger-removal corrections at the 10 kV OHL sections through the IBA/KBA; vantage-point surveys at six pre-selected locations; minimum 3 years continuous post-energisation, 5-yearly thereafter. Sturgeon long-term monitoring in coordination with Tennessee Aquarium/KFR&PC. Shardara IBA/KBA waterbird monitoring integrated with ACBK long-term programme. Adaptive management trigger response per Section 4 update finding 4.10.
OESMP-04 Operational Pollution Emergency Response Plan	Pre-positioned spill response equipment at the Shardara crossing and at strategic locations along the alignment. Designated response protocols by cargo type. Joint exercises with territorial Ministry of Emergency Situations and IBA management body at minimum annual frequency. Cross-border coordination with Uzbek Railways per Section 9.11 update.
OESMP-05 Operational Hazardous Cargo Transport Management Plan	The specific operational controls to be applied will be determined through the pre-operation hazard assessment, based on the credible accident scenarios, hazardous materials involved, potential consequences and receptors identified. The assessment will inform the necessary engineering, operational, emergency-response and monitoring measures, which will then be incorporated into the relevant KTZ operational procedures and the Operational ESMP.
OESMP-06 Operational GBVH and Gender Management Plan	Continuation of GBVH framework into operations under KTZ corporate code of conduct application. Operational workforce GBVH training. Operational GBVH GRM channels per Section 9.5 update. Crisis centre partnership maintenance.
OESMP-07 Operational Worker Accommodation and Welfare Plan	KTZ corporate standards for operational worker accommodation at Yerdaut depot and Maktaaral disinfection complex, aligned with IFC-EBRD Workers' Accommodation: Processes and Standards 2009 benchmarks. Periodic third-party audit (5-yearly minimum) covering accommodation arrangements, OHS, and welfare provision.
OESMP-08 Operational Community Health and Safety Plan	Operational community awareness programme on level-crossing safety, hazardous-cargo accident response, evacuation routes, shelter-in-place protocols. Pre-commissioning awareness campaign in all five affected districts; refresher engagement annually during operations. Specific engagement at Maktaaral on cross-border cargo handling. Training and awareness-raising will also be informed by the findings of incident and near-miss investigations, inspections, audits and reported

Operational Plan	Scope
	unsafe conditions. KTZ and the EPC Contractor will periodically review these findings to identify recurring hazards, trends and lessons learned, and use them to determine priority topics for toolbox talks, refresher training and other awareness-raising activities. The review will also identify where incidents or near misses indicate the need for improvements to procedures, engineering or operational controls, supervision or other safety measures, rather than relying on training alone.
OESMP-09 Operational Climate Resilience Review and Adaptation Plan	The hydraulic and climate-risk assessment will take account of the regulated nature of the Syr Darya and will not rely solely on projected changes in natural catchment flows. Assessment of future flood risk at the Project crossing will include consultation with the relevant authorities and regional bodies responsible for operation and flood-risk management across the Syr Darya reservoir cascade, and consideration of available information on reservoir operating regimes, release rules and potential future changes in cascade management. The resulting regulated-flow scenarios, together with projected climate change, will be used to confirm the appropriate design flood conditions and the residual climate risk to the Project.
OESMP-11 Operational GRM and Stakeholder Engagement Plan	Operational GRM continuation per Section 9.20 update — 12-month transition overlap with EPC Contractor CLO; KTZ operational CLO function at Turkistan regional office; 3-level GRM structure with same timescales; annual community meetings in years 1-3 then triennial; quarterly GRM aggregate reports; annual report to lenders; IESC review; 5-yearly comprehensive GRM review.
OESMP-13 Operational Irrigation Network Monitoring Plan	Per Section 8.Q update — quarterly inspection of intersected canals during first 3 operational years, annual thereafter subject to satisfactory performance. Retrofit-trigger criteria. Community-facing GRM access for irrigation-related concerns. Cost responsibility framework. KTZ will include all Project culverts and associated drainage structures within the routine O&M inspection and maintenance programme. This will include periodic inspection and removal of sediment, debris, vegetation and other blockages; maintenance of inlets, outlets and erosion-protection structures; and inspection of upstream and downstream areas for evidence of erosion, scour, sediment deposition, ponding, overtopping or altered drainage/flooding patterns. Inspections will also be undertaken following significant rainfall or flood events. Identified defects, blockages or erosion/flooding issues will be recorded and corrective maintenance or additional protection measures implemented as required.
OESMP-14 Operational Embankment-Groundwater Monitoring Plan	Per Section 8.R update — quarterly inspection of agricultural land condition adjacent to embankment during first 3 operational years, annual thereafter. Retrofit-trigger criteria for additional drainage. KTZ E&S contingency budget for retrofit interventions.

All biodiversity actions and plans requiring implementation during O&M phase will be implemented per the Project BAP.

10.14.2 O&M Staffing

Operational E&S management of the Darbaza–Maktaaral line is delivered through KTZ's existing operational E&S organization, not through a bespoke project-specific operational team. The Corporate ESMS Audit confirms that KTZ operates a mature, multi-tier IMS-based structure spanning corporate, network, regional, and line levels, with routine environmental and OHS management decentralised to operational-unit level — typically one environmental specialist and one OHS specialist per operational unit, undertaking routine inspections, overseeing compliance with national environmental and OHS requirements, and reporting through oblast-level (Turkistan/Shymkent regional) management to corporate headquarters in Astana. Executive accountability for environmental and OHS performance rests with the Deputy Chairmen of the Management Board. On commissioning, the line falls under these arrangements in the same way as the remainder of KTZ's operational network.

Routine operational E&S management. Routine environmental and OHS management at the operational stage — air quality, noise, waste, pollution prevention, OHS at the Yerdaut servicing point and Maktaaral facilities, station operations — is delivered by the standard operational-unit E&S complement under the IMS, with no incremental resourcing beyond KTZ's established model. The relevant OESMP plans (OESMP-01 Air Quality, OESMP-02 Noise and Vibration, OESMP-07 Worker Accommodation and Welfare, OESMP-08 Community Health and Safety where routine) are delivered through this existing structure.

Incremental specialist capability committed under the Corporate ESMS Audit CAP. The Corporate ESMS Audit identified that KTZ's existing structure does not yet embed specialist capacity in biodiversity management, structured stakeholder engagement, and resettlement oversight, and the ESMS Audit CAP commits an ESMS development programme to embed these. The line-specific operational commitments that exceed routine operations are delivered through this incremental capability rather than through new standalone project roles:

Biodiversity / BAP delivery — delivered through the corporate biodiversity capability KTZ commits to embed under the ESMS Audit CAP (which addresses the audit finding that no corporate biodiversity risk-management procedure, CHA trigger, or BAP requirement currently exists). This capability is responsible for BAP delivery, operational biodiversity monitoring (OESMP-03), and adaptive management trigger response over the asset's operational life, coordinating with ACBK, the KBA Partnership, and the sturgeon conservation partners. Where in-house capability is being built, KTZ retains specialist external support (see capacity development below).

Stakeholder engagement and GRM continuation — delivered through the corporate stakeholder-engagement capability KTZ commits to embed under the ESMS Audit CAP, supporting the operational GRM (OESMP-11) with the 12-month transition overlap from the construction-phase CLO per Section 9.20 update, based at the KTZ Turkistan regional office.

GBVH continuation — delivered through the operational application of KTZ's corporate Code of Conduct and HR/Human Rights policy framework (which the ESMS Audit confirms exists at corporate level), with a designated female focal point at the Turkistan regional office maintaining the crisis-centre partnerships established during construction (OESMP-06).

Climate resilience review — the 5-yearly climate resilience review (OESMP-09) is delivered at KTZ corporate level (Astana) with regional support, drawing on specialist external support for the periodic review cycle as needed.

Cross-border coordination — operational biosecurity and emergency-response coordination with Uzbek Railways at the Maktaaral interface (OESMP-04, OESMP-05) is delivered through the relevant operational and corporate functions, building on the cross-border engagement framework established under Section 9.11 update.

Executive accountability and escalation. Operational E&S accountability follows KTZ's existing IMS escalation pathway from operational-unit specialists through oblast-level management to corporate headquarters, with executive accountability through the Deputy Chairmen of the Management Board.

The Corporate ESMS Audit CAP commitment to clearer delineation of decision-making authority and escalation mechanisms applies to the operational phase, strengthening the existing pathway in line with PS1 / ESS1 expectations.

10.14.3 O&M Reporting

Operational reporting to lenders reverts to annual Environmental and Social Monitoring Report (EMR) at the Project Completion Report (PCR) milestone, with annual operational reporting continuing thereafter if recommended by the PCR until all issues are closed to lender satisfaction. Operational EMRs cover: OESMP implementation status; operational monitoring outcomes against trigger levels; GRM aggregate statistics; significant incidents; adaptive management trigger events and responses; BAP delivery and Net Gain demonstration progress; 5-yearly climate resilience review outcomes (in years 5, 10, 15, etc. of operations). Major incident notification to lenders within 48 hours remains throughout operations. Quarterly GRM reports to lenders during construction reduce to annual operational GRM reports.

10.14.4 O&M Adaptive Management Triggers

Operational adaptive management trigger framework:

- Biodiversity: confirmed mortality of a globally threatened (IUCN EN or CR) species, or collision events on the affected species assemblage exceeding the level assumed in offset design - additional minimisation measures and/or expansion of offset programme within 90 days; retrofit option (overhead-to-buried) preserved as contingency.
- Operational noise/vibration: confirmed exceedance of IFC daytime 55 dB(A) / night-time 45 dB(A) or FRA TNVIM 72 VdB Occasional Events criterion at any monitored receptor - additional mitigation (additional barriers, façade insulation, trackform escalation including floating slab where indicated).
- Operational air quality: confirmed exceedance of WHO 2021 AQG annual values at any monitored receptor attributable to Project - operational source-control measures (locomotive emissions standards review, station idling restrictions); engagement with affected community.
- Climate hazard: 5-yearly review identifying material change in hazard envelope vs design assumptions - review of asset performance, additional adaptation measures, escalation to electrification business case re-examination.
- Hazardous cargo incident: any significant incident - review of operational procedures, training, infrastructure; community engagement on response.
- GBVH GRM aggregate trend: material increase in GBVH cases or shift in case pattern - review of training delivery, contractor performance, partnership effectiveness.

11. Conclusions and Recommendations

11.1 Conclusions

The corridor traverses a flat, semi-arid landscape of steppe, semi-desert and irrigated agricultural land. The single most material biological receptor is the Shardara Reservoir Important Bird Area and Key Biodiversity Area, which the line crosses for approximately 16 km on a raised embankment and where the Syr Darya River is bridged at KM 83.5. The Shardara IBA/KBA triggers Critical Habitat under the lenders' biodiversity safeguards for the Dalmatian Pelican, the Pygmy Cormorant and the Syr-Darya Shovelnose Sturgeon; it further supports the Lesser White-fronted Goose, internationally significant migratory and wintering waterbird assemblages, and the Aral Barbel as additional biodiversity receptors. Terrestrial sections support IUCN Vulnerable mammals and reptiles and Kazakhstan Red List flora. The Indigenous Peoples safeguard is confirmed as not triggered.

The impact assessment identifies 128 distinct impacts across the design, land take, construction and operations and maintenance stages. The majority of construction-phase impacts are temporary, localized and reversible, relating to dust, noise, vibration, soil disturbance, vegetation clearance, potential interruption or impairment of irrigation infrastructure, and community health and safety risks.

The principal operational impacts are predicted exceedances of the IFC noise guideline values at six locations along the alignment, predicted operational vibration exceedances at Maktaaral and Ushagash, the operational-phase severance of pasture land and interruption to agricultural access and livestock movement at multiple locations along the alignment (addressed through the existing crossing provision, as-built verification against actual agricultural and livestock access requirements, and corrective measures where a material connectivity deficiency is identified), and the ongoing risk of avian collision and electrocution on the two 10 kV overhead distribution lines within the IBA/KBA.

A comprehensive mitigation framework has been developed in accordance with ADB SPS 2009, IFC PS 2012, the AIIB ESF 2024, the WBG EHS Guidelines for Railways and the applicable laws of the Republic of Kazakhstan. The framework is documented in the ESMP, which sets out 35 design and pre-construction, 63 construction, and 24 operations and maintenance commitments, each anchored to a specific impact or ESCA CAP item and supported by topic-specific management plans. With effective implementation, many of the identified environmental and social impacts are expected to reduce to Low or Not Significant, although a number of residual impacts remain at Medium or High significance and require the specific mitigation, monitoring and management measures identified in the ESMP and associated management plans.

One significant residual impact remains at High: the permanent loss of approximately 150 ha of habitat within the Shardara IBA/KBA, for which the achievement of No Net Loss and Net Gain for the Critical Habitat-triggering species is conditional on implementation of the Biodiversity Action Plan and Offset Management Plan. The overall climate risk over the 120-year design life is rated High, driven by river flood at the Syr Darya crossing, rainfall-induced landslide on embankment slopes adjacent to the Shardara Reservoir, and rising mean surface temperature; with the adaptation measures committed in the ESMP, the residual is expected to reduce to Moderate, subject to detailed design verification at the EPC stage.

On the basis of these findings, the Project is confirmed as technically feasible, strategically warranted, and capable of being brought into alignment with the safeguard requirements of ADB, IFC and AIIB through full implementation of the ESMP, the BAP, the LARP and the ESCA Corrective Action Plan.

11.2 Recommendations and Next Steps

The ESMP, its mitigation and monitoring programmes and the topic-specific management plans referenced in Section 10.3 shall be incorporated into the EPC Contract between KTZ and Integra

Construction KZ LLP as binding contractual obligations. The EPC Contractor shall implement the ESMP through its CESMP, which shall adopt all applicable ESMP requirements and include site-specific measures for matters not currently known, including final construction camp locations, traffic management arrangements and the schedule of pre-clearance ecological surveys.

KTZ shall supervise and monitor implementation of the CESMP, and non-conformance may be treated as a breach of contractual obligations. The EPC Contractor shall maintain a suitably qualified environmental, health and safety and community liaison team sufficient to implement, monitor and report on Project activities throughout the remaining construction phase.

Prior to or in parallel with mobilisation of the remaining works, KTZ shall continue implementation of the LARP and SEP; finalise, resource and implement the BAP and BOMP; close the outstanding ESCA CAP actions incorporated into the construction-phase ESMP; and undertake the hydraulic capacity review of the Syr Darya bridge, culverts and drainage structures against SSP5-8.5 P90 projected peak-discharge conditions. For sections already constructed, KTZ shall verify the adequacy of the as-built agricultural and livestock crossing provision against actual access requirements and practical usability and, where a material connectivity deficiency is identified, implement technically and operationally practicable corrective measures before the start of operations.

KTZ shall complete the ongoing restoration of the Ushagash LOTOK irrigation channel and the ongoing relocation of the Atakent LOTOK irrigation channel, including completion of the associated land-acquisition requirements for the Atakent works. Irrigation functionality and access required for operation and maintenance shall be verified following completion of these works, and any Project-related deficiencies identified through completion or commissioning shall be rectified. For sections already constructed, KTZ shall complete as-built verification of relevant irrigation and drainage crossing structures and undertake consultation with users at locations where irrigation-related concerns were raised to determine whether construction has resulted in physical damage to irrigation or drainage infrastructure and whether any associated crop, production, income or other economic losses have occurred. The findings shall be documented in an Irrigation Verification Report and, where Project-related physical deficiencies or economic losses are verified, a Corrective Action Plan shall identify the required remedial works, compensation and/or livelihood-restoration measures, responsibilities, budget and implementation schedule. Compensation and livelihood-restoration measures shall be implemented in accordance with the applicable provisions of the LARP.

During operations, KTZ shall implement the committed mitigation and monitoring measures, including noise barriers at Maktaaral and Erdaulet; a detailed operational vibration assessment at Maktaaral and Ushagash, with additional Project-specific vibration mitigation implemented where the assessment demonstrates that it is required; Bird Flight Diverters on the 10 kV lines through the IBA/KBA and the 1 km buffers; the Post-Construction Fatality Monitoring program; the Pollution Emergency Response Plan for the Shardara crossing; and the Operational Waste Management Plan. KTZ shall also inspect and maintain Project-intersected irrigation and drainage infrastructure, with quarterly inspections during the first three years of operation, annual inspections thereafter where satisfactory performance has been demonstrated, and additional inspections following significant flooding or other relevant events. Project-related deterioration, obstruction or impaired hydraulic performance identified through these inspections or the GRM shall be subject to timely corrective action. Performance shall be reported through semi-annual environmental and social monitoring reports to ADB, AIIB and IFC, as applicable, with the ESMP and BAP/BOMP reviewed at substantial completion, at the end of the defects liability period and at five-yearly intervals thereafter.

Vista
Environment

Annex A – ESMP

The Environmental and Social Management Plans (ESMPs) for the Design and Pre-Construction Phase, the Construction Phase, and the Operations and Maintenance Phase are presented in the following tables. All mitigation measures referenced derive from the mitigation measures described in detail in the ESIA, certain of which are summarized in the impact summary tables at Section 8.3 and discussed further in the topic-based narrative at Section 8.4. For the avoidance of doubt, the mitigation measures presented in full in the approved ESIA shall prevail and shall constitute the definitive and mandatory measures to be implemented by the responsible parties in accordance with the EPC Contract.

Each row in the following tables identifies:

- The ESIA Impact ID as the anchor back to the impact assessment;
- The EMP Ref No. in the form [Phase]-[Topic]-[Number], where Phase is D (Design and Pre-Construction), C (Construction) or O (Operations and Maintenance), Topic is a two- or three-letter topic code, and Number is a sequential count;
- The Commitment — the specific mitigation or management measure;
- The Monitoring Indicator — what is observed, measured or reviewed to verify implementation;
- The Implementation Responsibility — typically the EPC Contractor (or KTZ Operations for the O&M phase);
- The Monitoring Responsibility — typically KTZ.

Construction on the Project commenced ahead of the disclosure of this ESIA and ESMP. The Design and Pre-Construction Phase EMoP at Table A-1 is therefore principally a verification framework that requires the EPC Contractor to confirm that the as-built design reflects the mitigation commitments set out in the ESIA, to identify and report any departures from those commitments, and to identify any unanticipated impacts. The mitigation measures themselves remain as committed in the ESIA.

The ESMP also incorporates the corrective actions identified through the Environmental and Social Compliance Audit (ESCA) completed in February 2026. Where a row in the ESMP responds primarily to an ESCA Corrective Action Plan (CAP) item rather than to a specific ESIA Impact ID, the relevant CAP item identifier is shown in the ESIA Impact ID column as the anchor (for example, "ESCA OHS-3").

Vista Environment

Table A-1: Design and Pre-Construction Phase ESMP

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
AF001	D-AGR-01	Agriculture	Severance of agricultural land by alignment; extinguishment of informal crossing points	Verify the adequacy of the completed/as-built agricultural and livestock crossing provision against actual access requirements and practical usability, informed by consultation with affected land users. Where a material connectivity deficiency is identified, KTZ and the EPC Contractor shall consult affected users and implement technically and operationally practicable corrective measures before operation.	As-built access verification completed; consultation records retained; material deficiencies and agreed corrective measures recorded and closed before operation.	EPC Contractor	KTZ
AF001	D-AGR-02	Agriculture	Severance — community-specific issues	Verify the practical adequacy of the completed/as-built crossing arrangements at locations where community access concerns were raised. For the Sattarov/Oshakty area, recognise KM42.8 as the documented alternative to the additional KM44.8 request and verify its practical accessibility. Implement additional or upgraded provision only where the verification identifies a material connectivity deficiency and the measure is technically and operationally practicable	Written response issued to residents and Akimat; record of communication retained; outcome logged in the GRM	EPC Contractor	KTZ / CLO
AF002	D-AGR-03	Agriculture — Irrigation	Loss of irrigation and drainage network connectivity	Verify relevant completed irrigation and drainage crossing structures through as-built records, inspection and appropriate commissioning/functionality checks, and undertake consultation with users at	Irrigation Verification Report completed, including as-built/functionality verification and consultation with users at locations where concerns were raised;	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				locations where irrigation-related concerns were raised. Determine whether construction has resulted in Project-related physical damage or deficiencies and whether any associated crop, production, income or other economic losses have occurred. Document the findings in an Irrigation Verification Report. Where Project-related physical deficiencies or economic losses are verified, prepare a Corrective Action Plan identifying required remedial works, compensation and/or livelihood-restoration measures, responsibilities, budget and implementation schedule. Physical corrective and reinstatement works shall be implemented through the ESMP, while compensation and livelihood-restoration measures shall be implemented in accordance with the applicable provisions of the LARP. Reinstate access required for operation and maintenance where affected.	Project-related physical deficiencies and verified crop, production, income or other economic losses identified; Corrective Action Plan, responsibilities and budget established where required; remedial works and applicable compensation/livelihood-restoration actions tracked to closure.		
AF002	D-AGR-04	Agriculture — Irrigation	Loss of irrigation and drainage network connectivity	Confirm through as-built records, inspection and appropriate commissioning/functionality checks that relevant irrigation and drainage crossings function as intended and do not materially obstruct irrigation supply or drainage. Where a Project-related hydraulic or functional deficiency is identified, implement technically	As-built and functionality verification completed; identified hydraulic or functional deficiencies recorded; corrective measures completed and verified.	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				practicable corrective measures and verify restoration of the affected function.			
AF007	D-AGR-05	Agriculture — Groundwater	Embankment interrupts shallow groundwater flow; risk of waterlogging and drying	Undertake targeted investigation where baseline conditions, observed waterlogging or drying, shallow groundwater conditions, or embankment configuration indicate a credible risk of interference with shallow groundwater movement. Confirm any Project-related effect and implement technically practicable drainage or other corrective measures where required	Ground investigation report submitted to KTZ; locations of elevated risk identified for post-construction monitoring under the Construction and O&M ESMPs	EPC Contractor	KTZ
AR001	D-AR-01	Archaeology	Direct loss of burial mounds within footprint	Complete receptor-by-receptor verification of known archaeological sites and associated protection zones potentially affected by the Project, recording their relationship to the final/as-built footprint and the status of avoidance, protection, investigation and authority requirements. For completed works, document known disturbance and implement any measures required by the competent authority. For remaining works, known sites and protection zones shall be treated as no-go/controlled areas unless the required treatment and approval are in place	Investigation records held for each affected feature; localized realignment locations documented	EPC Contractor	KTZ; national cultural heritage authorities
AR002	D-AR-02	Archaeology	Impact on setting of burial mounds adjacent to alignment	Verify that the alignment has maximized offset distance from known burial mounds where this was achievable within	Offset distances documented for each affected feature; departures	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				wider engineering constraints; offset distances at each affected feature recorded	from the indicative design assessed in the ESIA identified and explained		
HG001	D-HG-01	Hydrology	Increased flood risk from embankment as barrier to surface flow	Verify culverts provided at all watercourses and natural drainage lines intersected by the alignment; verify culvert sizing against design flows including a climate change allowance; identify any locations where culvert capacity is inadequate	Culvert schedule complete and verified; hydraulic capacity confirmed; locations requiring oversized culverts, attenuation or relief structures identified and reported	EPC Contractor	KTZ
HG001	D-HG-02	Hydrology — Shardara	Hydrological connectivity across Shardara Reservoir crossing	Verify that the four additional bridge structures within the Shardara Reservoir crossing have been incorporated into the as-built design, in addition to the main Syr Darya river crossing, to maintain hydrological connectivity across the reservoir	Bridge structures verified on as-built drawings and on site; total hydraulic opening across the IBA/KBA crossing confirmed against design intent	EPC Contractor	KTZ
LV001	D-LV-01	Landscape and Visual	Industrialising features introduced to landscape	Verify that the alignment follows natural contours to the extent practicable and that embankment height is minimised commensurate with flood protection requirements; identify and report any departures from these principles	As-built embankment heights and alignment compared to indicative design assessed in ESIA; departures documented and explained; locations of greatest landscape exposure identified for landscape planting under D-LV-02	EPC Contractor	KTZ
LV001	D-LV-02	Landscape and Visual	Industrialising features introduced to landscape	Develop a landscape planting plan for sidings, stations and bridge abutments using native species of local genetic stock; planting plan to address the principal	Landscape planting plan submitted to KTZ; plan reviewed and approved; planting implementation	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				viewpoints identified in Section 8.4.1 of the ESIA	scheduled within first available planting season		
PG001	D-BIO-01	Biodiversity — Shardara IBA/KBA	Impact on Internationally Protected Area and Critical Habitat	Verify that the formation has been narrowed across the IBA/KBA to constrain the permanent footprint to approximately 150 ha; verify strict footprint controls in place for the construction works within the IBA/KBA	As-built footprint within IBA/KBA measured and verified against the 150 ha commitment; departures identified and reported to KTZ and ADB	EPC Contractor	KTZ
PG001	D-BIO-02	Biodiversity — BAP	BAP and offset framework	Confirm that the Biodiversity Action Plan (BAP) and Biodiversity Offset Management Plan (BOMP) are in preparation and on track for submission to KTZ and ADB; identify the offset commitments required to achieve No Net Loss for the IBA/KBA and Net Gain for the Critical Habitat triggers	BAP and BOMP submission dates confirmed and tracked; consultation with national biodiversity authorities documented	EPC Contractor; KTZ	KTZ
AF004	D-LT-01	Land Take — Agriculture	Loss of productive agricultural land for permanent footprint and temporary facilities	Confirm that land acquisition has been undertaken in accordance with the LARP; verify that temporary land take for construction compounds, spoil management areas, borrow pits and working areas has been located on lower-value land where practicable	Land acquisition records complete; LARP implementation status report submitted to KTZ; temporary works area locations documented and reviewed	EPC Contractor; KTZ LARP team	KTZ ´
AF004	D-LT-02	Land Take — Soils	Reinstatement of temporary works areas	Confirm Soil Management Plan in place (under CESMP-01) for stripping, separate storage and replacement of topsoil and subsoil in layers; commit to reinstatement	Soil Management Plan submitted and approved; reinstatement schedule prepared for each temporary works area	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				of all temporary works areas to former condition on completion			
SE001	D-LT-03	Socio-economics	Loss of agricultural income from land take, interruption of activities, increased travel time	Confirm LARP prepared, addressing affected owners, tenants and informal users, with specific provisions for vulnerable households.	LARP submitted and approved; LARP eligibility process documented; vulnerability assessment completed; compensation framework in place	KTZ LARP team	KTZ
TE001	D-LT-04	Biodiversity — Shardara IBA/KBA	Permanent habitat loss of ~150 ha within the IBA/KBA	Detailed habitat mapping of the as-built embankment footprint within the IBA/KBA, by habitat type (braided channels and floodplain grassland; Tugai scrub, reedbed marshland; open mud); confirmation of permanent loss areas by habitat type as the basis for the offset framework under D-BIO-02	Habitat mapping report submitted; areas by habitat type quantified; baseline for offset framework established	EPC Contractor	KTZ
TE006	D-LT-05	Biodiversity — Dalmatian Pelican	Permanent habitat loss for Dalmatian Pelican within IBA/KBA	Habitat use survey of Dalmatian Pelican confirmed within the as-built footprint and at offset receptor sites under the BAP	Habitat use survey complete; baseline for offset framework established	EPC Contractor	KTZ
TE018	D-LT-06	Biodiversity — Migratory Birds	Permanent habitat loss in Afro-Eurasian and Central Asian migratory flyways	Migratory bird use survey covering the spring (March–May) and autumn (August–October) migration periods, confirmed within the as-built footprint and at offset receptor sites	Migratory bird survey reports complete for at least one full migration cycle prior to operations; baseline for offset framework established	EPC Contractor	KTZ
TE024	D-LT-07	Biodiversity — Other IUCN	Permanent habitat loss for other IUCN-threatened bird species	Survey of other IUCN-threatened bird species confirmed within the as-built footprint and at offset receptor sites	Survey reports complete; baseline for offset framework established	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
		Threatened Birds					
TE028	D-LT-08	Biodiversity — Wintering Birds	Permanent habitat loss for wintering bird assemblage	Wintering bird survey covering the November–March wintering period, confirmed within the as-built footprint and at offset receptor sites	Wintering bird survey reports complete for at least one full wintering cycle prior to operations	EPC Contractor	KTZ
TE032	D-LT-09	Biodiversity — Breeding Birds	Permanent habitat loss for breeding bird assemblage	Breeding bird survey covering the April–July breeding period, confirmed within the as-built footprint and at offset receptor sites	Breeding bird survey reports complete for at least one full breeding cycle prior to operations	EPC Contractor	KTZ
TE036	D-LT-10	Biodiversity — Other Bird Species	Permanent habitat loss for other bird species	Survey of other bird species confirmed within the as-built footprint and at offset receptor sites	Survey reports complete; baseline for offset framework established	EPC Contractor	KTZ
TE040	D-LT-11	Biodiversity — Lesser White-fronted Goose	Permanent habitat loss for Lesser White-fronted Goose	Habitat use survey for Lesser White-fronted Goose confirmed within the as-built footprint and at offset receptor sites; species-specific provisions to be incorporated into the BAP given IUCN Vulnerable status and IBA citation	Species-specific survey complete; BAP commitments for the species recorded	EPC Contractor	KTZ
TE058	D-LT-12	Biodiversity — Natural Habitat	Permanent loss of Natural Habitat (wetland complex)	Confirmation of Natural Habitat areas within the as-built footprint, categorised by habitat type, as the basis for the No Net Loss requirement under the BAP	Habitat mapping report consistent with D-LT-04; quantification of Natural Habitat areas by type	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
TE078	D-LT-14	Biodiversity — Reptile Habitat	Habitat loss for IUCN Red Listed Reptiles	New steppe habitat creation provisions confirmed within temporary works areas, including areas not compacted to facilitate burrow creation; siting informed by pre-clearance reptile survey under D-BIO-04	Habitat creation plans documented; locations within temporary works areas identified	EPC Contractor	KTZ
AR001, AR002	D-AR-03	Cultural Heritage Management	Need for comprehensive Cultural Heritage Management Plan beyond chance finds (per ESCA CAP CH-1)	Prepare and implement a Cultural Heritage Management Plan consistent with IFC PS8 and ADB ESS8, addressing identified burial mounds and other physical cultural resources, site-specific mitigation measures for known sites, archaeological supervision arrangements during high-risk earthworks in culturally sensitive areas, and procedures for engagement with descendant and adjacent communities	Cultural Heritage Management Plan submitted and approved by KTZ and national cultural heritage authorities; archaeological supervision records retained for relevant works	EPC Contractor (Cultural Heritage Monitor)	KTZ; national cultural heritage authorities
ESCA IPG-1	D-SE-01	Social — Vulnerability Screening	Vulnerable groups not systematically identified or documented at project level (per ESCA CAP IPG-1)	Undertake project-level screening to identify vulnerable groups within the Project area of influence, including low-income households, elderly persons, persons with disabilities, female-headed households, and any other categories identified through stakeholder engagement; formally document the Indigenous Peoples screening conclusion within project records, with a commitment to re-screen should project scope change	Vulnerable groups screening report submitted; Indigenous Peoples screening conclusion documented; differentiated engagement and communication measures integrated into the Stakeholder Engagement Plan and GRM	KTZ Dept of Ecology / CLO	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
ESCA IPG-2	D-SE-02	Social — Gender	Gender considerations not systematically integrated (per ESCA CAP IPG-2)	Undertake a proportionate, project-level gender risk and opportunity assessment aligned with ADB ESS2/ESS10 and IFC PS1 requirements; develop and implement a Gender Action Plan with targeted actions to improve women's access to employment and camp-related services, encourage inclusion of women-owned suppliers where feasible, and integrate gender considerations into stakeholder engagement and community programmes; assign responsibilities and monitor implementation	Gender risk and opportunity assessment completed; Gender Action Plan submitted and approved by KTZ; implementation tracked through KTZ reporting	KTZ Dept of Ecology	KTZ
ESCA LC-1, EA-5	D-MS-01	Management Systems — Compliance Tracking and Cumulative Impacts	Compliance tracking and cumulative/corridor-wide impact analysis (per ESCA CAP LC-1 and EA-5)	Establish and maintain a project-level Compliance Tracking Register documenting all national approvals (including OVOS Stage III, State Ecological Expertise conditions), lender covenants, and CAP items, with status, owner, and closure evidence; complete a project-level Cumulative Impact Assessment addressing the alignment as a whole and its interaction with other infrastructure, land use and biodiversity values along the corridor, particularly in the Shardara Reservoir vicinity	Compliance Tracking Register live and updated at least monthly; Cumulative Impact Assessment report submitted within 90 days of ESMP effectiveness and disclosed	KTZ; KTZ Dept of Ecology	KTZ
CRA sectionC.1, sectionE.1	D-CC-02	Climate — Hydraulic Resilience	Hydraulic design of bridge, culverts and drainage structures based on current hydrology may not accommodate projected climate-driven	Complete a hydraulic capacity review of the Syr Darya 500 m bridge, all culverts and drainage structures along the alignment, benchmarked against SSP5-8.5 P90 projected peak discharge conditions (incorporating projected spring	Hydraulic review report completed and submitted to KTZ and Lenders remediation schedule with named responsibilities and completion	EPC Contractor (Design Engineer)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
			peak discharge (per CRA HIGH river-flood risk)	precipitation increases of up to +50% in Syr Darya headwaters); identify any structures requiring upsizing, scour protection, or relief structures; remediation incorporated into remaining works or maintenance programme with defined completion dates; cross-reference D-HG-01	dates approved; departures from CRA recommendations explained		
CRA sectionE.1	D-CC-03	Climate — Track Resilience	Continuous Welded Rail (CWR) sections specified to current temperatures may experience thermal expansion, buckling and ballast degradation under projected warming of >2°C above 1985–2014 baseline by mid-design life	Specify elevated Stress-Free Temperature (SFT) for all CWR sections referenced to SSP5-8.5 P90 projected maximum rail surface temperatures to at least 2050 (rail surface temperatures typically 20–30°C above air temperature in direct sun); SFT specification confirmed in writing by Design Engineer with climate-adjusted temperature basis documented	SFT specification submitted and approved prior to track installation in affected sections; design certificate retained on file	EPC Contractor (Design Engineer)	KTZ
CRA sectionE.1	D-CC-04	Climate — Wildfire Resilience	Trackside infrastructure (cable insulation, signalling equipment housings, sleepers) and adjacent vegetation present an elevated wildfire risk given baseline FWI >60 (extreme fire weather), with fire alert duration projected to increase substantially by 2050	Specify fire-resistant materials for at-risk components (cable insulation, signalling equipment housings, junction boxes); design a 20–30 m cleared firebreak zone on each side of the running rail through wildfire-prone sections; landscape planting under D-LV-02 to use low-flammability native species only (high-biomass and resinous species prohibited); firebreak width and vegetation management frequency specified in O&M manual	Material specifications approved; firebreak design documented on as-built drawings; planting specification confirms low-flammability species; O&M manual section drafted	EPC Contractor (Design Engineer)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
CS001, AF001	D-SEV-02	Severance — Livestock Passage Usability	Structures designated for livestock passage need to be practically accessible and usable by livestock; usability depends on the dimensions and configuration of the structure, drainage conditions, approaches, visibility and its relationship to established livestock movement routes.	For structures designated for livestock passage, confirm that the as-built arrangement provides safe and practicable livestock access, including suitable approaches, adequate drainage and avoidance of permanent ponding, appropriate gradients and sight-lines through the structure, and guide fencing where required to direct livestock to the crossing. Lighting shall be provided where necessary to ensure practical use of longer or poorly illuminated structures. Requirements shall be confirmed having regard to site conditions and consultation with affected livestock users.	Designated livestock passages inspected against as-built drawings and site conditions; practical accessibility and usability confirmed through inspection and consultation with affected livestock users; any required corrective works identified and incorporated into the pre-operation verification under C-SEV-01	EPC Contractor	KTZ

Vista Environment

Table A-2: Construction Phase ESMP

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
AF003	C-AGR-01	Agriculture	Contamination of irrigation channels and fields from fuel/chemical/oil loss of containment	Implement Pollution Prevention Plan (CESMP-01) including bunded fuel and chemical storage; dedicated refuelling areas located at least 50 m from any watercourse; spill response equipment at each work front; routine inspection and maintenance of plant	Site inspections record bunded storage in place; refuelling location records; spill kit registers maintained; plant inspection records; zero spills to irrigation infrastructure	EPC Contractor	KTZ
AF005	C-AGR-02	Agriculture	Soiling of crops and greenhouse surfaces from fugitive dust	Implement dust suppression measures under CESMP-01 (AQ component) at all locations within 250 m of polytunnel and polythene-covered horticulture; soft-fruit producers identified in stakeholder engagement programme; complaints monitoring established	Air quality monitoring at representative locations adjacent to horticultural areas; visual inspection records; complaints received and addressed through GRM	EPC Contractor	KTZ; CLO
AF002	C-AGR-03	Agriculture — Irrigation	Continuity of irrigation supply during construction	Implement the Irrigation Network Management Plan (CESMP-11), including scheduling canal interruptions outside the May–September cropping season where achievable; minimum 14 days' written notice to affected water	Schedule of planned canal interruptions maintained; notification records retained; temporary bypass arrangements documented where required; duration of interruptions recorded;	EPC Contractor (Community Liaison Officer)	KTZ; CLO

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				users before any planned interruption of an active canal; temporary bypass arrangements where interruption during the cropping season is unavoidable; and no interruption exceeding 72 hours without a documented alternative supply arrangement.	irrigation-related complaints tracked through the GRM.		
AF002	C-AGR-04	Agriculture — Irrigation	Sediment and gradient control at canal crossings	Sediment control measures upstream of each crossing structure during construction; protection of canal invert and banks immediately upstream and downstream of crossings; reinstatement of canal profile to pre-construction condition on completion	Sediment control measures in place; site inspection records; reinstatement verified	EPC Contractor	KTZ
AF002	C-AGR-05	Agriculture — Irrigation	Commissioning and functionality of irrigation and drainage crossings	Before handover, verify relevant irrigation and drainage crossings through as-built records, inspection and appropriate commissioning/functionality checks. Where impaired functionality attributable to the Project is identified, complete remedial works before handover or in accordance with	As-built and commissioning/functionality records retained; identified deficiencies and remedial works recorded and tracked to closure.	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				an agreed time-bound corrective action.			
AF002	C-AGR-06	Maktaaral Station irrigation canal	Relocation of Atakent/Maktaaral Station LOTOK irrigation channel	Complete the ongoing relocation of the LOTOK irrigation channel associated with the Maktaaral Station works while maintaining irrigation functionality during the remaining works. Complete the associated land-acquisition process in accordance with the LARP and applicable national requirements. Following completion, verify that the relocated channel is functional and that access required for operation and maintenance has been maintained or reinstated.	LOTOK relocation completed; irrigation functionality verified; O&M access confirmed; associated land-acquisition requirements completed and documented.	EPC Contractor	KTZ
AF002	C-AGR-07	Agriculture — Irrigation	Ushagash LOTOK channel restoration	Complete the ongoing restoration of the LOTOK irrigation channel at Ushagash. Following installation of the channel, verify that irrigation functionality has been restored and that the completed works do not impede operation and maintenance access. Record and rectify any Project-related deficiency identified during completion and commissioning.	Channel installation completed; functionality verified; O&M access confirmed; completion and commissioning records retained; identified deficiencies closed.	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
AQ001	C-AQ-01	Air Quality	Dust and gaseous emissions from concrete batching	No batching plants located within 500 m of sensitive receptors (residential areas, schools, hospitals, nurseries); batching plant dust controlled through bag filters or equivalent	Batching plant locations verified against receptor offsets; dust control equipment installed and operational; air quality monitoring at nearest sensitive receptors	EPC Contractor	KTZ
AQ002	C-AQ-02	Air Quality	Mobile fossil-fuel equipment emissions	No-idling policy enforced; energy-efficient site operations; low-emission engines compliant with applicable standards; routine plant maintenance	Anti-idling signage in place; plant emissions records; toolbox talks on idling; spot inspection records	EPC Contractor	KTZ
AQ003	C-AQ-03	Air Quality	Fugitive dust from earthworks, stockpiles and vehicle movements	Implement full IAQM 'highly recommended' measures for High Risk classification: damping down of haul roads and exposed surfaces; sheeting of stockpiles and loaded vehicles; wheel-washing at site exits; speed limits on unpaved roads (15–25 km/h); minimisation of drop heights; phased earthworks; stabilisation of long-term stockpiles	Dust Management Plan approved and implemented; visual dust inspections recorded; wheel-wash and damping records; PM10 monitoring at representative sensitive receptors	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
AQ004	C-AQ-04	Air Quality	Emissions from stationary equipment (generators)	Use of mains power where available; efficient generators maintained to manufacturer standards; generators emitting black smoke for more than 5 minutes powered off and maintained	Mains power connections documented; generator maintenance records; visual inspections	EPC Contractor	KTZ
AR003	C-AR-01	Archaeology — Chance Finds	Possibility of encountering unknown below-ground artefacts	Implement Archaeological Chance Finds Protocol (CESMP-08); all staff involved in ground-disturbing activities trained on Protocol as part of induction with refresher training at appropriate intervals; immediate cessation of works on discovery and notification to KTZ within 24 hours	Protocol document approved; training records retained for all relevant personnel; chance finds register maintained; incident reports issued within 24 hours of any find	EPC Contractor (Cultural Heritage Monitor)	KTZ; national cultural heritage authorities
CS001	C-CS-01	Community Health and Safety	Risk of incidents at work sites from public encroachment	Perimeter fencing of all active work fronts and storage compounds; controlled access points; bilingual signage (Kazakh and Russian); night lighting where appropriate; advance notification of works to communities; identification of safe alternative routes around work fronts	Fencing and signage in place at all work fronts; community notification records; complaints through GRM	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
CS002	C-CS-02	Community Health and Safety	Traffic risk to community from construction vehicles	Implement Traffic Management Plan (CESMP-06) including designation and signing of haul routes; speed restrictions for project vehicles; defensive-driving training for all construction drivers; prohibition of haulage during peak community-movement periods; engineered improvements at high-risk junctions where required	Haul routes designated and signed; driver training records; traffic incident register; community complaints through GRM	EPC Contractor	KTZ
CS003	C-CS-03	Community Health and Safety	Inadequate emergency response capability during construction incidents	Implement Construction Emergency Response Plan (CESMP-05) coordinated with national and regional emergency services; mutual-aid arrangements documented; tabletop and live drills at appropriate intervals during construction	Emergency Response Plan approved; coordination records with emergency services; drill reports retained	EPC Contractor	KTZ
MR001	C-MR-01	Material Resources	Demand for aggregate, gravel and other materials exceeds local supply capacity	Implement Material Resources Management Plan including assessment of local supply capacity; use of established commercial quarries where available; maximisation of cut-and-fill balance; reuse of suitable excavated material where geotechnical requirements allow;	Resources Management Plan approved; borrow pit licences verified; reuse records; supply chain documentation	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				environmental assessment of any project-specific borrow pits			
MR001	C-MR-02	Material Resources	Borrow pit management	Only state-licensed borrow pits used; borrow pit licences and permits submitted to KTZ prior to material delivery; borrow pit-specific method statements (CESMP-14) for each pit	Borrow pit licence register; method statements approved	EPC Contractor	KTZ
NO002	C-NV-01	Noise — Construction	Excessive construction noise causing nuisance and sleep disturbance	Implement Construction Noise Management Plan (CESMP-10); all plant to meet noise emission standards; restriction of high-noise activities to 07:00–19:00; night-time and Sunday work prohibited without special permit from KTZ and local authorities; portable noise screens at sensitive receptor locations; consultation with religious sites, schools and village leaders on sensitive timing	Construction Noise Management Plan approved; plant noise specifications documented; working hours records; consultation records; noise monitoring at representative sensitive receptors	EPC Contractor	KTZ
NO002	C-NV-02	Noise — Construction	Construction noise at six locations of concern	Targeted construction noise management at the six locations identified in Section 8.4.3: Maktaaral, Erdaulet (incl. Aktas), Küriş, Ushagash, Sarıžylga–Bereke, and Şyrıldak–Jabaytöbe; noise monitoring	Monitoring records at each location; complaints register; mitigation deployment records	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				during active works at each location; reactive deployment of additional mitigation where complaints received			
NO004	C-NV-03	Vibration — Construction	Risk of vibration damage to nearby buildings	Implement Construction Vibration Management framework as set out in Section 8.4.3: pre-construction structural condition surveys at all receptors within ≤30 m band, with photographic and dimensional records witnessed by property owner or representative	Condition surveys complete prior to works at each section; survey records retained; baseline established for any subsequent damage allegation	EPC Contractor	KTZ
NO004	C-NV-04	Vibration — Construction	Real-time vibration monitoring	Continuous monitoring of peak particle velocity at representative receptors within the ≤30 m band during vibration-generating activities; trigger and action levels set at 50% and 75% of applicable DIN 4150-3 guideline value; defined contractor and supervisor responses including reduction of working intensity, change of method, or cessation of activity	Monitoring records retained; trigger/action event log; response actions documented	EPC Contractor	KTZ
NO004	C-NV-05	Vibration — Construction	Method statement controls at sensitive receptors	Vibration-generating activities within 30 m of identified receptors subject to method-	Method statements approved prior to works; plant	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				statement controls: plant selection with appropriate vibration specifications; restriction of vibratory compaction in favour of static/oscillatory where vibration-sensitive receptors present; substitution of piling methods at sensitive locations; limitation of working hours; prohibition of simultaneous high-vibration activities within the same zone of influence	specifications documented; compliance records		
NO004	C-NV-06	Vibration — Construction	Specific commitments at Ushagash	At Ushagash: condition surveys of all receptors within ≤30 m band undertaken in advance of further vibration-generating works, priority to the two receptors within ≤10 m band; continuous real-time vibration monitoring during all earthworks, compaction and piling activities within 50 m of any identified receptor; trigger and action levels set at DIN 4150-3 Line 3 (sensitive building) values pending confirmation by condition surveys	Survey records; monitoring records; trigger/action event log; building category confirmation documented	EPC Contractor	KTZ
SG001	C-SG-01	Soils and Geology	Compaction of soils and loss of soil structure	Implement Soil Management Plan under CESMP-01: stripping	Soil Management Plan approved; site inspection	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				of topsoil and subsoil in separate layers; storage in piles no more than 3 m depth in locations protected from wind and rain erosion and from compaction; avoidance of soil handling under wet conditions; reverse-layer placement during reinstatement	records; soil stack locations and depths recorded		
SG002	C-SG-02	Soils and Geology	Diffuse and point-source pollution from spills, leaks and runoff	Implement Pollution Prevention Plan under CESMP-01: sediment traps and silt fences at active work fronts; oil interceptors at vehicle wash and refuelling areas; bunded storage of fuels and chemicals (110% capacity); defined refuelling protocols; spill response equipment at each work front; management of dewatering and temporary discharges through settlement/treatment	Pollution Prevention Plan approved; bunding inspection records; spill kits in place; spill response training records; incident register	EPC Contractor	KTZ
SG003	C-SG-03	Soils and Geology — Contamination	Mobilisation of existing contamination and disposal of contaminated material	Pre-construction targeted contamination investigation at locations of elevated risk (historic fuel storage, former workshops); where contamination identified, management under site-specific Contaminated Land	Investigation report; CLMP approved where required; disposal records; out-of-bounds register	EPC Contractor	KTZ; national authorities

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				Management Plan agreed with national authorities; existing unlicensed waste disposal sites in the vicinity expressly prohibited for project use and designated out-of-bounds			
TE002	C-BIO-01	Biodiversity — Shardara IBA/KBA	Temporary habitat loss for compounds, spoil storage and working areas within IBA	Implement habitat restoration plan for all temporary works areas within the IBA/KBA; reinstatement to pre-construction habitat type; restoration witnessed by KTZ Department of Ecology and recorded	Habitat restoration plan approved; restoration records; vegetation establishment monitored for at least two growing seasons post-restoration	EPC Contractor (Ecologist)	KTZ
TE003	C-BIO-02	Biodiversity — Shardara IBA/KBA	Disturbance to birds from noise, light and human activity	Implement noise control on all plant (silenced compressors, broadband reversing alarms, plant maintained to manufacturer noise specification); piling limited to daylight hours; directional, low-lumen, warm-spectrum lighting only with shielding to prevent spill onto open water, reedbed and floodplain habitat; no lighting outside active work fronts	Plant noise specifications; lighting installation records; site inspections; bird response surveys at IBA receptor sites	EPC Contractor (Ecologist)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
TE004	C-BIO-03	Biodiversity — Shardara IBA/KBA	Pollution of soil, air and water within IBA	Implement Site-Specific Construction Management Plan for work in and around Shardara IBA (CESMP-15); oil-contaminated sites cleaned up per agreed spill clean-up guidelines; Pollution Emergency Response equipment pre-positioned within and adjacent to the IBA/KBA crossing	Site-Specific CESMP approved; incident records; PER equipment register; water quality monitoring at Syr Darya crossing during in-river works	EPC Contractor (Ecologist)	KTZ
TE005	C-BIO-04	Biodiversity — Shardara IBA/KBA	Hydrological fragmentation during embankment construction	Construction sequence to maintain hydrological connectivity during the in-river works; bridge structures incorporated into the embankment commissioned as early as practicable in the works sequence to minimise the period of impounded water	Construction sequence documented and reviewed; bridge commissioning dates tracked; hydrological monitoring within the reservoir during construction	EPC Contractor	KTZ
TE007, TE010, TE012, TE016, TE022, TE026, TE030, TE042, TE063, TE077	C-BIO-05	Biodiversity — Bird/Mammal/Reptile Disturbance	Disturbance to birds, mammals and reptiles during works	Implement noise and light control measures (as TE003 above) along the full alignment; directional, low-lumen, warm-spectrum lighting only with shielding; no lighting outside active work fronts; plant noise control consistent with TE003	Lighting and plant noise inspection records; disturbance complaints from monitoring or GRM	EPC Contractor (Ecologist)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
TE008, TE017, TE023, TE027, TE031, TE035, TE039	C-BIO-06	Biodiversity — Hydrological Fragmentation	Hydrological fragmentation affecting birds	As-built bridge structures within the Shardara crossing verified (cross-reference D-HG-02 and C-BIO-04); commissioning of bridges as early as practicable; monitoring of waterbird use of the impounded area west of embankment during construction period	Bridge commissioning records; waterbird monitoring records	EPC Contractor (Ecologist)	KTZ
TE009, TE011, TE019, TE021, TE025, TE029, TE033, TE037, TE041, TE043	C-BIO-07	Biodiversity — Direct Harm to Birds	Kill / injure birds during site clearance	Pre-construction nest surveys along the alignment; vegetation clearance delayed until young have fledged if active nests found; salvage of fallen young where possible; records retained	Nest survey reports; vegetation clearance schedule reviewed against survey timing; salvage records	EPC Contractor (Ecologist)	KTZ
TE050	C-BIO-08	Biodiversity — Ecosystem Services	Loss of water storage capacity behind embankment during construction	Bridge structures commissioned as early as practicable to maintain hydrological connectivity and limit period of reduced storage; coordination with Kazsushar (reservoir authority) on construction sequencing	Construction sequence documented and shared with Kazsushar; reservoir water-level records during construction reviewed for departures from baseline	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
TE051	C-BIO-09	Biodiversity — Fish (Ecosystem Services)	Decrease in fish populations during construction	Bridge commissioning as early as practicable (cross-reference C-BIO-08); rescue and translocation of stranded fish during the in-river works where feasible, in consultation with national fisheries authorities	Bridge commissioning records; fish rescue records	EPC Contractor (Ecologist)	KTZ; national fisheries authorities
TE052	C-BIO-10	Biodiversity — Fish	Disturbance to IUCN Red-Listed Fish from in-river bridge works	No in-river works during the spring spawning window for Syr-Darya Shovelnose Sturgeon and Aral Barbel; precise window confirmed with national fisheries authorities prior to works; directional warm-spectrum lighting only at the river crossing	Spawning window agreed with fisheries authorities and documented; works schedule excludes spawning window; lighting specifications verified	EPC Contractor (Ecologist)	KTZ
TE053	C-BIO-11	Biodiversity — Fish	Pollution affecting IUCN Red-Listed Fish	Standard international good-practice pollution control implemented at all in-river works: silt bunding and sediment traps at all watercourse crossings; bunded fuel and chemical storage minimum 50 m from any watercourse; designated washdown and refuelling areas; Pollution Emergency Response equipment pre-positioned at the river crossing	Pollution control measures documented and verified on site; water quality monitoring upstream and downstream of in-river works	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
TE054	C-BIO-12	Biodiversity — Fish	Kill / injure fish during site clearance	No in-river works during the spawning window (cross-reference C-BIO-10); rescue of stranded fish where feasible	Works schedule records; rescue records	EPC Contractor (Ecologist)	KTZ
TE059	C-BIO-13	Biodiversity — Natural Habitat	Temporary habitat loss for compounds and spoil management	Implement habitat restoration plan for all temporary works areas; reinstatement to pre-construction habitat type using native species; monitoring of restoration success	Habitat restoration plan approved; reinstatement records; vegetation establishment monitored for at least two growing seasons	EPC Contractor (Ecologist)	KTZ
TE060	C-BIO-14	Biodiversity — Invasive Species	Introduction and spread of Invasive Alien Species	Pre-construction surveys for existing IAS along the alignment and at temporary works areas; appropriate management techniques applied where IAS recorded; all equipment previously used outside the local area or in areas with known IAS to be power-washed and steam-cleaned prior to arrival at site	IAS survey reports; equipment cleaning records; biosecurity protocols documented	EPC Contractor (Ecologist)	KTZ
TE061	C-BIO-15	Biodiversity — Invertebrates	Pollution affecting IUCN Red Listed Invertebrates	Pollution control measures as per TE053; targeted attention to watercourses identified as supporting Red-Listed invertebrate populations	Water quality monitoring records; invertebrate baseline confirmed	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
TE062	C-BIO-16	Biodiversity — Invertebrates	Kill / injure IUCN Red Listed Invertebrate species during site clearance	Pre-site-clearance checks of watercourses for any evidence of presence; individuals identified to be relocated in consultation with relevant authorities	Pre-clearance check records; relocation records	EPC Contractor (Ecologist)	KTZ
TE065	C-BIO-17	Biodiversity — Mammals	Kill / injure IUCN Red Listed Mammal species during site clearance	Pre-construction surveys for protected/rare mammal species along the alignment; protection of animal dens and breeding areas through changes in works schedule where required	Pre-construction mammal survey reports; schedule adjustments documented	EPC Contractor (Ecologist)	KTZ
TE070	C-BIO-18	Biodiversity — Flora	Kill / injure IUCN Red Listed Flora during site clearance	Spring botanical survey of the full alignment, with priority survey of loess cliff and steppe sections potentially supporting Salvia korolkowii and Eminium lehmannii; rescue translocation where Red-Listed populations are confirmed within the clearance footprint	Botanical survey report; translocation records; survival monitoring at recipient sites	EPC Contractor (Ecologist)	KTZ
TE080	C-BIO-19	Biodiversity — Reptiles	Kill / injure IUCN Red Listed Reptile species during site clearance	Pre-clearance reptile survey of all steppe and semi-desert RoW sections during the active season (April–June); systematic salvage and translocation of all individuals to pre-identified receptor sites in consultation	Reptile survey and translocation records; receptor site condition monitoring	EPC Contractor (Ecologist)	KTZ; national herpetological authorities

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				with national herpetological authorities			
WH001	C-WH-01	Occupational Health and Safety	Worker accommodation: unsanitary conditions, poor living standards	All worker accommodation areas to comply with IFC/EBRD Workers' Accommodation: Processes and Standards (2009) benchmark; Camp Management Plan (CESMP-09) submitted by each subcontractor and approved by Integra; routine internal inspections; periodic third-party audits	Camp Management Plan approved per subcontractor; inspection records; audit reports	EPC Contractor (Labour Officer)	KTZ
WH002	C-WH-02	Occupational Health and Safety	Working at height	Implement Working at Height procedures and permit-to-work systems in accordance with GIIP and WBG EHS Guidelines; register of workers qualified to work at height; adequate training and supervision; certified access equipment; fall protection systems	OHS Plan (CESMP-02) approved; permit register; worker qualification register; training records; incident register	EPC Contractor (H&S Specialist)	KTZ
WH003	C-WH-03	Occupational Health and Safety	Lifting operations	Lifting procedures developed; lifting plans required for non-routine lifts; certified equipment used; exclusion zones established during lifts; trained lifting supervisors	Lifting plans on file; equipment certification records; supervisor competence records	EPC Contractor (H&S Specialist)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
WH004	C-WH-04	Occupational Health and Safety	Excavation work	Excavation safety procedures implemented including shoring, benching, safe access; daily inspections; competent supervision	Permit-to-work register for excavations; daily inspection records	EPC Contractor (H&S Specialist)	KTZ
WH005	C-WH-05	Occupational Health and Safety	Emergency response during construction	Site-specific Emergency Response Plans (CESMP-05) developed based on risk assessment; training, equipment and regular drills	Emergency Response Plan approved; drill reports; training records	EPC Contractor (H&S Specialist)	KTZ
WH006	C-WH-06	Workforce	Workers' grievance mechanism	Workers' grievance redress mechanism established and operated by KTZ in accordance with the lenders' safeguards on labour and working conditions; mechanism accessible to all categories of worker including subcontracted and migrant labour; permits anonymous grievances; available in languages spoken by the workforce	Workers' GRM documented; grievance register maintained; quarterly summary reporting; independent review of grievance handling by KTZ	EPC Contractor (Labour Officer)	KTZ
WM001	C-WM-01	Waste Management	Poor site management causing environmental degradation	Implement Construction Waste Management Plan; routine inspection and audit regime; site housekeeping standards	Waste Management Plan approved; housekeeping inspection records; audit reports	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
WM002	C-WM-02	Waste Management	Waste volume exceeds local treatment/disposal capacity	Assessment of licensed waste management capacity within appropriate distance of the alignment; waste forecast matched to capacity; waste hierarchy (reduction, reuse, recycling, recovery, disposal); alternative arrangements where local capacity insufficient	Capacity assessment documented; waste forecast vs. capacity reviewed quarterly; alternative arrangements documented where applicable	EPC Contractor	KTZ
WM003	C-WM-03	Waste Management	Inappropriate disposal of construction and demolition waste	All waste directed to licensed disposal facilities; chain-of-custody documentation from generation to disposal; unlicensed legacy waste sites in the vicinity expressly prohibited and designated out-of-bounds; hazardous waste stored on impervious hardstanding with 110% secondary containment; segregation at source; workforce training on waste management	Disposal manifests and chain-of-custody records; hazardous waste storage compliant with bunding and labelling requirements; out-of-bounds register; training records	EPC Contractor	KTZ
ESCA OHS-3	C-WH-07	Occupational Health and Safety	Site-level OHS supervision with stop-work authority (per ESCA CAP OHS-3)	Designate competent Health and Safety Supervisors at each active work front, with documented authority to stop unsafe work; supervisors to hold appropriate qualifications and reporting line direct to the EPC Contractor's H&S Specialist;	H&S Supervisors named and qualified for each active work front; stop-work authority documented in OHS Plan; stop-work events logged and reviewed	EPC Contractor (H&S Specialist)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				stop-work events logged and reviewed monthly with KTZ			
ESCA OHS-7, OHS-8	C-WH-08	Occupational Health and Safety — Training and PPE	OHS training refreshers and PPE enforcement (per ESCA CAP OHS-7 and OHS-8)	Implement routine OHS training and refresher programme, including weekly toolbox talks at each work front, task-specific briefings before high-risk activities, and competency refreshers at appropriate intervals; reinforce mandatory PPE requirements through enforcement measures including documented warnings, removal from site for repeated non-compliance, and inspection sign-off prior to start of shift	Toolbox talk records and attendance registers; refresher training schedule documented; PPE compliance observed during inspections; non-compliance log with enforcement actions	EPC Contractor (H&S Specialist)	KTZ
ESCA LWC-2	C-WH-09	Labour and Working Conditions — Subcontractors	Subcontractor employment compliance (per ESCA CAP LWC-2)	Each subcontractor required to provide evidence of compliant employment contracts, wages, working hours and OHS arrangements prior to mobilisation, against Project minimum standards aligned with IFC PS2 and ADB ESS2; routine audit of subcontractor labour records by EPC Contractor; non-compliance grounds for stand-down pending remedy	Subcontractor labour compliance documentation reviewed and signed off prior to mobilisation; audit records retained; stand-down events documented	EPC Contractor (Labour Officer)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
ESCA CHS-3	C-CS-04	Community Health and Safety — Notification	Community notification of high-impact construction activities (per ESCA CAP CHS-3)	Implement community notification procedures for high-impact construction activities (vibration-generating works, night works under special permit, road closures, canal interruptions, sensitive religious or school-time periods); notification through CLO at least 48 hours in advance, in Kazakh and Russian, through community focal points, posters in public locations, and SMS to affected households where contact details have been collected; emergency works exception with subsequent notification within 24 hours	Notification records retained for all high-impact activities; community focal point contact lists maintained; complaints related to absence of notification tracked through GRM	EPC Contractor (CLO interface)	KTZ CLO
ESCA ERP-3	C-WH-10	Emergency Preparedness — Equipment	Emergency equipment inventory and availability (per ESCA CAP ERP-3)	Maintain documented inventory of emergency response equipment at each active work front, including first-aid kits, fire-fighting equipment, spill response equipment, eyewash stations, and pre-positioned PER equipment at the Shardara crossing (cross-reference C-BIO-03); routine inspection and replenishment programme;	Emergency equipment inventory documented per work front; inspection records; replenishment records; readiness verified during KTZ inspections	EPC Contractor (H&S Specialist)	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				equipment readiness checked weekly			
CRA sectionC.1, sectionE.1, OHS	C-CC-01	Climate — OHS Heat Action	Construction-phase Wet Bulb Globe Temperature (WBGT) at the upper end of the screened range (32°C) constitutes a HIGH worker safety risk (44% single-day productivity loss at 400W work intensity); construction-phase heat stress treated as HIGH for OHS planning	Develop and implement an OHS Heat Action Plan, in place before the construction-phase peak summer season, including: work rescheduling away from peak WBGT hours (typically 11:00–16:00 when WBGT >28°C); mandatory work-rest ratios scaled to WBGT level; site-level WBGT monitoring at each active work site June–September; provision of hydration stations and electrolyte replenishment; acclimatisation protocols for new and returning workers; heat illness recognition and first-response procedures; supervisor training on heat illness; reportable trigger when WBGT >32°C at any active work site requires mandatory rest schedule within 1 hour; cross-reference C-WH-02 and CESMP-02	Heat Action Plan approved prior to first peak-summer construction season; daily WBGT records during June–September retained; weekly incident summary June–September and monthly Oct–May; heat-illness incidents requiring medical attention trigger same-day incident report; zero heat-related medical evacuations	EPC Contractor (H&S Specialist)	KTZ
CRA sectionC.1, sectionE.1	C-CC-02	Climate — Embankment / Slope Resilience	Embankment slopes adjacent to the Shardara Reservoir and at flood-prone watercourses are exposed to scour and	Implement scour protection at Syr Darya bridge abutments and at culvert inlets/outlets carrying flows from the Shardara	Scour protection and slope stabilisation works documented on as-built drawings; armouring specifications retained;	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
			rainfall-induced landslide risk (CRA HIGH rating); track embankment carries highest vulnerability over 120-year design life given >8.4 M m³ embankment volume	Reservoir; implement slope stabilisation and retaining walls on embankment sections adjacent to the Shardara Reservoir and at flood-prone watercourses, designed against SSP5-8.5 P90 projected peak discharge; armouring specification confirmed by Design Engineer	verification inspection post-installation; baseline established for operational embankment condition inspections under O-CC-02		
CRA sectionC.1, sectionE.1	C-CC-03	Climate — Water Management	Construction water demand in the chronically water-stressed Syr Darya Basin (Water Stress Index >40%) carries risk of competition with local agricultural water users	Develop and implement a Construction Water Management Plan to minimise consumptive use during construction: rainwater harvesting at compounds where practical; greywater recycling for damping down where suitable; metering of all abstraction from local sources; sourcing of water from licensed abstraction points only; coordination with the Ministry of Water Resources and Irrigation and the Syr Darya basin water organisation; engagement with affected agricultural water users where shared sources are used; complaints monitoring through the GRM	Construction Water Management Plan approved; abstraction records retained; consultation records with MoWRI and basin water organisation retained; complaints register	EPC Contractor	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
CRA sectionC.1, sectionE.1	C-CC-04	Climate — Flood Monitoring	Construction works at watercourse crossings, particularly the Syr Darya, are exposed to flood risk during snowmelt and intense convective rainfall events	Install flood monitoring and early warning systems at key watercourse crossings, including the Syr Darya bridge and major culverts; trigger thresholds linked to upstream basin gauge readings and Kazhydromet flood alerts; site emergency response procedures activated on trigger including evacuation of in-river works, securing of plant and materials, and notification chain; coordination with Kazhydromet and Kazsushar	Flood monitoring system installed and operational prior to first snowmelt season; trigger thresholds documented; coordination agreement with Kazhydromet and Kazsushar in place; activation events logged	EPC Contractor	KTZ
CS001, AF001, TE064, TE079	C-SEV-01	Severance — Verification of As-Built Crossing Provision	Potential for the completed railway embankment to result in localised restrictions on established livestock and agricultural access where the location, configuration or practical accessibility of the as-built crossing provision does not adequately reflect actual movement requirements.	Prior to the start of operations, KTZ and the EPC Contractor shall verify the adequacy of the as-built crossing provision against actual agricultural and livestock access requirements. Verification shall include consultation with affected communities and local authorities and shall give particular attention to locations where specific access concerns have been raised and to longer-spaced reaches where the availability of suitable alternative crossings may result in material diversions.	As-built crossing provision verified through site inspection and consultation with affected communities and local authorities; findings and consultation outcomes documented; any material connectivity deficiencies and agreed corrective measures recorded; required corrective measures completed and verified prior to operational handover.	EPC Contractor/KTZ	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				Where verification identifies a material connectivity deficiency, KTZ and the EPC Contractor shall identify and implement technically and operationally practicable corrective measures. These may include improving access to an existing crossing, adapting a suitable existing structure or, where necessary and technically feasible, providing additional crossing provision. Any required corrective measures shall be completed before the start of operations.			

Vista Environment

Table A-3: Operations and Maintenance Phase ESMP

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
AF006	O-AGR-01	Agriculture	Death or injury to domesticated livestock entering the railway boundary	Installation of stock-proof fencing along the full length of the Right of Way, designed to a specification appropriate to the livestock present; inclusion of fencing inspection and maintenance in KTZ's routine track inspection regime with defined response times for repair of breaches; provision of agricultural underpasses to maintain livestock movement (cross-reference D-AGR-01)	Stock-proof fencing installed and recorded on as-built drawings; fencing inspection and maintenance records; livestock incident register	KTZ Operations	KTZ
AF006	O-AGR-02	Agriculture	Death or injury to domesticated livestock entering the railway boundary	KTZ to provide local livestock owners with an emergency telephone number for reporting livestock observed on railway land; KTZ to maintain protocols for informing train drivers of hazards on the line and for the safe removal of livestock	Community communication records; emergency response protocols documented; incident log of livestock-related events	KTZ Operations	KTZ
AF008	O-AGR-03	Operational Irrigation Performance	Disruption to irrigation	Incorporate irrigation and drainage infrastructure intersected by the railway into the operational inspection and maintenance programme. Inspect intersected irrigation canals and associated structures quarterly during the first three years of operation, reducing to annual inspection thereafter where satisfactory performance has been demonstrated, with additional inspections following significant flooding or other events	Inspection and maintenance records; records of blockage, erosion, ponding or impaired flow; irrigation-related complaints and investigations; corrective measures tracked to closure.	KTZ Operations	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				capable of affecting hydraulic performance. Investigate irrigation-related complaints through the GRM and implement corrective measures where Project-related obstruction, deterioration or impaired hydraulic performance is identified.			
CS004	O-CS-01	Community Health and Safety	Risk of injury or fatality to public from trespass on railway infrastructure	Perimeter fencing of the Right of Way along the full length of the alignment; provision of safe authorised crossing points at appropriate intervals; community engagement and rail safety awareness programmes in adjacent settlements (including school visits with material developed for children); warning signage in Kazakh and Russian; enforcement by KTZ's operational security arrangements in coordination with national authorities	Perimeter fencing complete; signage installed; awareness programme delivered with school visit records; trespass incident register	KTZ Operations	KTZ
CS005	O-CS-02	Community Health and Safety	Accidents at level crossings	All public road level crossings to be fully automated with barriers, audible and visual warning systems, and signage; design of crossings to applicable national and international standards with sight-line clearance and approach geometry appropriate for the relevant road speed; defined operational regime for crossing maintenance and warning system testing; awareness material on crossing use, with school visits	Level crossing as-built drawings verified; warning system test records; awareness material distributed; level crossing incident register	KTZ Operations	KTZ Dept of Ecology

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
CS005	O-CS-03	Community Health and Safety	Accidents at farm crossings	At farm crossings, provision made for users to be able to contact signalman to advise of long loads or slow crossing animal movements; conservative defaults applied to crossing protection where road usage data is limited	Farm crossing communication arrangements documented; usage protocol issued to farm crossing users	KTZ Operations	KTZ Dept of Ecology
NO001	O-NV-01	Noise — Operational	Operational train noise affecting residents (sleep disturbance and amenity loss)	Implement results of operational noise modelling (Section 8.4.4): committed noise barriers around the Maktaaral and Erdaulet stations; further noise mitigation at Küriş, Ushagash, Sarıžylga–Bereke and Şyrıldak–Jabaytöbe to be confirmed by detailed noise modelling at the EPC stage and implemented under the EPC Contract; source-control measures including horn-use protocols at night, restriction of locomotive idling at passing loops, and routine wheel/rail maintenance to limit rolling noise; façade insulation at properties where source/pathway mitigation insufficient	Noise barrier installation documented at Maktaaral and Erdaulet stations; detailed noise model report submitted; mitigation package implemented at the four other locations; operational noise monitoring records at representative receptors at the six locations; complaints register	KTZ	KTZ
NO003	O-NV-02	Vibration — Operational	Operational vibration affecting human receptors	Undertake the detailed operational vibration assessment at Maktaaral and Ushagash using site-validated source/propagation and building-coupling data. Standard trackform and routine rail, track and rolling-stock maintenance shall form the base controls. Where the detailed assessment demonstrates that applicable criteria cannot be achieved	Detailed assessment completed; additional mitigation requirements documented and implemented where required; early operational monitoring completed; grievances/adaptive actions recorded	KTZ	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				through the base design and standard controls alone, implement technically appropriate additional source, pathway or receptor mitigation. Undertake early operational vibration monitoring at representative receptors and apply adaptive management where required.			
TE081, TE108, TE109, TE112, TE115, TE116	O-BIO-01	Biodiversity — Operational Pollution	Pollution of water and soil from locomotive fuel and cargo spillage	Implement Pollution Emergency Response Plan specific to the Shardara Reservoir crossing, with pre-positioned spill response equipment at strategic locations within and adjacent to the IBA/KBA crossing; designated response protocols; joint exercises with the national water management authority (Kazsushar) and IBA management body	PERP approved and operational; pre-positioned equipment register; joint exercise records; spill incident register	KT	KTZ
TE081, TE108, TE109, TE112, TE115, TE116	O-BIO-02	Biodiversity — Operational Pollution	Pollution from track drainage and dust suppression activities	Operational drainage discharges from passing loops and bridge approaches treated through interceptors at locations adjacent to surface watercourses; controlled-emission toilets on rolling stock; controls on cargo carried over the Shardara crossing (no unstabilised hazardous bulk liquids during operations); track drainage system at the passing loops on the Shardara Reservoir embankment to incorporate a tank and isolation valve allowing temporary containment of spills before discharge, to prevent release to the reservoir or the Syr Darya watercourse	Drainage discharge inspection records; rolling stock toilet inspection records; cargo manifests	KTZ	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
TE083, TE085, TE086, TE088, TE090, TE092, TE094, TE096, TE098	O-BIO-03	Biodiversity — Bird Mortality	Bird mortality through electrocution and collision with electrical infrastructure	Provision of Bird Flight Diverters (BFDs) on the two 10 kV overhead distribution lines along the embankment within the IBA/KBA crossing and the additional 1 km buffers north and south of the crossing; BFD spacing ≤5 m excluding 10 m close to poles; BFDs to be sourced from a reputable manufacturer (e.g. Powerline Sentry or equivalent), designed for ≥25-year in-situ retention, sized to wire diameter, and incorporating high-contrast light- and dark-coloured surfaces, reflective elements and phosphorescent components for nocturnal visibility; BFDs of proven high-visibility type compliant with international good practice (IFC/EBRD/KfW 2023); all energised pole-top and gantry infrastructure designed to good-practice bird-safe standards comprising minimum 1.5 m horizontal and 0.6 m vertical clearance between energised parts, insulation of all exposed and live parts, and installation of perch deterrents on any retrofitted infrastructure	BFD specifications approved; installation locations documented on as-built drawings; BFD spacing verified on installation; post-construction fatality monitoring (PCFM) at the IBA/KBA section under the Biodiversity Action Plan	KTZ ´	KTZ
TE083, TE085, TE086, TE088, TE090, TE092, TE094, TE096, TE098	O-BIO-04	Biodiversity — Bird Mortality	Bird mortality — adaptive management	Post-construction fatality monitoring (PCFM) at the IBA/KBA section for at least three years following commissioning, comprising minimum four surveys per month along the entire embankment alignment (east and west)	PCFM monitoring reports submitted annually; adaptive management decisions documented; offset retrofit installations recorded	KTZ Operations	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				during peak migratory months (March–April and September–October) and two surveys per month in other months, with searcher-efficiency and scavenger-removal trials applied to derive corrected mortality estimates; vantage-point monitoring at pre-selected locations along the embankment for at least three years post-construction and repeated every five years for the operational life of the railway; adaptive management response where PCFM identifies fatality rates above thresholds set in the BAP, including retrofit of BFDs to off-site overhead lines as offset commitments under the BAP/BOMP; additional or amended mitigation (increased BFD density or different BFD specification) deployed within 90 days where monitoring identifies mortality of a globally threatened (IUCN Endangered or Critically Endangered) species or where collision events persist			
TE082, TE084, TE087, TE089, TE091, TE093, TE095, TE097, TE099, TE122	O-BIO-05	Biodiversity — Operational Disturbance	Disturbance of birds and reptiles from operational lighting and train noise	Operational lighting on bridges, signal gantries, and stations to use directional, downward-facing, warm-spectrum LED with full cut-off shielding to minimise night-migrant attraction and disorientation; no upward-facing or open-spectrum floodlighting in operational use; horn-use protocols at the IBA/KBA section to minimise unnecessary horn events; restriction of	Operational lighting specifications and installation documented; horn-use protocol issued; site inspection records	KTZ Operations	KTZ Dept of Ecology

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				locomotive idling at passing loops in or adjacent to the IBA/KBA; horn use prohibited and train speeds restricted within the IBA/KBA during the bird breeding season (April–August); operational lighting commitments extended to a 1 km buffer north and south of the IBA/KBA			
TE113	O-BIO-06	Biodiversity — Mammal Mortality	Mortality of IUCN Red Listed Mammals through collision with trains	Wildlife-permeable fencing along sections with high gazelle movement probability (informed by pre-construction camera-trap survey); complementary wildlife underpasses at intervals of no more than 1 km in identified corridors; underpass design to follow international good practice for mammal crossings	Fencing and underpass installations documented; wildlife use of underpasses monitored during the early operational period; mammal collision register	KTZ Operations	KTZ Dept of Ecology
TE121	O-BIO-07	Biodiversity — Reptile Mortality	Mortality of IUCN Red Listed Reptiles through collision with trains	Wildlife-permeable fencing along sections with high reptile movement probability (informed by pre-construction surveys); complementary wildlife crossing structures at intervals appropriate to reptile mobility	Fencing and crossing structures documented; reptile collision register; effectiveness reviewed after first operational year	KTZ Operations	KTZ Dept of Ecology
TE081, TE108, TE109, TE112	O-BIO-07	Biodiversity — Hazardous Cargo	Derailment of RID/COTIF dangerous goods wagon on IBA/KBA embankment or Syr Darya bridge, causing acute chemical contamination of the	Prepare a Hazardous Cargo Incident Response Procedure (HCIRP) as a standalone annex to the Operational Emergency Response Plan prior to first revenue train, covering: dangerous goods inventory accessible to response teams; pre-positioned spill	HCIRP approved and appended to OERP prior to first revenue train; equipment register audited annually; joint-exercise records maintained; speed restrictions in Operating Rules; cross-border protocol	KTZ Operations	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
			Shardara Reservoir and Syr Darya with potential transboundary consequences downstream into Uzbekistan	containment equipment at Yerdaut, Promezhutochnaya and the southern IBA/KBA embankment; notification chain to Kazsushar, Ministry of Emergency Situations, Kazhydromet and BWO Syr Darya; speed restrictions for Class 1–8 trains through the IBA/KBA in low-visibility or adverse-weather conditions; cross-border notification procedures for Uzbek downstream authorities per Espoo Convention and 1992 ICWC obligations; annual joint-response exercises with Kazsushar and BWO Syr Darya	confirmed in writing prior to first revenue train; HCIRP activations reported to lenders within 14 days		
WH007	O-WH-01	Occupational Health and Safety	Worker injury during maintenance of track and railway infrastructure	Implement safe systems of work for maintenance activities, including access control to live railway through defined possession arrangements with the operational control centre; lookout and warning systems for any working without full possession; competence-based selection and certification of maintenance staff; supervised operation; provision of appropriate PPE	Operational H&S management system documented; possession arrangements operational; certification records; incident register	KTZ Operations	KTZ
WH008	O-WH-02	Occupational Health and Safety	Electrocution during maintenance of electrical systems	Implement electrical safety procedures including lockout/tagout, isolation and earthing of electrical infrastructure before work; certification and continuing training of staff authorised to work on electrical systems; defined permit-to-work arrangements; use of insulated tooling and appropriate PPE;	Electrical safety procedures documented; certification records; permit-to-work register; incident register	KTZ Operations	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				developed in accordance with GIIP for railway operations			
WH009	O-WH-03	Operational Emergency Response	Inadequate response to railway emergencies (derailment, collision, fire)	Implement Operational Emergency Response Plan, coordinated with national and regional emergency services; defined notification, command-and-control, mutual-aid and joint-response arrangements; pre-positioned response equipment at strategic locations along the alignment, including the PER equipment at the IBA/KBA crossing (cross-reference O-BIO-01); tested through tabletop and live drills at appropriate intervals through the operational life of the railway	OERP approved and operational; coordination agreements documented; pre-positioned equipment register; drill reports; emergency event register	KTZ Operations	KTZ
ESIA section8.4.4 Waste	O-WM-01	Waste Management — Operations	Hazardous and non-hazardous waste generated at the rolling stock and engine maintenance facility (used oil, oily rags, asbestos brake linings, chemicals, scrap metal, general waste)	Develop and implement an Operational Waste Management Plan for the maintenance facility and all stations; plan structured to the waste hierarchy (reduce, reuse, recycle, recover, dispose); hazardous waste (used oil, asbestos brake linings, solvents) stored on impervious hardstanding with 110% secondary containment and segregated at source; chain-of-custody manifests from generation to licensed disposal facility; out-of-bounds register prohibiting use of unlicensed legacy waste sites in the area; workforce training on waste handling and hazardous waste procedures; plan	Operational Waste Management Plan approved prior to commissioning; quarterly waste generation and disposal records; hazardous waste manifests retained; bunding and labelling inspections; training records; annual third-party audit of facility waste handling	KTZ Operations	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
				aligned with national legislative requirements and IFC PS3			
Akui consultation	O-AQ-01	Air Quality — Operational	Diesel locomotive emissions affecting residents adjacent to alignment	Operational air quality monitoring at representative sensitive receptors adjacent to the alignment (including Akui village, where the issue was raised at the May 2026 consultations); annual monitoring campaigns covering NO2, PM10 and PM2.5 over a representative 7-day period during peak rail traffic; results compared to national and IFC guideline values; corrective action through locomotive maintenance, fleet renewal or operational scheduling where exceedances identified	Annual monitoring reports submitted; results disclosed to affected communities via the CLO; corrective actions documented where required	KTZ Operations	KTZ
CRA sectionE.1, sectionG.1	O-CC-01	Climate — Track Temperature Operations	Operational risk of rail thermal expansion, buckling and derailment under projected high-temperature events; ballast degradation; service safety risk	Implement a temperature-triggered train speed restriction protocol defining staged restrictions at exceedances above SFT (standard practice: first restriction at SFT+10°C, suspension of operations at SFT+20°C or per KTZ network rules, whichever is more conservative); install track temperature monitoring on all designated high-sensitivity CWR sections with SCADA-linked alerting; protocol incorporated into Operating Rules and O&M manual prior to commissioning; >5 speed restriction events per summer season (Jun–Sep) triggers review of SFT specification adequacy by Design Engineer	Speed restriction protocol incorporated into Operating Rules; track temperature monitoring system operational with availability >95% Jun–Sep; speed restriction events logged continuously; annual summary each October; any unplanned suspension due to rail temperature triggers incident report within 14 days	KTZ Operations	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
CRA sectionG.1	O-CC-02	Climate — Embankment Inspections	Embankment integrity over the operational life is exposed to flood, snowmelt and landslide risk; deformation, piping, seepage and surface erosion may develop progressively or be triggered by individual events	Conduct embankment condition inspections twice annually (February pre-snowmelt and June post-snowmelt) along the full alignment, with additional event-triggered inspections after any 24-hour rainfall exceeding 20 mm or following any Syr Darya flood alert; defects categorised by severity; moderate defect triggers remediation plan within 30 days; critical defect triggers immediate works stoppage and lender notification within 14 days; baseline conditions established under C-CC-02; particular attention to embankment sections adjacent to the Shardara Reservoir	Inspection reports submitted twice annually and after each qualifying event; defect register maintained with status, severity and closure evidence; corrective actions tracked to closure; semi-annual E&S report includes embankment condition summary	KTZ Operations (Maintenance)	KTZ
CRA sectionE.1	O-CC-03	Climate — Wildfire Management	Trackside vegetation and operational infrastructure remain exposed to wildfire risk over the operational life, with fire alert duration projected to continue increasing under climate change	Maintain the 20–30 m cleared firebreak zone on each side of the running rail through wildfire-prone sections as designed under D-CC-04; vegetation management at frequencies specified in the O&M manual; routine inspection and replenishment of fire-fighting equipment along the alignment (cross-reference O-WH-03 emergency equipment); coordination with national emergency services for wildfire response; locomotive maintenance to limit spark generation	Firebreak inspection records (semi-annual minimum); vegetation management records; fire-fighting equipment inspection register; wildfire incident log; coordination agreements with national emergency services in place	KTZ Operations	KTZ

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
CRA sectionE.1, sectionG.2	O-CC-04	Climate — Resilience Review & Emergency Response	Climate trends and observed infrastructure performance may warrant revision of risk ratings or adaptation measures over the operational life	Develop emergency response and service continuity plans for all CRA HIGH-rated hazards (river flood, mean surface temperature, rainfall-induced landslide) prior to commencement of revenue operations, including contingency freight arrangements and defined maximum restoration timelines for track, embankment and bridge failures; tabletop exercise before revenue operations and annual review thereafter; conduct climate resilience reviews at (i) substantial completion, (ii) end of defects liability period, and (iii) 5-yearly intervals during operations, or following any significant climate event affecting the alignment; review findings reported to lenders in subsequent semi-annual E&S monitoring report; flood-related service disruption >24 hours, severe heat-related OHS incident, or structural failure linked to a climate event escalated to KTZ project management and notified to lenders within 14 days	Emergency response and service continuity plans approved prior to revenue operations; tabletop exercise records; annual review records; 5-yearly climate resilience review reports; lender event notifications retained; corrective actions tracked to closure in subsequent semi-annual report	KTZ Operations	KTZ
CS001, AF001, AF006, TE064, TE079, TE113, TE121	O-SEV-01	Severance — Operational Access Monitoring	Potential for localised livestock or agricultural access constraints to become apparent during operation, including where crossing approaches deteriorate, drainage or obstruction	Monitor the functional accessibility of designated livestock and agricultural crossings as part of routine railway inspections and through feedback received from affected communities and the Project GRM. Where monitoring or community feedback identifies a material restriction on	Designated livestock and agricultural crossings included in routine inspection arrangements; access-related grievances and community feedback recorded and investigated; identified material deficiencies and	KTZ Operations / KTZ CLO	KTZ CLO

ESIA Impact ID	EMP Ref No.	Topic	Impact / Issue	Commitment	Monitoring Indicator	Impl. Resp.	Mon. Resp.
			affects usability, or community experience identifies an access issue not evident during pre-operation verification.	established livestock or agricultural access attributable to the Project, KTZ shall investigate the issue and implement technically and operationally practicable corrective measures. Measures may include maintenance or improvement of crossing approaches, drainage, fencing or other access features, or adaptation of an existing structure where required.	corrective actions tracked to closure.		

Vista Environment

Annex B – Preliminary BAP

A. Executive Summary

The Darbaza Rail Project (Project) is a freight railway in Turkestan Region, southern Kazakhstan, operated by KTZ Express. The railway crosses the Shardara Reservoir, one of the most internationally significant wetlands in Central Asia and recognised as an Important Bird Area (IBA) and a Key Biodiversity Area (KBA). Approximately 16 km of the Project passes through the Shardara Reservoir IBA/KBA on a raised, 100 m wide embankment. The Project ESIA confirms that, despite a comprehensive mitigation programme including bird flight diverters (BFDs) on the Project's own overhead distribution lines, pollution controls, and seasonal construction restrictions, significant residual biodiversity impacts remain that cannot be addressed through on-site mitigation alone.

This Preliminary BAP identifies six receptor groups requiring action:

1. Shardara Reservoir IBA/KBA and its Natural Habitat (~150 ha permanent loss)
2. Dalmatian pelican (Critical Habitat)
3. Pygmy cormorant (Critical Habitat)
4. Internationally significant wintering, migratory, and breeding bird assemblages
5. Threatened reptile species, including Central Asian tortoise and European Glass lizard
6. Syr Darya shovelnose sturgeon (Critical Habitat)

For the first five biodiversity features, biodiversity offsets are required to achieve No Net Loss (NNL) and Net Gain (NG). For the sturgeon, the sixth biodiversity feature, additional conservation actions are required to meet the Critical Habitat NG obligation under IFC PS6 and ADB SPS.

The document introduces five indicative Habitat offset actions (referenced H1 to H5), three bird collision reduction offset actions (referenced B3 to B5), and four sturgeon additional conservation actions (referenced S1–S4), with an indicative assessment of the feasibility of each. The high level feasibility assessment comprises a review of the proposed actions likely ecological feasibility, social feasibility, financial feasibility, legal/regulatory feasibility and the feasibility of KTZ ‘s governance and ability to be accountable with sufficient leadership. Introductory actions for threatened species are introduced only.

Collectively the habitat, bird offsets, and fish related additional conservation actions will be designed, implemented and managed in accordance with the Shardarya Reservoir's conservation objectives. The alignment of conservation objectives will be central to the development of the final BAP and evidenced throughout.

The overall indicative budget commitment, excluding on-site mitigation, is in the range of USD 2 to 4 million. Confirmed budgets will be presented in the Final BAP. KTZ commits to delivering the Final BAP, including confirmed site assessments, stakeholder consultation, implementation agreements, and detailed monitoring and adaptive management frameworks, before loan review and approval.

B. Introduction and Project Overview

The Darbaza Rail Project comprises a standard-gauge freight railway in Turkestan Region, southern Kazakhstan. The railway connects Darbaza to Maktaaral and will be developed and operated by KTZ, Kazakhstan's national railway operator. Construction commenced in January 2024 on a retrospective basis and is near-complete at the time of writing. It is expected that the Project will be financed by the Asian Development Bank (ADB), International Finance Corporation (IFC), and Asian Infrastructure

Investment Bank (AIIB), each of which requires a Biodiversity Action Plan meeting the requirements of their respective environmental and social standards.

The most ecologically sensitive section of the alignment crosses the Shardara Reservoir for approximately 16 km via a raised embankment up to 20 m high and 100 m wide. The Shardara Reservoir is a very large freshwater body on the Syr Darya river, covering approximately 900 km², and is internationally recognised as an IBA and KBA for its waterbird populations, including globally threatened species. The reservoir and the Syr Darya river also support fish species of critical conservation concern, specifically the Syr Darya shovelnose sturgeon.

This Preliminary BAP has been prepared ahead of a Final, lender-ready BAP to demonstrate KTZ's awareness of its biodiversity obligations and commitment to meeting them. It is explicit that it does not yet achieve full compliance with ADB, IFC, or AIIB standards. The Final BAP will close this gap and will be submitted to lenders for approval before loan disbursement. The language used throughout this document is intentionally forward-looking: where the Final BAP will confirm, commit to, and deliver the actions described.

BAP Purpose

The purpose of a BAP is to define, resource, and govern the actions required to offset residual adverse biodiversity impacts that cannot be fully addressed through standard mitigation measures alone and achieve a Net Gain for biodiversity features that meet Critical Habitat thresholds, irrespective of any project related impacts. The Final BAP will therefore be written to serve three audiences simultaneously:

- The Lenders, ADB, IFC and AIIB: providing confidence that committed offset and additional conservation actions are technically sound, adequately resourced, and will achieve the required conservation objectives.
- Implementing Partners (yet to be confirmed at this Preliminary BAP stage): providing sufficient methodological guidance, milestones, and monitoring requirements to inform and enable effective delivery once contracts are signed.
- KTZ as the Executing Agency: providing governance clarity, accountability structure, and adaptive management guidance to ensure KTZ can fulfil its obligations.

The Final BAP will not duplicate mitigation or compensatory measures already committed to in the Project ESMP or the BMP (e.g. the fitting of Bird Flight Diverters to the Project's 10kV Over Head Powerline). It specifically addresses the residual biodiversity losses that will persist after standard mitigation has been implemented.

Relevant Project Documents

This BAP should be read in conjunction with the other environmental and social baselines, assessments and action plans. Relevant Project documents are summarised in .

Table 108: Project documents relevant to this Preliminary BAP.

Document	Relationship to this BAP
ESIA (2026)	It provides a project overview, the baseline data, the impact assessment, and introduces both the requisite mitigation for construction and operation and the residual impact findings that define the scope and scale of this BAP.

BMP (2026)	Defines on-site biodiversity mitigation, including but not limited to the inclusion of bird diverters and insulation on the new 10 kV OHL. The BAP builds on and does not duplicate these measures.
ESMP (2026)	Sets out the operational environmental and social management framework within which the BMP and BAP sit.

C. Biodiversity Offsets: Standards and Principles

A biodiversity offset is a measurable conservation action designed to compensate for significant residual adverse impacts on biodiversity that cannot be fully avoided, minimised, or remediated on-site through the mitigation hierarchy. Offsets are a measure of last resort, they should only be considered once all reasonable avoidance and mitigation options have been exhausted. The goal is to achieve at least No Net Loss (NNL) of biodiversity, and preferably a Net Gain (NG), relative to the Project's retrospective baseline. This Preliminary BAP uses the Business and Biodiversity Offsets Programme (BBOP) principles as the primary framework for offset design, consistent with ADB ESS6, IFC PS6, and the AIIB ESF.

For this Project, biodiversity offsets are required for the Sharara Reservoir IBA/KBA, its constituent Natural Habitat and the various important bird assemblages it supports, particularly dalmatian pelican and pygmy cormorant, for which the reservoir meets the thresholds for Critical Habitat.

An Additional Conservation Action (ACA) differs from an offset in that it is not necessarily triggered by an adverse residual impact. Under ADB SPS and IFC PS6, if a project is located in Critical Habitat, the project is required to achieve a NG for the species or feature that triggered the Critical Habitat, regardless of whether the project directly impacts them. Like offsets though, they must still be (i.e. beyond what would occur without the Project), measurable and deliver the NG in perpetuity. For this Project, the Syr Darya shovelnose sturgeon is the principal receptor requiring additional conservation actions. The species is Critically Endangered on the IUCN Red List and the Syr Darya river constitutes Critical Habitat. The Project introduces construction-stage disturbance and pollution risks at the river crossing, but the reason for the ACA is the Critical Habitat NG obligation.

In accordance with BBOP and GIP, the Project's offsets and ACAs are designed around five essential requirements. The feasibility of these requirements forms the basis of this Preliminary BAP. Ecological feasibility ensures that proposed offset and ACA sites can genuinely deliver the intended biodiversity outcomes, considering habitat condition, landscape connectivity, species requirements, and the realistic timeframes over which gains can be achieved. Social feasibility assesses whether local communities support the proposed arrangements, have secure and recognised rights over the relevant land, and can realistically participate in and benefit from long-term management. Financial feasibility ensures that sufficient, reliable funding is in place not just for initial implementation but for the full duration of the offset commitment, which for critical habitat must aim for perpetuity. Legal and regulatory feasibility considers whether the offset and ACA commitments are legally recognised, enforceable, and aligned with national biodiversity requirements. KTZ governance feasibility assesses whether the specific institutional and management arrangements governing the offset and ACA areas are in place, clearly defined and sufficient to deliver, and sustain, the conservation objectives over the long term.

While this Preliminary BAP explores a series of possible offset and ACA's feasibility, the Final BAP will provide more details on the final, agreed actions, the methods for quantifying NNL and NG, and how additionality and permanence will ultimately deliver NNL and NG.

D. Stakeholder Consultation

Effective stakeholder engagement is an essential requirement for the robust design and successful implementation of biodiversity offsets and ACAs. Conservation actions will very likely fail without local and technical engagement. Consultation with local communities and receptor-specific experts provide

project-relevant knowledge and insight that surveys and research often miss. Equally, engagement with government-level stakeholders help align offsets and ACAs with legal requirements, national policy and strategies, and national governance structures making sure the actions are sensitive to, and address relevant institutional capacity, bureaucratic culture, and the political priorities.

Biodiversity consultation has been undertaken with conservation organisations, government authorities, academic and scientific institutions, and recognised species specialists. Details are presented in .

Table 109: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process.

Ref	Organisation / Expert	Type	Date	Purpose
1	Shardara Reservoir Management Authority	Email correspondence and formal letter request - no response	February/March 2026	Reservoir operations, water hydrology aquatic habitat
2	Aral–Syrdarya Basin Inspection (Committee for Water Resources)	Email correspondence and formal letter request - no response	February/March 2026	Water management, basin ecology, fisheries regulation
3	Committee of Forestry and Wildlife (Ministry of Ecology and Natural Resources)	Email and meeting correspondence with Mr Musaliev - Regional Head	March 2026	Protected areas, wildlife regulation, habitat oversight
4	Kazakhstan Fisheries Research and Production Center (KazNIIRKh)	Email correspondence and formal letter request - no response	February/March 2026	Fisheries, aquatic ecology, reservoir fish and Sturgeon
5	RSE Kazhydromet	Email correspondence and formal letter request - no response	February/March 2026	Hydrology, water levels, climate and meteorological data
6	Institute of Geography and Water Security	Email correspondence and formal letter request - no response	February/March 2026	Hydrology, water balance, climate–water interactions
7	Al-Farabi Kazakh National University – Department of Zoology	Email correspondence - no response	February/March 2026	Herpetology, specifically desert reptiles
8	Auezov South Kazakhstan University – Ecology Department	Email correspondence - no response	February/March 2026	Regional reptile knowledge
9	Ministry of Water Resources and Irrigation	Email correspondence and formal letter request - no response	March 2026	Water governance, basin management
10	ACBK	Emails, meetings, site surveys and data sharing	2025 and 2026 ongoing	Biodiversity data, particularly birds

Ref	Organisation / Expert	Type	Date	Purpose
11	Victoria Kovshar – professional ornithologist	Email and meeting correspondence and sharing of data.	2025 and 2026 ongoing	Bird data
12	Eurasian Regional Association of Zoos and Aquariums	Email and meeting correspondence and sharing of data.	March 2026	Syr Dara Shovelnose sturgeon
13	Tennessee Aquarium Conservation Institute (Bernie Kuhajda)	Email and meeting correspondence and sharing of data.	March and April 2026	As above

It is noted that the Project's biodiversity focused consultation to date has largely focused on gathering data and informing the Critical Habitat Assessment and the Impact Assessment with its associated mitigation. While consultation relating to the offsets and ACAs has started and work to date has informed the potential offsets and ACAs presented in this Preliminary-BAP, the speed of construction and the retrospective nature of the ESIA have constrained early engagement, including consultation with KTZ on biodiversity commitments and offset budgets. This Preliminary BAP acknowledges that more consultation is required as part of developing the Final BAP.

Therefore, KTZ commits to a structured consultation programme as part of developing the Final BAP. The programme will prioritise engagement with ACBK and KECOG on bird offset design and monitoring; community consultation with the Shardara fishing and herder communities on reservoir-based habitat actions; land tenure and permissions for all indicative offset sites; and coordination with Kazakhstani environmental authorities, international experts and the Uzbekistan sturgeon hatchery on the sturgeon ACA. Table 110 sets out the minimum consultation that KTZ commits to as part of the Final BAP development.

Table 110: Committed Stakeholder Consultation Programme

Ref	Organisation / Expert	Biodiversity Focus
1	ACBK (Association for Conservation of Biodiversity of Kazakhstan)	Identify priority bird monitoring sites; identify and assess candidate existing OHL for retrofit (B1 – B5) co-design bird monitoring protocols
2	KECOG (Kazakhstan Electricity Grid Operating Company)	Identify ownership, condition, and access to priority OHLs for BFD retrofit (B1) and pole insulation (B2)
3	Shardara District Administration / Akimat	Confirm land tenure and permissions for all indicative offset sites (H1–H5), explore community management models
4	Shardara fishing communities and herder associations	Community-level consultation on reservoir-based habitat actions, identify co-benefit and co-management opportunities
5	Kazakhstani Ministry of Ecology & Natural Resources	Sturgeon survey permits (S1); captive breeding collaboration (S3); Species Action Plan (S4)
6	Uzbekistan Institute of Gene Pool of Plants & Animals/sturgeon hatchery	Explore captive breeding collaboration for shovelnose sturgeon (S3)
7	Tennessee Aquarium Conservation Institute (Bernie Kuhajda)	International experts on shovelnose sturgeon (S1, 2 & 3)

Ref	Organisation / Expert	Biodiversity Focus
8	ADB, IFC and AIIB	Review and approval of Final BAP prior to loan disbursement

E. Biodiversity Context and Residual Impacts

The Shardara Reservoir is one of the largest and most ecologically productive freshwater wetlands in Central Asia. It qualifies as an IBA for supporting internationally significant populations of dalmatian pelican (criterion A1, globally threatened), and waterbird assemblages exceeding 20,000 individuals at winter peak (criterion A4iii). The reservoir technically supports eight IBA qualifying species and multiple species listed in the Kazakhstan Red Data Book, but the ACBK surveys over the past c.20 years indicate a sharp decline in the abundance in the other qualifying species.

A nationally significant mixed breeding colony, including approximately 1,500 pairs of pygmy cormorant, 1,000 pairs of glossy ibis, and 300 to 400 pairs of little egret was confirmed approximately 1.2 km east of the embankment during the 2025 surveys. The reservoir and the Syr Darya river also constitute Critical Habitat for the Critically Endangered Syr Darya shovelnose sturgeon. Kazakstan Red List reptiles species are also present along the Project alignment, the European glass lizard and the Central Asian Tortoise, the latter is also an IUCN Vulnerable species.

The Project ESIA confirms that, despite the full application of mitigation, including BFDs on the Project's two 10 kV OHL, seasonal construction restrictions, pollution controls, and reinstatement of temporaryily lost habitat, the following significant residual impacts persist. These are the residual impacts for which this BAP has been developed. summarises each receptor, the nature of the residual impact, and the type of action required.

Table 111: Summary of Residual Impacts and Required Action

Biodiversity Receptor	Ecological Importance	Quantification and Residual Impact	Action Required
Shardara Reservoir IBA/KBA including Natural Habitat	IBA / KBA Natural Habitat	Permanent loss of c.150 ha of Natural Habitat (reedbed, Tugai scrub, braided channels, floodplain grassland). Indirect disturbance of c.800 ha. Cannot be compensated on-site.	NNL via offset
Dalmatian Pelican	Critical Habitat	Permanent loss of ~150 ha of habitat, additional indirect disturbance. and residual OHL collision and mortality risk after BFD installation on-site.*	NG via offset
Pygmy Cormorant	Critical Habitat	As above	NG via offset
Wintering Bird Assemblage	Internationally important	As above, particularly for large-bodied waterfowl (geese and swans)	NNL via offset
Migratory Bird Assemblage	Regionally important	As above for large Spring and Autumn bird movements.	NNL via offset
Breeding Bird Assemblage	Regionally important	As above, particularly loss of reedbed used by (glossy ibis, egrets etc).	NNL via offset
Raptor & Vulture Assemblage	Regionally important	As above	NNL via offset
Threatened Reptiles	Regionally important	Quantification to be confirmed	NNL via offset

Syr Darya Shovelnose Sturgeon	Critical Habitat	Construction disturbance, sedimentation and pollution risk. None at operation	NG via ACA

* The installation of BFDs on the Project's own OHL 10 kV lines are requisite on-site mitigation committed under the ESMP, and therefore not an offset.

F. Preliminary Offset and Additional Conservation Actions

This section introduces the range of potential actions that will be further reviewed and developed as part of the Final BAP. Each potential action has been suggested or refined by organisations and expects as part of the initial consolation, particularly ACBK and the Tennessee Aquarium Conservation Institute. The proposed actions have been grouped, each focusing on a key receptor or group of receptors (e.g. birds). The groupings of actions comprise:

- Habitat offsets (H1 to H5), which could benefit the birds that use the habitat(s), if the actions are designed and implemented accordingly
- Bird collision reduction offsets (B1 to B5)
- Sturgeon additional conservation actions (S1 to S4).

A summary of each possible action with an indicative assessment of its feasibility is presented in Table 112. No single action is likely to be sufficient on its own and the Final BAP will therefore develop an integrated approach using the most feasible combination of actions across each group.

Habitat Offsets (H1–H5)

Five indicative habitat offset actions have been proposed that could individually or in combination address the permanent loss of approximately c.150 ha of Natural Habitat, including reedbed, Tugai scrub and floodplain grassland. The proposed actions are:

- H1 - Reedbed and Tugai scrub management
- H2 - Hydrological management
- H3 - Grazing management
- H4 - Reedbed Restoration and Creation
- H5 - Constructed Wetlands and Pollution filters

The Final BAP will refine and develop these actions (and potentially others) and most likely, present a blended action(s) centred on active reedbed and Tugai scrub restoration and creation in the wider landscape. Where feasible and practical all habitat focused offset plans will be designed to include multiple co-benefits so that the implementation benefits the targeted habitats and their constituent for birds and fish e.g. the sturgeon. This will approach will increase the conservation outcome(s) and make best, efficient use of the available resources.

A critical and immediate prerequisite of all habitat focused offsets is to confirm the land tenure, current land use, and the identification of a suitable delivery partner or community management model. Initial research confirms that the reservoir land is government owned and managed, but this must be confirmed. Beyond tenure, each action carries its own specific uncertainties, reedbed restoration for example, is ecologically feasible but is contingent on identifying suitable sites with appropriate hydrology, and reedbed establishment is inherently slow, meaning the time lag to measurable gains must be factored carefully into the NNL/NG quantification. Alternatively, grazing exclusion is likely to be very low cost but it likely to be strongly opposed by the local communities who use the floodplain grasslands for their livestock. The Final BAP will include site-specific assessments, formal land agreements, and long-term management plans for all confirmed offset actions and sites.

Bird Collision Reduction Offsets (B1–B5)

The residual collision and mortality risk to the local bird assemblage from the Project's new OHLs cannot be fully eliminated by BFDs on the Project's own infrastructure. Most BFDs reduce collision risk by between 50 and 70% depending on the location, target species and quality of the diverter itself. Additional action is therefore required. The most likely offset action is the retrofitting of existing, already-dangerous distribution and transmission lines within and adjacent to the IBA with high-quality BFDs. Published evidence and good international practice (IFC/EBRD 2026 guidelines) supports this like-for-like approach, i.e. retrofitting a length of existing OHL at least equivalent to the length of new OHL introduced by the Project. For dalmatian pelican and pygmy cormorant, both Critical Habitat triggers that require NG, the combined effect of on-site BFDs (mitigation) and off-site retrofitting (offset) is expected to achieve a net reduction in collision risk above baseline. This approach is widely used where OHLs pose risks to birds and theoretically achieves an NNL equivalence. This approach and several others have been proposed and have been assessed. They comprise:

- Retrofit Existing Distribution Lines with BFDs
- Retrofit Existing Poles and Pylons with insulators
- Hunter & Fishing Community Engagement
- Dalmatian pelican habitat restoration and prey availability
- Pygmy cormorant habitat restoration and prey availability

The bird offsets assume that the use of BFD as part of the Project's mitigation and offset actions will collectively be sufficient to offset the collision risk introduced by the Project's new infrastructure. This can only be confidently determined with improved and specific bird data, that must confirm which species and in what abundance pass the Project's infrastructure (and therefore what the risk of collision is). The Project's 10 kV OHL configuration also remains to be fully confirmed, e.g. whether there is one or two lines, and whether any sections might be buried etc, as this will influence the scale of the risk and therefore the scale and extent of the offset requirements.

Sturgeon Additional Conservation Actions (S1–S4)

The Syr Darya shovelnose sturgeon is the world's smallest sturgeon, endemic to the Syr Darya river system, and classified as Critically Endangered. Populations have collapsed due to decades of dam construction, water abstraction, and overfishing. There are no confirmed recent records within the project area, though local fishermen and a 2019 US/Kazakh expedition suggest the species may persist in very low numbers in the Syr Darya system. Because the Syr Darya river is Critical Habitat for the species, the Project must achieve NG, regardless of direct impacts.

Four indicative ACA actions have been proposed by the international research team responsible for surveying and trying to confirm that the species survives. The proposed actions are:

- Supporting Sturgeon Baseline Surveys
- Spawning Habitat Assessment
- Captive Breeding & Restocking
- Species Action Plan

The Syr Darya shovelnose sturgeon ACAs are the most uncertain part of this Preliminary BAP. The baseline for the species is almost entirely unknown and local and international knowledge and expertise is limited. Baseline surveys using eDNA analysis, net sampling, and structured questionnaire interviews with local fishermen is the essential, pre-requisite first step. Investment in the other ACAs maybe unjustified without confirmed presence/absence and population data. The Final BAP will assess and refine the benefits and validity of pursuing the other proposed ACAs.

Vista
Environment

Vista Environment

Table 112: An introduction to the indicative and possible offset and ACA actions, including a high-level assessment of action's practical feasibility.

Ref	Action	Type	Ecological Feasibility	Social Feasibility	Financial Feasibility	Legal / Regulatory	KTZ Internal	Indicative Cost (USD)	Key Co-benefits
HABITAT OFFSETS (H1 – H5) NNL for IBA/KBA and Natural Habitat compensating loss of c.150 ha with co-benefits for Critical Habitat (targeting NG)									
H1	Reedbed and Tugai scrub management. Enhance reedbed and scrub mosaic and manage succession and restrict access/grazing, particularly between Project alignment and the road to the east	Habitat Management	High	Medium (land is government owned)	Medium	Medium	Low	To be confirmed	Dalmatian pelican, pygmy cormorant, wintering, migratory, breeding, and raptors assemblages. Plus fish, invertebrates and flora.
H2	Hydrological management. Create and maintain bunded shallow pools with inlets along reservoir margin to retain water during seasonal drawdown	Habitat Creation	High	Medium	Medium	Medium	Low	As above	As above.
H3	Grazing Management. Establish seasonal exclusion areas adjacent to Project alignment to protect regenerating reedbed and riparian vegetation. Community engagement essential	Habitat Protection	High	Low	Medium	Medium	Low	As above	Pygmy Cormorant, reedbed-dependent breeding birds grassland birds
H4	Reedbed Restoration and Creation. Identify and restore degraded former reedbeds in the wider landscape to compensate for c,9ha of losses	Habitat Restoration	High	Medium	Medium	Medium	Low	As above	Dalmatian pelican, pygmy cormorant; all waterbirds, breeding birds
H5	Constructed Wetland or Pollution Filter. Create and manage reedbeds at key reservoir inflow channels to intercept agricultural and urban pollutants	Habitat Creation / Pollution Control	High	High	Medium	Medium	Low	As above	Dalmatian pelican; all waterbirds, Syr Darya Sturgeon, fishing community, birds

Ref	Action	Type	Ecological Feasibility	Social Feasibility	Financial Feasibility	Legal / Regulatory	KTZ Internal	Indicative Cost (USD)	Key Co-benefits
BIRD OFFSETS (B1 – B5) NNL for wintering, migrating, breeding and raptor and vulture bird assemblages. NG for dalmatian pelican and pygmy cormorant.									
Bird Flight Diverters will be fitted to all Project OHLs at a spacing of 5 m through the reservoir IBA/KBA plus at least 1 km to the north and south, and at a spacing of every 20 m along the entirety of the Project alignment outside the reservoir. These commitments are project mitigation and are not included here.									
B1	Retrofit Existing Distribution Lines with BFDs. Identify and retrofit the existing OHLs that pose the greatest risk to birds within and adjacent to the IBA with BFDs at 5 m spacing.	Collision Risk Reduction	High	High	Medium	Medium	Low–Medium	As above	Dalmatian pelican, wintering, migratory & breeding assemblage, raptors & vultures
B2	Retrofit Existing Poles and Pylons. Insulate pole cross-arms and pole-tops within and adjacent to the IBA to reduce electrocution risk for large perching raptors	Electrocution Risk Reduction	High	High	Medium	Medium	Low	As above	Raptors & vultures, particularly steppe eagle and white-tailed eagle
B3	Hunter & Fishing Community Engagement. Collaboration and targeted awareness raising with 3 local hunting organisations and fishing communities to increase protection of rare bird species	Direct Persecution Reduction	Medium	Low	High	High	Low	As above	Dalmatian Pelican; all waterbirds, fish including the sturgeon.
B4	Dalmatian pelican specific habitat management and increase prey availability (to be developed alongside the habitat offsets)	Species Enhancement	Medium	Medium	Medium	Medium	Low–Medium	As above	All bird assemblages and all habitats
B5	Pygmy Cormorant specific habitat management and increase prey availability (to be developed alongside the habitat offsets)	Species Enhancement	Medium	Medium	Medium	Medium	Low–Medium	As above	All bird assemblages and all habitats
STURGEON ACA (S1–S4) NG for Syr Darya Shovelnose Sturgeon									

Ref	Action	Type	Ecological Feasibility	Social Feasibility	Financial Feasibility	Legal / Regulatory	KTZ Internal	Indicative Cost (USD)	Key Co-benefits
S1	Sturgeon Baseline Survey (eDNA, net surveys and questionnaires)	Baseline Survey	Low *	Medium	High	Medium	Medium	As above	Scientific community; national fisheries authority
S2	Spawning Habitat Assessment and Enhancement. Map and assess condition of available spawning and foraging habitat in the Syr Darya near the crossing.	Habitat Enhancement	Low *	Low	High	Medium	Low	As above	Scientific community; other native fish species
S3	Captive Breeding & Restocking Support — engage with the existing rare sturgeon Uzbekistan hatchery programme, to learn their practices with the potential aim of establishing a precautionary safe, holding area in Kazakhstan, in case the target sturgeon is captured.	Species Recovery	Low *	Medium	High	Low	Low	As above	Scientific community; national biodiversity
S4	Species Action Plan. Support the development of a Kazakhstani National Species Action Plan for the shovelnose sturgeon. Engage with national fisheries authority on management plan.	Policy & Advocacy	Medium	Medium	High	High	Medium	As above	Scientific community; national biodiversity; fisheries

* Ecological feasibility for sturgeon actions (S1–S3) is rated Low at this stage because of the very limited baseline data and that the species may already be extinct. I.e. the low rating is not because the actions are technically unsound.

Central Asian Tortoise and European Glass Lizard

The Central Asian tortoise *Testudo horsfieldii* (IUCN Vulnerable and Kazakhstan Red Data Book Category II; CITES Appendix II) has been confirmed present within the Project area, and was also recorded in high numbers (190 individuals along one 10 km section) during surveys associated with the adjacent Saryagash Bypass. The European glass lizard *Pseudopus apodus* (IUCN Least Concern but Kazakhstan Red Data Book) is also confirmed present in the grasland steppe, scrub, and semi-desert habitats along the terrestrial sections of the alignment north of the reservoir. Both species are legally protected under Kazakhstan national legislation.

Whilst construction-stage mitigation has been committed to under the ESMP and will reduce direct mortality risk, it is acknowledged that some incidental mortality of both species during clearance, earthworks, and construction traffic is likely but currently unquantified. Unlike more mobile vertebrates, both the Central Asian tortoise and the European glass lizard are slow-moving and vulnerable to being killed or injured during vegetation clearance and ground disturbance. The Saryagash Bypass data illustrates that, even with reasonable precautions, the probability of some mortality across a 115 km alignment cannot be discounted. In the absence of robust local population density data, it is not currently possible to estimate the number of individuals likely to be killed or injured, and therefore not possible to quantify the scale of any required offset to achieve NNL for either species.

The Project therefore commits to undertaking targeted reptile surveys across the steppe/desert sections of the alignment prior to construction commencement. Surveys will be designed in accordance with recognised Central Asian herpetological survey methods, using timed visual encounter surveys and cover object searches along representative transects, at sufficient replication and during the optimal activity season (March–May) to generate statistically robust estimates of local population density for both species. The resulting density estimates will be applied to the area of habitat permanently lost and temporarily disturbed within the construction footprint to produce a estimate of the likely number of individuals affected. This figure will then be used to inform the scale, design, and quantification of any required offset, which will be incorporated into the Final BAP.

Indicative Offset and Conservation Actions

The following indicative actions are identified as potential offset measures for Central Asian tortoise and European glass lizard, and will be assessed for feasibility as part of the Final BAP process:

- Tortoise breeding and supplementary release programme: supporting or establishing a captive breeding or head-starting facility in southern Kazakhstan, rearing hatchlings to a size class with materially higher survivorship than wild-born juveniles before release into protected steppe habitat. Precedent exists from ranching programmes developed in Uzbekistan (Bykova et al., 2007; CITES PC18 Doc. 9), though careful genetic provenance matching with the local *T. h. kazachstanica* population would be essential.

- Steppe habitat protection and management: securing formal protection or long-term management agreements over areas of high-quality, low-disturbance steppe and semi-desert habitat within the regional landscape, to reduce the key threats of overgrazing, agricultural conversion, and illegal collection that drive ongoing tortoise population declines in southern Kazakhstan. This could take the form of a community conservation agreement or a private protected area supported by Project funding.

- Anti-poaching and trade monitoring support: providing targeted support to the Committee of Forestry and Wildlife to strengthen enforcement of existing protections against illegal collection of the tortoise for the domestic and international pet trade within the project region. The IUCN and CITES process has identified illegal and poorly regulated trade as a primary driver of population-level declines in this species across Central Asia (Bondarenko *et al.*, 2008).

- Habitat connectivity and refuge enhancement: installation of hibernacula and basking structures, combined with light grazing management along the reinstated Project alignment, to improve habitat quality and connectivity for both tortoise and glass lizard populations adjacent to the alignment, consistent with the wider habitat offset programme described under actions H1–H5.

A. Roles and Responsibilities

Effective delivery of the Final BAP will require clear governance and accountability from the outset. summarises the committed roles of the key stakeholders. Implementing partners for the habitat, bird, and sturgeon actions have not yet been confirmed and will be identified and contracted as part of the Final BAP development process.

Table 113: Proposed roles and responsibilities for the key stakeholders during the design, implementation and monitoring of the Final BAP

Organisation	Role and Responsibility
KTZ (Executing Agency)	Ultimately accountable for all aspects of the BAP throughout its lifetime. KTZ will fund and deliver the Final BAP before loan disbursement, identify and contract each implementing partners, sign MoUs with confirmed implementing partners no later than six months after loan approval, provide institutional oversight, site access, and administrative support, deploy the contingency budget as required; and report annually to lenders on BAP performance. Ultimately, KTZ will be accountable for delivering NNL and NG for the relevant biodiversity features
Implementing Partners (To be confirmed)	Partners will be confirmed during Final BAP development for habitats, birds, and sturgeon. Partners will be responsible for day-to-day design and delivery of their respective actions, quarterly reporting to KTZ, expenditure, and ecological indicators and retention of all field records and data. Partners will be selected on the basis of technical expertise, local knowledge, and governance capacity. Ultimately the implementing partners will be responsible for the day to day delivery of the NNL and NG objectives
Independent Verifier (To be confirmed)	An independent biodiversity specialist or organisation will be contracted by and funded by KTZ. They will, however, report to the lenders. The verifier will conduct annual verification of BAP implementation and outcomes against agreed indicators and thresholds. The verifier will have unimpeded access to all field records, sites, and the implementing partners.
ADB, IFC and AIIB (Lenders)	The lenders will review and approve the Final BAP prior to loan disbursement, review annual monitoring and independent verification reports. The lenders will approve any significant adaptive management changes to the BAP and may audit BAP implementation at any time.

B. Adaptive Management

Managing biodiversity outcomes across multi-year offset and ACA actions is inherently uncertain. Species responses to the actions, climatic and weather variability, hydrological changes, land use pressures and so on are all hard to predict. Planned BAP outcomes are therefore not guaranteed and must be subject to continual management. Adaptive management the mechanism to achieve this and is therefore a core requirement of any BAP. It is also consistent with the BBOP principles and the requirements of ADB SPS, IFC PS6, and AIIB ESF.

Adaptive management comprises regular, structured monitoring, the technically robust assessment of results against the agreed conservation objectives, and being willing to change the plan when needed. It requires clear governance, pre-agreed decision-making processes, and a contingency budget that is available and deployable without delay when monitoring identifies underperformance or if conservation objectives are at risk.

KTZ commits to embedding a full adaptive management framework in the Final BAP. This will include, but not be limited to, defined quantified ecological indicators and monitoring requirements for each selected action, explicit thresholds for change defining when corrective action, or escalation to lenders is required (exemplars are provided in), a contingency budget and a governance structure confirming roles and responsibilities. To illustrate the intent and structure of the approach, two indicative examples of the threshold framework are presented below. These are necessarily preliminary given that actions and monitoring methodologies have not yet been confirmed, but they reflect the level of specificity and rigor that the Final BAP will achieve across all actions.

Adaptive management is also central to the committee Post Construction Fatality Monitoring that will be completed for at least three years after construction. Although the PCFM will be part of the ESIA mitigation (not an offset), the final methodology, including target species and fatality monitoring will be included in the final BAP. PCFM Is a critical part of the Project's adaptive management as the result will inform whether additional mitigation is needed.

Table 114: Exemplars of thresholds for change, which will be developed and agreed for each action and presented in the Final BAP.

C. Monitoring, Reporting and Verification

Monitoring is a core and essential component of any BAP. It is not a compliance exercise, it is the primary mechanism by which KTZ, implementing partners, and lenders will know whether the offset and ACAs are working. Monitoring will also inform whether any adaptive management actions are required. KTZ therefore commits to the following minimum monitoring, reporting and verification requirements, which will be expanded upon and confirmed in the Final BAP.

- An annual biodiversity monitoring programme will be maintained for the operational life of the Project, covering habitat condition, bird populations and collision mortality, and sturgeon presence and population status, using methods and indicators confirmed in the Final BAP
- An annual BAP performance report will be prepared by KTZ and submitted to lenders within 90 days of each year-end, documenting progress against conservation actions and milestones, ecological monitoring results assessed against conservation objectives, expenditure, and any adaptive management decisions taken

- An independent verifier, accountable to the lenders, will audit BAP performance annually, for at least the first three years, assessing the accuracy of monitoring data, the adequacy of methods, and the likelihood of achieving the conservation objectives. The verifier's report will be submitted directly to lenders and will be publicly disclosed in accordance with lender's requirements.
- Any confirmed threshold breach will be reported to lenders within 30 days of identification, with a corrective action plan submitted within a further 60 days.

G. KTZ Commitments and Next Steps

KTZ commits to the following actions to ensure the Final BAP is delivered and fully funded before loan review and approval. These commitments reflect the current stage of the project and the outstanding steps required to reach lender compliance. The Final BAP will elaborate, confirm, and contractually formalise each of these commitments.

- Contract a professional and experienced biodiversity specialist (team) to develop and write the Final BAP
- Initiate the stakeholder consultation programme set out in Table 110 and both develop and refine the offset and ACA actions
- Commission continued bird surveys to determine the baseline and risk of collision.
- Confirm ownership, access, and permissions for candidate existing OHLs for BFD retrofit and engage with the regional distribution network operator.
- Confirm land tenure and ecological suitability of all indicative habitat offset sites through site visits, GIS analysis, and formal engagement with the Shardara District Administration.
- Identify and contract a suitable delivery partner or community management entity for the long-term management of habitat offset areas
- Engage with Kazakhstani Ministry of Ecology and Natural Resources on the shovelnose sturgeon Species Action Plan and on the feasibility of captive breeding collaboration with Uzbekistan
- Develop and commit to the funds required to develop, implement and monitor each action for the duration of the Project's lifespan, plus a proportionate and secured contingency fund
- Prepare and submit the Final BAP to ADB, IFC, and AIIB for approval before loan disbursement. The Final BAP will include, but not be limited to, confirmed NNL/NG quantification methods, site-specific offset assessments and management plans, documented stakeholder consultation, signed MoUs with implementing partners, confirmed and committed budgets, a detailed monitoring programme, and an adaptive management framework with quantified thresholds.
- Commit to an annual independent verification of BAP performance, reported directly to lenders, for the operational life of the Project.

In conclusion, KTZ commits to achieving at least NNL for all Natural Habitat and IBA/KBA receptors, and NG for all Critical Habitat-triggering species, dalmatian pelican, pygmy cormorant, and Syr Darya shovelnose sturgeon, through the design, funding, and implementation of the Final BAP.

Adaptive management, inclusive of the PCFM, will be embedded throughout the Final BAP will include quantified ecological thresholds, predefined thresholds for change, and a contingency budget to fund corrective actions where monitoring demonstrates insufficient progress toward NNL and NG objectives. The BAP will be maintained for the operational life of the Project.

Vista
Environment

Vista Environment

DARBAZA RAIL PROJECT

Preliminary Biodiversity Action Plan

\

PRELIMINARY DOCUMENT DISCLAIMER

This is a Framework or Preliminary Biodiversity Action Plan (Preliminary BAP) only. It is not intended to be a Final or Lender compliant BAP. It has been prepared to reflect the current state of the project, i.e. construction is near-complete, the ESIA is in an advanced draft but not complete and stakeholder consultation with KTZ is ongoing.

This document is not intended to achieve compliance with ADB SPS, IFC PS6, or AIIB ESF. Its purpose is to confirm the biodiversity receptors and residual impacts requiring offset or additional conservation actions, present a high-level feasibility assessment of preliminary and potentially relevant actions, and formally commit KTZ to the funding and development of a Final, lender-compliant BAP. It therefore demonstrates the direction of travel with regards the requisite biodiversity offsets for the Darbaza rail project and provides a roadmap of minimum commitments for the final BAP.

The Final BAP will be fully aligned with ADB SPS/ESS6, IFC PS6, and AIIB ESF, including the full quantification of impacts, confirmed offset site assessments, documented stakeholder consultation, signed implementation agreements, and confirmed budgets.

Executive Summary

The Darbaza Rail Project (Project) is a freight railway in Turkestan Region, southern Kazakhstan, operated by KTZ Express. The railway crosses the Shardara Reservoir, one of the most internationally significant wetlands in Central Asia and recognised as an Important Bird Area (IBA) and a Key Biodiversity Area (KBA). Approximately 16 km of the Project passes through the Shardara Reservoir IBA/KBA on a raised, 100 m wide embankment. The Project ESIA confirms that, despite a comprehensive mitigation programme including bird flight diverters (BFDs) on the Project's own overhead distribution lines, pollution controls, and seasonal construction restrictions, significant residual biodiversity impacts remain that cannot be addressed through on-site mitigation alone.

This Preliminary BAP identifies five receptor groups requiring action:

7. Shardara Reservoir IBA/KBA and its Natural Habitat (~150 ha permanent loss)
8. Dalmatian pelican (Critical Habitat)
9. Pygmy cormorant (Critical Habitat)
10. Internationally significant wintering, migratory, and breeding bird assemblages
11. Syr Darya shovelnose sturgeon (Critical Habitat).

For the first four biodiversity features, biodiversity offsets are required to achieve No Net Loss (NNL) and Net Gain (NG). For the sturgeon, the fifth biodiversity feature, additional conservation actions are required to meet the Critical Habitat NG obligation under IFC PS6 and ADB SPS.

The document introduces five indicative Habitat offset actions (referenced H1 to H5), three bird collision reduction offset actions (referenced B3 to B5), and four sturgeon additional conservation actions (referenced S1–S4), with an indicative assessment of the feasibility of each. The high level feasibility assessment comprises an review of the proposed actions likely ecological feasibility, social feasibility, financial feasibility, legal/regulatory feasibility and the feasibility of KTZ 's governance and ability to be accountable with sufficient leadership.

The overall indicative budget commitment, excluding on-site mitigation, is in the range of USD 2 to 5 million. Confirmed budgets will be presented in the Final BAP. KTZ commits to delivering the Final BAP, including confirmed site assessments, stakeholder consultation, implementation agreements, and detailed monitoring and adaptive management frameworks, before loan review and approval.

Introduction and Project Overview

The Darbaza Rail Project comprises a standard-gauge freight railway in Turkestan Region, southern Kazakhstan. The railway connects Darbaza to Maktaaral and will be developed and operated by KTZ, Kazakhstan's national railway operator. Construction commenced in January 2024 on a retrospective basis and is near-complete at the time of writing. It is expected that the Project will be financed by the Asian Development Bank (ADB), International Finance Corporation (IFC), and Asian Infrastructure Investment Bank (AIIB), each of which requires a Biodiversity Action Plan meeting the requirements of their respective environmental and social standards.

The most ecologically sensitive section of the alignment crosses the Shardara Reservoir for approximately 16 km via a raised embankment up to 20 m high and 100 m wide. The Shardara Reservoir is a very large freshwater body on the Syr Darya river, covering approximately 900 km², and is internationally recognised as an IBA and KBA for its waterbird populations, including globally threatened species. The reservoir and the Syr Darya river also support fish species of critical conservation concern, specifically the Syr Darya shovelnose sturgeon.

This Preliminary BAP has been prepared ahead of a Final, lender-ready BAP to demonstrate KTZ's awareness of its biodiversity obligations and commitment to meeting them. It is explicit that it does not yet achieve full compliance with ADB, IFC, or AIIB standards. The Final BAP will close this gap and will be submitted to lenders for approval before loan disbursement. The language used throughout this document is intentionally forward-looking: where the Final BAP will confirm, commit to, and deliver the actions described.

BAP Purpose

The purpose of a BAP is to define, resource, and govern the actions required to offset residual adverse biodiversity impacts that cannot be fully addressed through standard mitigation measures alone and achieve a Net Gain for biodiversity features that meet Critical Habitat thresholds, irrespective of any project related impacts. The Final BAP will therefore be written to serve three audiences simultaneously:

- The Lenders, ADB, IFC and AIIB: providing confidence that committed offset and additional conservation actions are technically sound, adequately resourced, and will achieve the required conservation objectives.
- Implementing Partners (yet to be confirmed at this Preliminary BAP stage): providing sufficient methodological guidance, milestones, and monitoring requirements to inform and enable effective delivery once contracts are signed.

- KTZ as the Executing Agency: providing governance clarity, accountability structure, and adaptive management guidance to ensure KTZ can fulfil its obligations.

The Final BAP will not duplicate mitigation or compensatory measures already committed to in the Project ESMP or the BMP (e.g. the fitting of Bird Flight Diverters to the Project's 10kV Over Head Powerline). It specifically addresses the residual biodiversity losses that will persist after standard mitigation has been implemented.

Relevant Project Documents

This BAP should be read in conjunction with the other environmental and social baselines, assessments and action plans. Relevant Project documents are summarised in Table 115.

Table 115: Project documents relevant to this Preliminary BAP.

Document	Relationship to this BAP
ESIA (2026)	It provides a project overview, the baseline data, the impact assessment, and introduces both the requisite mitigation for construction and operation and the residual impact findings that define the scope and scale of this BAP.
BMP (2026)	Defines on-site biodiversity mitigation, including but not limited to the inclusion of bird diverters and insulation on the new 10 kV OHL. The BAP builds on and does not duplicate these measures.
ESMP (2026)	Sets out the operational environmental and social management framework within which the BMP and BAP sit.

Biodiversity Offsets: Standards and Principles

A biodiversity offset is a measurable conservation action designed to compensate for significant residual adverse impacts on biodiversity that cannot be fully avoided, minimised, or remediated on-site through the mitigation hierarchy. Offsets are a measure of last resort, they should only be considered once all reasonable avoidance and mitigation options have been exhausted. The goal is to achieve at least No Net Loss (NNL) of biodiversity, and preferably a Net Gain (NG), relative to the Project's retrospective baseline. This Preliminary BAP uses the Business and Biodiversity Offsets Programme (BBOP) principles as the primary framework for offset design, consistent with ADB ESS6, IFC PS6, and the AIIB ESF.

For this Project, biodiversity offsets are required for the Sharara Reservoir IBA/KBA, its constituent Natural Habitat and the various important bird assemblages it supports, particularly dalmatian pelican and pygmy cormorant, for which the reservoir meets the thresholds for Critical Habitat.

An Additional Conservation Action (ACA) differs from an offset in that it is not necessarily triggered by an adverse residual impact. Under ADB SPS and IFC PS6, if a project is located in Critical Habitat, the project is required to achieve a NG for the species or feature that triggered the Critical Habitat, regardless of whether the project directly impacts them. Like offsets though, they must still be (i.e. beyond what would occur without the Project), measurable and deliver the NG in perpetuity. For this Project, the Syr Darya shovelnose sturgeon is the principal receptor requiring additional conservation actions. The species is Critically Endangered on the IUCN Red List and the Syr Darya river constitutes Critical Habitat. The Project introduces construction-stage disturbance and pollution risks at the river crossing, but the reason for the ACA is the Critical Habitat NG obligation.

In accordance with BBOP and GIP, the Project's offsets and ACAs are designed around five essential requirements. The feasibility of these requirements forms the basis of this Preliminary BAP. Ecological feasibility ensures that proposed offset and ACA sites can genuinely deliver the intended biodiversity outcomes, considering habitat condition, landscape connectivity, species requirements, and the

realistic timeframes over which gains can be achieved. Social feasibility assesses whether local communities support the proposed arrangements, have secure and recognised rights over the relevant land, and can realistically participate in and benefit from long-term management. Financial feasibility ensures that sufficient, reliable funding is in place not just for initial implementation but for the full duration of the offset commitment, which for critical habitat must aim for perpetuity. Legal and regulatory feasibility considers whether the offset and ACA commitments are legally recognised, enforceable, and aligned with national biodiversity requirements. KTZ governance feasibility assesses whether the specific institutional and management arrangements governing the offset and ACA areas are in place, clearly defined and sufficient to deliver, and sustain, the conservation objectives over the long term.

While this Preliminary BAP explores a series of possible offset and ACA's feasibility, the Final BAP will provide more details on the final, agreed actions, the methods for quantifying NNL and NG, and how additionality and permanence will ultimately deliver NNL and NG.

Stakeholder Consultation

Effective stakeholder engagement is an essential requirement for the robust design and successful implementation of biodiversity offsets and ACAs. Conservation actions will very likely fail without local and technical engagement. Consultation with local communities and receptor-specific experts provide project-relevant knowledge and insight that surveys and research often miss. Equally, engagement with government-level stakeholders help align offsets and ACAs with legal requirements, national policy and strategies, and national governance structures making sure the actions are sensitive to, and address relevant institutional capacity, bureaucratic culture, and the political priorities.

Biodiversity consultation has been undertaken with conservation organisations, government authorities, academic and scientific institutions, and recognised species specialists. Details are presented in Table 116.

Table 116: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process.

Ref	Organisation / Expert	Type	Date	Purpose
1	Shardara Reservoir Management Authority	Email correspondence and formal letter request - no response	February/March 2026	Reservoir operations, water hydrology aquatic habitat
2	Aral–Syrdarya Basin Inspection (Committee for Water Resources)	Email correspondence and formal letter request - no response	February/March 2026	Water management, basin ecology, fisheries regulation
3	Committee of Forestry and Wildlife (Ministry of Ecology and Natural Resources)	Email and meeting correspondence with Mr Musaliev - Regional Head	March 2026	Protected areas, wildlife regulation, habitat oversight
4	Kazakhstan Fisheries Research and Production Center (KazNIIRKh)	Email correspondence and formal letter request - no response	February/March 2026	Fisheries, aquatic ecology, reservoir fish and Sturgeon

Ref	Organisation / Expert	Type	Date	Purpose
5	RSE Kazhydromet	Email correspondence and formal letter request - no response	February/March 2026	Hydrology, water levels, climate and meteorological data
6	Institute of Geography and Water Security	Email correspondence and formal letter request - no response	February/March 2026	Hydrology, water balance, climate–water interactions
7	Al-Farabi Kazakh National University – Department of Zoology	Email correspondence - no response	February/March 2026	Herpetology, specifically desert reptiles
8	Auezov South Kazakhstan University – Ecology Department	Email correspondence - no response	February/March 2026	Regional reptile knowledge
9	Ministry of Water Resources and Irrigation	Email correspondence and formal letter request - no response	March 2026	Water governance, basin management
10	ACBK	Emails, meetings, site surveys and data sharing	2025 and 2026 ongoing	Biodiversity data, particularly birds
11	Victoria Kovshar – professional ornithologist	Email and meeting correspondence and sharing of data.	2025 and 2026 ongoing	Bird data
12	Eurasian Regional Association of Zoos and Aquariums	Email and meeting correspondence and sharing of data.	March 2026	Syr Dara Shovelnose sturgeon
13	Tennessee Aquarium Conservation Institute (Bernie Kuhajda)	Email and meeting correspondence and sharing of data.	March and April 2026	As above

It is noted that the Project's biodiversity focused consultation to date has largely focused on gathering data and informing the Critical Habitat Assessment and the Impact Assessment with its associated mitigation. While consultation relating to the offsets and ACAs has started and work to date has informed the potential offsets and ACAs presented in this Preliminary-BAP, the speed of construction and the retrospective nature of the ESIA have constrained early engagement, including consultation with KTZ on biodiversity commitments and offset budgets. This Preliminary BAP acknowledges that more consultation is required as part of developing the Final BAP.

Therefore, KTZ commits to a structured consultation programme as part of developing the Final BAP. The programme will prioritise engagement with ACBK and KECOG on bird offset design and monitoring; community consultation with the Shardara fishing and herder communities on reservoir-based habitat actions; land tenure and permissions for all indicative offset sites; and coordination with Kazakhstani environmental authorities, international experts and the Uzbekistan sturgeon hatchery on the sturgeon ACA. Table 117 sets out the minimum consultation that KTZ commits to as part of the Final BAP development.

Table 117: Committed Stakeholder Consultation Programme

Ref	Organisation / Expert	Biodiversity Focus
1	ACBK (Association for Conservation of Biodiversity of Kazakhstan)	Identify priority bird monitoring sites; identify and assess candidate existing OHL for retrofit (B1 – B5) co-design bird monitoring protocols
2	KECOG (Kazakhstan Electricity Grid Operating Company)	Identify ownership, condition, and access to priority OHLs for BFD retrofit (B1) and pole insulation (B2)
3	Shardara District Administration / Akimat	Confirm land tenure and permissions for all indicative offset sites (H1–H5), explore community management models
4	Shardara fishing communities and herder associations	Community-level consultation on reservoir-based habitat actions, identify co-benefit and co-management opportunities
5	Kazakhstani Ministry of Ecology & Natural Resources	Sturgeon survey permits (S1); captive breeding collaboration (S3); Species Action Plan (S4)
6	Uzbekistan Institute of Gene Pool of Plants & Animals/sturgeon hatchery	Explore captive breeding collaboration for shovelnose sturgeon (S3)
7	Tennessee Aquarium Conservation Institute (Bernie Kuhajda)	International experts on shovelnose sturgeon (S1, 2 & 3)
8	ADB, IFC and AIIB	Review and approval of Final BAP prior to loan disbursement

Biodiversity Context and Residual Impacts

The Shardara Reservoir is one of the largest and most ecologically productive freshwater wetlands in Central Asia. It qualifies as an IBA for supporting internationally significant populations of dalmatian pelican (criterion A1, globally threatened), and waterbird assemblages exceeding 20,000 individuals at winter peak (criterion A4iii). The reservoir technically supports eight IBA qualifying species and multiple species listed in the Kazakhstan Red Data Book, but the ACBK surveys over the past c.20 years indicate a sharp decline in the abundance in the other qualifying species.

A nationally significant mixed breeding colony, including approximately 1,500 pairs of pygmy cormorant, 1,000 pairs of glossy ibis, and 300 to 400 pairs of little egret was confirmed approximately 1.2 km east of the embankment during the 2025 surveys. The reservoir and the Syr Darya river also constitute Critical Habitat for the Critically Endangered Syr Darya shovelnose sturgeon.

The Project ESIA confirms that, despite the full application of mitigation, including BFDs on the Project's two 10 kV OHL, seasonal construction restrictions, pollution controls, and reinstatement of temporaryily lost habitat, the following significant residual impacts persist. These are the residual impacts for which this BAP has been developed. Table 118 summarises each receptor, the nature of the residual impact, and the type of action required.

Table 118: Summary of Residual Impacts and Required Action

Biodiversity Receptor	Ecological Importance	Residual Impact	Action Required
Shardara Reservoir IBA/KBA including Natural Habitat	IBA / KBA Natural Habitat	Permanent loss of ~150 ha of Natural Habitat (reedbed, Tugai scrub, braided channels, floodplain grassland). Cannot be compensated on-site.	NNL via offset
Dalmatian Pelican	Critical Habitat	Permanent loss of habitat and residual OHL collision and mortality risk after BFD installation on-site.*	NG via offset

Pygmy Cormorant	Critical Habitat	As above	NG via offset
Wintering Bird Assemblage	Internationally important	As above, particularly for large-bodied waterfowl (geese and swans)	NNL via offset
Migratory Bird Assemblage	Regionally important	As above for large Spring and Autumn bird movements.	NNL via offset
Breeding Bird Assemblage	Regionally important	As above, particularly loss of reedbed used by (glossy ibis, egrets etc).	NNL via offset
Raptor & Vulture Assemblage	Regionally important	As above	NNL via offset
Syr Darya Shovelnose Sturgeon	Critical Habitat	Construction disturbance, sedimentation and pollution risk. None at operation	NG via ACA

* The installation of BFDs on the Project's own OHL 10 kV lines are requisite on-site mitigation committed under the ESMP, and therefore not an offset.

Preliminary Offset and Additional Conservation Actions

This section introduces the range of potential actions that will be further reviewed and developed as part of the Final BAP. Each potential action has been suggested or refined by organisations and expects as part of the initial consolation, particularly ACBK and the Tennessee Aquarium Conservation Institute. The proposed actions have been grouped, each focusing on a key receptor or group of receptors (e.g. birds). The groupings of actions comprise:

- Habitat offsets (H1 to H5), which could benefit the birds that use the habitat(s), if the actions are designed and implemented accordingly
- Bird collision reduction offsets (B1 to B5)
- Sturgeon additional conservation actions (S1 to S4).

A summary of each possible action with an indicative assessment of its feasibility is presented in Table 119. No single action is likely to be sufficient on its own and the Final BAP will therefore develop an integrated approach using the most feasible combination of actions across each group.

Habitat Offsets (H1–H5)

Five indicative habitat offset actions have been proposed that could individually or in combination address the permanent loss of approximately c.150 ha of Natural Habitat, including reedbed, Tugai scrub and floodplain grassland. The proposed actions are:

- H1 - Reedbed and Tugai scrub management
- H2 - Hydrological management
- H3 - Grazing management
- H4 - Reedbed Restoration and Creation
- H5 - Constructed Wetlands and Pollution filters

The Final BAP will refine and develop these actions (and potentially others) and most likely, present a blended action(s) centred on active reedbed and Tugai scrub restoration and creation in the wider landscape. Where feasible and practical all habitat focused offset plans will be designed to include multiple co-benefits so that the implementation benefits the targeted habitats and their constituent for birds and fish e.g. the sturgeon. This will approach will increase the conservation outcome(s) and make best, efficient use of the available resources.

A critical and immediate prerequisite of all habitat focused offsets is to confirm the land tenure, current land use, and the identification of a suitable delivery partner or community management model. Initial research confirms that the reservoir land is government owned and managed, but this must be confirmed. Beyond tenure, each action carries its own specific uncertainties, reedbed restoration for example, is ecologically feasible but is contingent on identifying suitable sites with appropriate hydrology, and reedbed establishment is inherently slow, meaning the time lag to measurable gains must be factored carefully into the NNL/NG quantification. Alternatively, grazing exclusion is likely to be very low cost but it likely to be strongly opposed by the local communities who use the floodplain grasslands for their livestock. The Final BAP will include site-specific assessments, formal land agreements, and long-term management plans for all confirmed offset actions and sites.

Bird Collision Reduction Offsets (B1–B5)

The residual collision and mortality risk to the local bird assemblage from the Project's new OHLs cannot be fully eliminated by BFDs on the Project's own infrastructure. Most BFDs reduce collision risk by between 50 and 70% depending on the location, target species and quality of the diverter itself. Additional action is therefore required. The most likely offset action is the retrofitting of existing, already-dangerous distribution and transmission lines within and adjacent to the IBA with high-quality BFDs. Published evidence and good international practice (IFC/EBRD 2026 guidelines) supports this like-for-like approach, i.e. retrofitting a length of existing OHL at least equivalent to the length of new OHL introduced by the Project. For dalmatian pelican and pygmy cormorant, both Critical Habitat triggers that require NG, the combined effect of on-site BFDs (mitigation) and off-site retrofitting (offset) is expected to achieve a net reduction in collision risk above baseline. This approach is widely used where OHLs pose risks to birds and theoretically achieves an NNL equivalence. This approach and several others have been proposed and have been assessed. They comprise:

- Retrofit Existing Distribution Lines with BFDs
- Retrofit Existing Poles and Pylons with insulators
- Hunter & Fishing Community Engagement
- Dalmatian pelican habitat restoration and prey availability
- Pygmy cormorant habitat restoration and prey availability

The bird offsets assume that the use of BFD as part of the Project’s mitigation and offset actions will collectively be sufficient to offset the collision risk introduced by the Project's new infrastructure. This can only be confidently determined with improved and specific bird data, that must confirm which species and in what abundance pass the Project’s infrastructure (and therefore what the risk of collision is). The Project’s 10 kV OHL configuration also remains to be fully confirmed, e.g. whether there is one or two lines, and whether any sections might be buried etc, as this will influence the scale of the risk and therefore the scale and extent of the offset requirements.

Sturgeon Additional Conservation Actions (S1–S4)

The Syr Darya shovelnose sturgeon is the world's smallest sturgeon, endemic to the Syr Darya river system, and classified as Critically Endangered. Populations have collapsed due to decades of dam construction, water abstraction, and overfishing. There are no confirmed recent records within the project area, though local fishermen and a 2019 US/Kazakh expedition suggest the species may persist in very low numbers in the Syr Darya system. Because the Syr Darya river is Critical Habitat for the species, the Project must achieve NG, regardless of direct impacts.

Four indicative ACA actions have been proposed by the international research team responsible for surveying and trying to confirm that the species survives. The proposed actions are:

- Supporting Sturgeon Baseline Surveys

- Spawning Habitat Assessment
- Captive Breeding & Restocking
- Species Action Plan

The Syr Darya shovelnose sturgeon ACAs are the most uncertain part of this Preliminary BAP. The baseline for the species is almost entirely unknown and local and international knowledge and expertise is limited. Baseline surveys using eDNA analysis, net sampling, and structured questionnaire interviews with local fishermen is the essential, pre-requisite first step. Investment in the other ACAs maybe unjustified without confirmed presence/absence and population data. The Final BAP will assess and refine the benefits and validity of pursuing the other proposed ACAs.

Table 119: An introduction to the indicative and possible offset and ACA actions, including a high-level assessment of action's practical feasibility.

Ref	Action	Type	Ecological Feasibility	Social Feasibility	Financial Feasibility	Legal / Regulatory	KTZ Internal	Indicative Cost (USD)	Key Co-benefits
HABITAT OFFSETS (H1 – H5) NNL for IBA/KBA and Natural Habitat compensating loss of c.150 ha with co-benefits for Critical Habitat (targeting NG)									
H1	Reedbed and Tugai scrub management. Enhance reedbed and scrub mosaic and manage succession and restrict access/grazing, particularly between Project alignment and the road to the east	Habitat Management	High	Medium (land is government owned)	Medium	Medium	Low	To be confirmed	Dalmatian pelican, pygmy cormorant, wintering, migratory, breeding, and raptors assemblages. Plus fish, invertebrates and flora.
H2	Hydrological management. Create and maintain bunded shallow pools with inlets along reservoir margin to retain water during seasonal drawdown	Habitat Creation	High	Medium	Medium	Medium	Low	As above	As above.
H3	Grazing Management. Establish seasonal exclusion areas adjacent to Project alignment to protect regenerating reedbed and riparian vegetation. Community engagement essential	Habitat Protection	High	Low	Medium	Medium	Low	As above	Pygmy Cormorant, reedbed-dependent breeding birds grassland birds
H4	Reedbed Restoration and Creation. Identify and restore degraded former reedbeds in the wider landscape to compensate for c,9ha of losses	Habitat Restoration	High	Medium	Medium	Medium	Low	As above	Dalmatian pelican, pygmy cormorant; all waterbirds, breeding birds
H5	Constructed Wetland or Pollution Filter. Create and manage reedbeds at key reservoir inflow channels to intercept agricultural and urban pollutants	Habitat Creation / Pollution Control	High	High	Medium	Medium	Low	As above	Dalmatian pelican; all waterbirds, Syr Darya Sturgeon, fishing community, birds

Ref	Action	Type	Ecological Feasibility	Social Feasibility	Financial Feasibility	Legal / Regulatory	KTZ Internal	Indicative Cost (USD)	Key Co-benefits
BIRD OFFSETS (B1 – B5) NNL for wintering, migrating, breeding and raptor and vulture bird assemblages. NG for dalmatian pelican and pygmy cormorant.									
Bird Flight Diverters will be fitted to all Project OHLs at a spacing of 5 m through the reservoir IBA/KBA plus at least 1 km to the north and south, and at a spacing of every 20 m along the entirety of the Project alignment outside the reservoir. These commitments are project mitigation and are not included here.									
B1	Retrofit Existing Distribution Lines with BFDs. Identify and retrofit the existing OHLs that pose the greatest risk to birds within and adjacent to the IBA with BFDs at 5 m spacing.	Collision Risk Reduction	High	High	Medium	Medium	Low–Medium	As above	Dalmatian pelican, wintering, migratory & breeding assemblage, raptors & vultures
B2	Retrofit Existing Poles and Pylons. Insulate pole cross-arms and pole-tops within and adjacent to the IBA to reduce electrocution risk for large perching raptors	Electrocution Risk Reduction	High	High	Medium	Medium	Low	As above	Raptors & vultures, particularly steppe eagle and white-tailed eagle
B3	Hunter & Fishing Community Engagement. Collaboration and targeted awareness raising with 3 local hunting organisations and fishing communities to increase protection of rare bird species	Direct Persecution Reduction	Medium	Low	High	High	Low	As above	Dalmatian Pelican; all waterbirds, fish including the sturgeon.
B4	Dalmatian pelican specific habitat management and increase prey availability	Species Enhancement	Medium	Medium	Medium	Medium	Low–Medium	As above	All bird assemblages
B5	Pygmy Cormorant specific habitat management and increase prey availability	Species Enhancement	Medium	Medium	Medium	Medium	Low–Medium	As above	All bird assemblages
STURGEON ACA (S1–S4) NG for Syr Darya Shovelnose Sturgeon									
S1	Sturgeon Baseline Survey (eDNA, net surveys and questionnaires)	Baseline Survey	Low *	Medium	High	Medium	Medium	As above	Scientific community; national fisheries authority

Ref	Action	Type	Ecological Feasibility	Social Feasibility	Financial Feasibility	Legal / Regulatory	KTZ Internal	Indicative Cost (USD)	Key Co-benefits
S2	Spawning Habitat Assessment and Enhancement. Map and assess condition of available spawning and foraging habitat in the Syr Darya near the crossing.	Habitat Enhancement	Low *	Low	High	Medium	Low	As above	Scientific community; other native fish species
S3	Captive Breeding & Restocking Support — engage with the existing rare sturgeon Uzbekistan hatchery programme, to learn their practices with the potential aim of establishing a precautionary safe, holding area in Kazakhstan, in case the target sturgeon is captured.	Species Recovery	Low *	Medium	High	Low	Low	As above	Scientific community; national biodiversity
S4	Species Action Plan. Support the development of a Kazakhstani National Species Action Plan for the shovelnose sturgeon. Engage with national fisheries authority on management plan.	Policy & Advocacy	Medium	Medium	High	High	Medium	As above	Scientific community; national biodiversity; fisheries

* Ecological feasibility for sturgeon actions (S1–S3) is rated Low at this stage because of the very limited baseline data and that the species may already be extinct. I.e. the low rating is not because the actions are technically unsound.

D. Roles and Responsibilities

Effective delivery of the Final BAP will require clear governance and accountability from the outset. Table 120 summarises the committed roles of the key stakeholders. Implementing partners for the habitat, bird, and sturgeon actions have not yet been confirmed and will be identified and contracted as part of the Final BAP development process.

Table 120: Proposed roles and responsibilities for the key stakeholders during the design, implementation and monitoring of the Final BAP

Organisation	Role and Responsibility
KTZ (Executing Agency)	Ultimately accountable for all aspects of the BAP throughout its lifetime. KTZ will fund and deliver the Final BAP before loan disbursement, identify and contract each implementing partners, sign MoUs with confirmed implementing partners no later than six months after loan approval, provide institutional oversight, site access, and administrative support, deploy the contingency budget as required; and report annually to lenders on BAP performance. Ultimately, KTZ will be accountable for delivering NNL and NG for the relevant biodiversity features
Implementing Partners (To be confirmed)	Partners will be confirmed during Final BAP development for habitats, birds, and sturgeon. Partners will be responsible for day-to-day design and delivery of their respective actions, quarterly reporting to KTZ, expenditure, and ecological indicators and retention of all field records and data. Partners will be selected on the basis of technical expertise, local knowledge, and governance capacity. Ultimately the implementing partners will be responsible for the day to day delivery of the NNL and NG objectives
Independent Verifier (To be confirmed)	An independent biodiversity specialist or organisation will be contracted by and funded by KTZ. They will, however, report to the lenders. The verifier will conduct annual verification of BAP implementation and outcomes against agreed indicators and thresholds. The verifier will have unimpeded access to all field records, sites, and the implementing partners.
ADB, IFC and AIIB (Lenders)	The lenders will review and approve the Final BAP prior to loan disbursement, review annual monitoring and independent verification reports. The lenders will approve any significant adaptive management changes to the BAP and may audit BAP implementation at any time.

E. Adaptive Management

Managing biodiversity outcomes across multi-year offset and ACA actions is inherently uncertain. Species responses to the actions, climatic and weather variability, hydrological changes, land use pressures and so on are all hard to predict. Planned BAP outcomes are therefore not guaranteed and must be subject to continual management. Adaptive management the mechanism to achieve this and is therefore a core requirement of any BAP. It is also consistent with the BBOP principles and the requirements of ADB SPS, IFC PS6, and AIIB ESF.

Adaptive management comprises regular, structured monitoring, the technically robust assessment of results against the agreed conservation objectives, and being willing to change the plan when

needed. It requires clear governance, pre-agreed decision-making processes, and a contingency budget that is available and deployable without delay when monitoring identifies underperformance or if conservation objectives are at risk.

KTZ commits to embedding a full adaptive management framework in the Final BAP. This will include, but not be limited to, defined quantified ecological indicators and monitoring requirements for each selected action, explicit thresholds for change defining when corrective action, or escalation to lenders is required (exemplars are provided in Table 121), a contingency budget and a governance structure confirming roles and responsibilities. To illustrate the intent and structure of the approach, two indicative examples of the threshold framework are presented below. These are necessarily preliminary given that actions and monitoring methodologies have not yet been confirmed, but they reflect the level of specificity and rigour that the Final BAP will achieve across all actions.

Table 121: Exemplars of thresholds for change, which will be developed and agreed for each action and presented in the Final BAP.

Indicator	Amber Threshold Review Required	Red Threshold Immediate Action Required
Reedbed restoration and creation	Target habitat area (ha) established but vegetation cover below 50% of baseline reedbed density by end of Year 3, or fewer than the agreed number of offset sites confirmed and under active management by Year 2	Less than 25% vegetation cover achieved across target restoration areas by end of Year 3, or confirmed evidence of sustained degradation (e.g. uncontrolled grazing, drainage failure, or land use change) compromising the long-term viability of any confirmed offset site
BFD installation progress	Fewer than 75% of target BFD units installed on priority OHL sections by the end of Year 1 of implementation, or any confirmed carcass of dalmatian pelican or pygmy cormorant beneath the retrofitted lines	Target retrofit length not achieved by end of Year 2, or ≥3 confirmed carcasses of any globally threatened waterbird species within the IBA/KBA in any 12-month post-installation period, relative to the pre-installation baseline

F. Monitoring, Reporting and Verification

Monitoring is a core and essential component of any BAP. It is not a compliance exercise, it is the primary mechanism by which KTZ, implementing partners, and lenders will know whether the offset and ACAs are working. Monitoring will also inform whether any adaptive management actions are required. KTZ therefore commits to the following minimum monitoring, reporting and verification requirements, which will be expanded upon and confirmed in the Final BAP.

- An annual biodiversity monitoring programme will be maintained for the operational life of the Project, covering habitat condition, bird populations and collision mortality, and sturgeon presence and population status, using methods and indicators confirmed in the Final BAP
- An annual BAP performance report will be prepared by KTZ and submitted to lenders within 90 days of each year-end, documenting progress against conservation actions and milestones, ecological monitoring results assessed against conservation objectives, expenditure, and any adaptive management decisions taken
- An independent verifier, accountable to the lenders, will audit BAP performance annually, for at least the first three years, assessing the accuracy of monitoring data, the adequacy of

methods, and the likelihood of achieving the conservation objectives. The verifier's report will be submitted directly to lenders and will be publicly disclosed in accordance with lender's requirements.

- Any confirmed threshold breach will be reported to lenders within 30 days of identification, with a corrective action plan submitted within a further 60 days.

KTZ Commitments and Next Steps

KTZ commits to the following actions to ensure the Final BAP is delivered and fully funded before loan review and approval. These commitments reflect the current stage of the project and the outstanding steps required to reach lender compliance. The Final BAP will elaborate, confirm, and contractually formalise each of these commitments.

- Contract a professional and experienced biodiversity specialist (team) to develop and write the Final BAP
- Initiate the stakeholder consultation programme set out in Table 117 and both develop and refine the offset and ACA actions
- Commission continued bird surveys to determine the baseline and risk of collision.
- Confirm ownership, access, and permissions for candidate existing OHLs for BFD retrofit and engage with the regional distribution network operator.
- Confirm land tenure and ecological suitability of all indicative habitat offset sites through site visits, GIS analysis, and formal engagement with the Shardara District Administration.
- Identify and contract a suitable delivery partner or community management entity for the long-term management of habitat offset areas
- Engage with Kazakhstani Ministry of Ecology and Natural Resources on the shovelnose sturgeon Species Action Plan and on the feasibility of captive breeding collaboration with Uzbekistan
- Develop and commit to the funds required to develop, implement and monitor each action for the duration of the Project's lifespan, plus a proportionate and secured contingency fund
- Prepare and submit the Final BAP to ADB, IFC, and AIIB for approval before loan disbursement. The Final BAP will include, but not be limited to, confirmed NNL/NG quantification methods, site-specific offset assessments and management plans, documented stakeholder consultation, signed MoUs with implementing partners, confirmed and committed budgets, a detailed monitoring programme, and an adaptive management framework with quantified thresholds.
- Commit to an annual independent verification of BAP performance, reported directly to lenders, for the operational life of the Project.

In conclusion, KTZ commits to achieving at least NNL for all Natural Habitat and IBA/KBA receptors, and NG for all Critical Habitat-triggering species, dalmatian pelican, pygmy cormorant, and Syr Darya shovelnose sturgeon, through the design, funding, and implementation of the Final BAP.

Adaptive management will be embedded throughout the Final BAP will include quantified ecological thresholds, predefined thresholds for change, and a contingency budget to fund corrective actions where monitoring demonstrates insufficient progress toward NNL and NG objectives. The BAP will be maintained for the operational life of the Project.

Annex C – Habitat Maps

Annex D – Site / Topic ESMPs

Annex E – Preliminary Climate Risk Assessment

The Darbaza–Maktaaral Railway Expansion Project is a 115 km greenfield freight railway being constructed by Kazakhstan Temir Zholy JSC (KTZ) in Turkistan Oblast, southern Kazakhstan, on behalf of Kazakhstan Temir Zholy Finance B.V. as Client. The line connects Darbaza (near Saryagash) to the Maktaaral–Syrdarya border checkpoint, providing an alternative freight corridor to Uzbekistan and relieving congestion at the Saryagash–Tashkent border crossing. Once operational, the line will accommodate approximately 46 train movements per day, predominantly freight. Construction commenced in 2024 and overall project completion is planned for December 2026.

Key infrastructure includes a 500-metre bridge across the Syr Darya River, three stations (Yerdaut, Intermediate, and Maktaaral) and two passing loops, 33 structures comprising 24 bridges, five railway overpasses, four road overpasses, one reinforced concrete tunnel, and 127 drainage culverts, together with traction substations, overhead power lines, and signalling and telecommunications systems. The alignment traverses five rayons of Turkistan Oblast across predominantly flat, arid steppe terrain, adjacent to the Shardara Reservoir — an internationally designated Important Bird Area and Key Biodiversity Area. The project is classified as ADB Category A for environment and involuntary resettlement.

This Climate Resilience Assessment (CRA) identifies and characterises climate hazards relevant to the project, assesses risk over the 120-year design life of the railway (to 2145), and recommends adaptation measures for integration into remaining construction works, operations, and long-term maintenance planning. The assessment supports compliance with ADB Safeguard Policy Statement (2009), AIIB Environmental and Social Framework (2024), and IFC Performance Standard requirements, and forms an input to the Supplementary Environmental and Social Impact Assessment (Supplementary ESIA) prepared by VISTA Environment AB (VEAB) on behalf of the Client.

Overall Risk Finding: HIGH

Overall Risk: HIGH

The project faces HIGH overall risk from climate hazards. River flood carries HIGH baseline risk: the 500-metre Syr Darya bridge is the most climate-sensitive single asset on the alignment, exposed to embankment scour, bridge undermining, and culvert blockage. Spring precipitation in the Syr Darya headwaters is projected to increase by up to +50% under upper-bound estimates by 2050, introducing additional uncertainty into hydraulic design loading assumptions. Mean surface temperature risk escalates from LOW at baseline to HIGH over the design life, driven by projected warming of more than 2°C above the 1985– 2014 baseline by 2145, with direct implications for rail thermal expansion, track buckling, and worker heat stress. Rainfall-induced landslide is rated HIGH by the ADB screening tool, though this risk is concentrated primarily at embankment slopes adjacent to the Shardara Reservoir rather than across the flat steppe alignment as a whole.

Additional MODERATE risks include heat stress (with construction-phase conditions at the upper end of the screened WBGT range warranting HIGH treatment for occupational health and safety planning), drought and water scarcity in the chronically water-stressed Syr Darya Basin, and wildfire given confirmed HIGH fire weather index values (FWI >60) across the corridor. Dust storm hazard is not assessed by the ADB screening methodology and requires a separate dedicated assessment, as the project corridor lies within the influence zone of the Aralkum dust emission source.

Priority Recommendations

The following adaptation measures are recommended as high priority: (i) detailed hydraulic and hydrological modelling for the Syr Darya bridge incorporating projected spring precipitation increases under SSP5-8.5; (iii) heat-resilient rail design standards, including continuous welded rail stress-free temperature specifications and speed restriction protocols for extreme heat events; (iv) an occupational health and safety heat action plan for construction workers, covering work rescheduling, mandatory rest periods, and hydration protocols; (v) a dedicated dust storm hazard assessment for the project corridor; and (vi) designation of a Climate Resilience Focal Point within the KTZ project implementation unit to oversee monitoring and reporting obligations across the design life of the railway.

A. Background and Context

A.1. Project Overview

The Darbaza–Maktaaral Railway Expansion Project is intended to relieve congestion at the Saryagash–Tashkent border crossing, which currently handles a substantial share of regional freight traffic between Kazakhstan and Uzbekistan. Once operational, the line is expected to accommodate approximately 46 train movements per day, primarily freight services, and increase freight capacity by 15.7 million tons annually. The project will also reduce reliance on rail transit through Uzbekistan.

Key infrastructure components include the main railway alignment, three stations (Yerdaut, Intermediate, and Maktaaral) and two passing loops, 33 structures comprising 24 bridges (including the 500-metre Syr Darya crossing), five railway overpasses, four road overpasses, one reinforced concrete tunnel, and 127 drainage culverts. Additional facilities include traction substations, overhead power lines, signalling and communication systems, and worker accommodation. Construction commenced in 2024, with overall project completion planned for December 2026. The project is classified as ADB Category A for environment and involuntary resettlement.

A.2. Project Setting and Climate Context

The project corridor traverses five rayons of Turkistan Oblast — Saryagash, Keles, Shardara, Zhetysay, and Maktaaral — passing through a predominantly flat, arid to semi-arid agricultural and steppe landscape. The region is characterised by a continental climate with extreme seasonal temperature variation, hot dry summers, cold winters, and low annual precipitation (100–200 mm), overlying alluvial and loess-like soils that are susceptible to erosion and, in seismically active conditions, liquefaction.

Figure 61: Project Alignment



The Syr Darya River is a defining hydrological and ecological feature. The alignment crosses the river at approximately KM 83.5 adjacent to the Shardara Reservoir, a major national water resource and internationally designated Important Bird Area (IBA) and Key Biodiversity Area (KBA) for migratory waterbirds. CHA findings should be reflected once finalised.

Central Asia is recognised as one of the regions most vulnerable to climate change impacts, particularly in relation to increasing temperatures, water scarcity, drought, and land degradation. Kazakhstan has experienced a documented warming trend of approximately 0.8°C since 1991, with projected increases of 2–4°C by mid-century under moderate to high emissions scenarios.

The Syr Darya Basin already experiences chronic water scarcity driven by high agricultural demand. In parallel, the seasonally inundated area of the Shardara Reservoir has been gradually decreasing over recent decades, a trend expected to continue under climate change. Together, these stressors present material risks to long-term railway infrastructure.

These risks are reinforced by Kazakhstan Temir Joly (KTZ's) corporate climate analysis prepared under IFRS S2 (October 2025). KTZ assessed physical climate hazards across 12 network assets using SSP2-4.5 and SSP5-8.5 scenarios to 2050.

For southern Kazakhstan sites comparable to the Darbaza–Maktaaral corridor, including Arys station approximately 120 km north of the alignment, KTZ projects continued increases in extreme temperature conditions, with maximum summer temperatures exceeding 40°C under future climate scenarios. Heat stress days (WBGT >28°C) are projected to increase substantially relative to historical conditions, while wildfire exposure and fire alert duration are also expected to increase.

KTZ's analysis identifies flood, extreme heat, and wildfire as high-impact risks across the network, consistent with the findings of this CRA.

A.3. Objectives of the CRA

This Climate Resilience Assessment aims to:

- Identify and characterise climate hazards relevant to the project alignment, components, and design life.
- Assess the exposure, vulnerability, and risk of key project assets to identified hazards, under both baseline and projected future climate conditions.
- Recommend priority adaptation measures and resilience options to reduce identified risks and inform remaining works, ESMPs, project operations and long-term planning.
- Provide a monitoring and evaluation framework to track climate resilience performance throughout project implementation and operation.
- Support compliance with ADB, AIIB, and IFC climate risk and adaptation requirements, and alignment with Kazakhstan's NDC and NAP.

A.4. Methodology

Hazard exposure data are primarily derived from ADB's Climate and Disaster Risk Screening Tool (Project No. 2242, April 2026), supplemented by global datasets covering temperature, flood risk, seismicity, landslide susceptibility, wildfire exposure, and water stress. Vulnerability ratings reflect ADB sector-specific calibration for railway infrastructure.

B. Observed and Projected Climate Trends

B.1. Baseline Climate Conditions

Key baseline climate and hazard characteristics for the Turkistan Region include:

- **Temperature:** Hot summers (mean daily maxima regularly exceeding 35–40°C in July–August) and cold winters (<−15°C). Mean annual temperature is approximately 13–15°C.
- **Precipitation:** Low annual precipitation (100–200 mm), predominantly occurring in spring. High evapotranspiration intensifies effective aridity.
- **Drought:** Severe drought conditions are periodically observed within the region, indicating elevated baseline drought exposure.
- **Wildfire:** Baseline wildfire exposure is elevated due to dry climatic conditions and highly combustible steppe vegetation.

These baseline conditions are consistent with KTZ's corporate-level IFRS S2 climate analysis (October 2025), which assessed physical hazard exposure across 12 KTZ network sites, including Arys-1 station in southern Kazakhstan — the nearest KTZ asset to the project alignment.

The analysis identified Arys as one of the highest-risk sites on the KTZ network for extreme heat, with historical maximum temperatures already exceeding 42°C. The site was also classified as having very high wildfire risk, with fire alert duration projected to increase by up to 100% above historical levels by 2050 under moderate emission scenarios. These findings reinforce the physical hazard characterisation presented in this CRA.

- **Seismicity:** Moderate seismic hazard (PGA 0.05–0.2g) and liquefaction susceptibility in alluvial areas are noted as project context; these are geophysical rather than climate hazards and are not assessed further in this CRA.
- **Hydrology:** The Syr Darya Basin is dominated by snowmelt hydrology. The extent of the Shardara Reservoir varies seasonally and interannually, and the alignment crosses multiple irrigation canals.

Seasonal temperature variability in southern Kazakhstan is pronounced, with mean daily maxima regularly exceeding 35– 40°C in July and August, falling below −15°C in mid-winter. Annual precipitation averages 100–200 mm and is concentrated in spring, well below evapotranspiration demand throughout the summer months. This seasonal moisture deficit underpins the chronic water stress of the Syr Darya Basin and contributes to elevated drought, heat stress, and wildfire exposure across the project corridor during the summer operational period. Figures 1 and 2 below illustrate projected future temperature and precipitation trends that will intensify these baseline conditions over the design life of the railway.

B.2. Projected Climate Changes Over Design Life

Over the 120-year design life of the railway, significant changes in climate conditions are projected. Key trends include:

- **Mean Surface Temperature:** Mean temperatures are projected to increase by more than 2.0°C above the 1985–2014 baseline by 2115–2145 (NASA NEX-GDDP-CMIP6). This increases exposure from Low at baseline to High over the design life and represents the most significant escalating climate driver for the project.
- **Drought:** Drought exposure is projected to increase from Moderate to High over the design life. Rising temperatures are expected to intensify evapotranspiration and increase the frequency and severity of drought conditions.

- **River Flood:** Moderate baseline exposure is expected to remain broadly stable. However, changes in snowmelt seasonality and precipitation intensity introduce uncertainty, particularly for peak discharge conditions at the Syr Darya crossing.
- **Rainfall-Induced Landslide:** No significant change is projected, with RX1d and R10mm indices remaining below escalation thresholds. Moderate exposure is therefore expected to remain relatively unchanged over the design life.
- **Heat Stress (WBGT):** Although the ADB screening indicates no change in overall WBGT exposure classification, rising average temperatures are expected to increase the frequency of peak WBGT events. At 32°C WBGT — the upper end of the screened range — manual workers at 400W intensity experience 44% single-day productivity loss (KTZ IFRS S2 data). The construction-phase OHS risk should be treated as HIGH for planning purposes.
- **Water Scarcity and Wildfire:** Both hazards are expected to remain at elevated exposure levels throughout the design life.

Climate model projections for the Yujno-kazachstanskaya region confirm that mean annual temperatures will increase by approximately 2–3°C above the 1995–2014 baseline by mid-century under SSP2-4.5, rising further through the latter half of the design life. This sustained warming underpins the escalation of mean surface temperature risk from LOW at baseline to HIGH over the 120-year design life of the railway and directly informs the adaptation measures recommended for rail thermal management, including continuous welded rail stress-free temperature specifications, speed restriction protocols during extreme heat events, and OHS heat action planning for construction workers. Figure 62shows the projected change in spring (March–April–May) precipitation across Kazakhstan and Central Asia under the upper-bound model estimate (P90, SSP5-8.5) for 2040–2059. Southern Kazakhstan shows limited projected change in mean precipitation, but the Syr Darya headwater catchments in Kyrgyzstan and northwestern China (darker teal, lower right of the figure) show projected spring precipitation increases of up to 50% under upper-bound conditions. Spring precipitation directly drives peak river discharge and snowmelt-related flooding in the Syr Darya, which is the primary flood mechanism at the railway's river crossing. This introduces material uncertainty into hydraulic design loading assumptions for the Syr Darya bridge and embankments, even though mean flood exposure is projected to remain broadly stable.

Figure 62: Projected Spring (March–April–May) Precipitation Percent Change — Kazakhstan and Central Asia (2040–2059, SSP5-8.5, P90 model ensemble, relative to 1995–2014 baseline).

Source: World Bank Climate Knowledge Portal.



C. Climate Risk Assessment

C.1. Risk Summary

Risk ratings are determined based on the interaction between hazard exposure and subsector vulnerability. Risk ratings for the railway component (Polyline 1, Darbaza–Maktaaral alignment) derived from ADB's Climate and Disaster Risk Screening Tool.

Risk Rating Definitions:

High: The project component is likely to experience significant adverse impacts if the hazard occurs. Without specific adaptation measures, impacts may include structural damage, extended service disruption, or safety risks to workers and users. Priority action is required.

Moderate: The project component may experience moderately adverse impacts if the hazard occurs. Impacts are expected to be manageable with appropriate engineering controls and maintenance, but may affect operations or increase lifecycle costs.

Low: The project component is likely to experience only minor adverse impacts if the hazard occurs. Standard design provisions are expected to be sufficient.

Not Exposed: The project component is not exposed to the hazard.

Table 122: Summary Climate Risk Ratings

Hazard	Baseline Risk	Future Risk (2145)	Baseline Exposure	Future Exposure (2145)	Vulnerability
Mean Surface Temperature Increase	LOW	HIGH	LOW	HIGH	MODERATE
River Flood	HIGH	HIGH	MODERATE	MODERATE	HIGH
Rainfall-Induced Landslide	HIGH	HIGH	MODERATE	MODERATE	HIGH
Drought	MODERATE	MODERATE	MODERATE	HIGH	LOW
Heat Stress (WBGT)	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Water Scarcity	MODERATE	MODERATE	HIGH	HIGH	LOW
Wildfire	MODERATE	MODERATE	HIGH	HIGH	LOW
Tropical Cyclones	NOT EXPOSED	NOT EXPOSED	NOT EXPOSED	NOT EXPOSED	MODERATE

Risk = Hazard Exposure × Asset Vulnerability. Ratings are provided for both current baseline conditions and a future horizon corresponding to the 120-year design life of the railway (to 2145).

Note on Heat Stress: *The MODERATE rating above reflects the ADB screening tool output for the operational railway. The hazard narrative in Section 4.2 presents evidence that construction-phase heat stress at the upper end of the screened WBGT range (32°C) constitutes a HIGH worker safety risk requiring dedicated OHS action planning. For occupational health and safety planning purposes, construction-phase heat stress should be treated as HIGH.*

Residual risk: *The ratings above reflect pre-adaptation conditions. Implementation of the priority adaptation measures recommended in Section 5.2 — in particular hydraulic and scour protection for the Syr Darya bridge, slope stabilisation on reservoir-adjacent embankments, heat-resilient rail design, and OHS heat action planning — is expected to reduce residual risk for the highest-rated hazards from HIGH to MODERATE, subject to detailed design verification. Where adaptation measures are not implemented, the HIGH risk ratings should be treated as the operative planning assumption.*

C.2. Hazard-by-Hazard Assessment

The table below summarises key observed conditions, projected climate changes, infrastructure impacts, and associated risk ratings for the principal climate hazards affecting the project.

Table 123: Hazard Risk Assessment

Hazard	Observed Conditions	Projected Changes	Key Infrastructure Impacts	Risk Rating
Mean Surface Temperature >2°C	Baseline exposure is classified as LOW under the ADB screening methodology, Mean temperatures have increased by approximately 0.8°C since 1991.	Mean temperatures are projected to increase by more than 2.0°C above the baseline by 2145 (NASA NEX-GDDP-CMIP6). Exposure is projected to increase from Low to High over the design life.	Rail thermal expansion and buckling; ballast degradation; increased cooling demand at stations; elevated heat stress risks for workers.	HIGH
River Flood	Moderate baseline exposure. The alignment crosses the Syr Darya River and multiple irrigation canals. High water tables occur during snowmelt periods.	Moderate exposure is expected to remain broadly stable. However, changes in snowmelt seasonality and precipitation intensity introduce uncertainty, particularly for peak discharge conditions at the Syr Darya crossing.	Embankment scour; bridge undermining; culvert blockage; temporary access disruption; flooding damage to substations and other infrastructure near watercourses.	HIGH
Rainfall-Induced Landslide	Moderate baseline exposure near the Shardara Reservoir and embankment slopes.	No significant changes are projected in RX1d or R10mm indices. Moderate baseline exposure is therefore not expected to change significantly over the design life.	Embankment slope failure; material washout; track destabilisation; operational disruption and line closure risk. Risk applies primarily to embankment slopes adjacent to the Shardara Reservoir; widespread hillside landsliding is not	HIGH

Hazard	Observed Conditions	Projected Changes	Key Infrastructure Impacts	Risk Rating
			expected on the predominantly flat steppe alignment.	
Heat Stress (Workers)	Moderate baseline exposure, with WBGT values typically ranging between 25–32°C during summer months. Prolonged periods of high heat are already characteristic of the region.	The ADB screening MODERATE rating reflects a WBGT range of 25–32°C. The upper end of this range (32°C WBGT) causes a 44% single-day productivity loss at 400W work intensity per the KTZ IFRS S2 epidemiological data. The KTZ IFRS S2 report documents that Arys-1 station (120 km north of this project corridor and therefore cooler) already experiences WBGT >32°C on more than 50 days per year under SSP5-8.5 by 2050. The Darbaza–Maktaaral corridor, being further south, will record higher frequencies. Rating construction-phase heat stress as MODERATE without noting that conditions at the upper end of the screened range constitute a HIGH worker safety risk is a material understatement with direct OHS implications under ADB Safeguard Policy Statement requirements. The risk rating for the construction phase should be reconsidered as HIGH.	Worker heat illness; reduced workforce productivity; increased OHS management requirements; passenger comfort impacts at surface stations.	MODERATE
Drought	Baseline drought exposure is moderate under the ADB screening methodology, while the region	Drought exposure is projected to increase from Moderate to High by 2145. However, relatively low railway sector vulnerability	Reduced water availability for construction and maintenance activities; increased dust generation;	MODERATE

Hazard	Observed Conditions	Projected Changes	Key Infrastructure Impacts	Risk Rating
	nevertheless experiences recurrent drought conditions and chronic water stress associated with arid climatic conditions.	limits the overall risk level. Note: the ADB screening supplementary data independently classifies the drought hazard level as HIGH (>40% drought years in a 30-year period). The MODERATE overall risk rating reflects LOW railway sector vulnerability applied to this exposure.	potential competition with local communities and agricultural users for water resources.	
Water Scarcity	High baseline water stress (WSI >40%). The Syr Darya Basin is chronically water-stressed due to agricultural demand and limited water availability.	High exposure is expected to continue throughout the design life, with no significant improvement projected.	Reduced availability of water for construction and operational activities; increased risk of competition for water resources.	MODERATE
Wildfire	HIGH baseline wildfire exposure (FWI >60 per ADB screening supplementary data; classified as extreme fire weather). The KTZ IFRS S2 report documents fire alert duration at Arys-1 (120 km north) projected to increase by up to 100% above historical levels by 2050 under SSP2-4.5. The project corridor, being further south, carries equal or greater exposure.	HIGH exposure expected to remain elevated throughout design life. Fire alert duration projected to increase significantly (+100% by 2050 under SSP2-4.5 for comparable southern Kazakhstan sites).	Destruction of steppe and trackside vegetation; scorching of sleepers and plastic cable insulation; damage to signalling equipment; track blockage from burning debris; operational disruption and potential service suspension during severe fire events. Worker and passenger evacuation risk.	MODERATE

Figure 63 and Figure 64 show riverine flood hazard along the Syr Darya corridor at 100-year return period inundation depth, under current baseline conditions (Figure 63) and projected conditions in 2050 under the Business as Usual/Pessimistic climate scenario (Figure 64). Data are from the WRI Aqueduct Floods v2 dataset. The dominant flood feature is the Shardara Reservoir and Syr Darya river system, visible as the large dark blue zone running north–south on the left of each map. The reservoir receives snowmelt from the Tian Shan mountains and its water level varies substantially between years. The project railway crosses the Syr Darya at approximately KM 83.5 of the alignment on a 500-

metre bridge currently under construction. Dark blue tones indicate inundation depths exceeding 1 metre; lighter blue and lavender tones indicate shallower inundation (0.5–1 metre). Comparison of the two figures indicates limited change in flood extent between baseline and 2050 under the pessimistic scenario. The flood risk discussion should be read alongside the projected spring precipitation increase shown in Figure 62, which introduces additional uncertainty into peak discharge design assumptions at the crossing.

Figure 63: River Flood Hazard Map — Syr Darya Corridor (Baseline, Riverine Flooding, 100-Year Return Period). Inundation depth shown in decimetres. Source: WRI Aqueduct Floods v2 (2020).

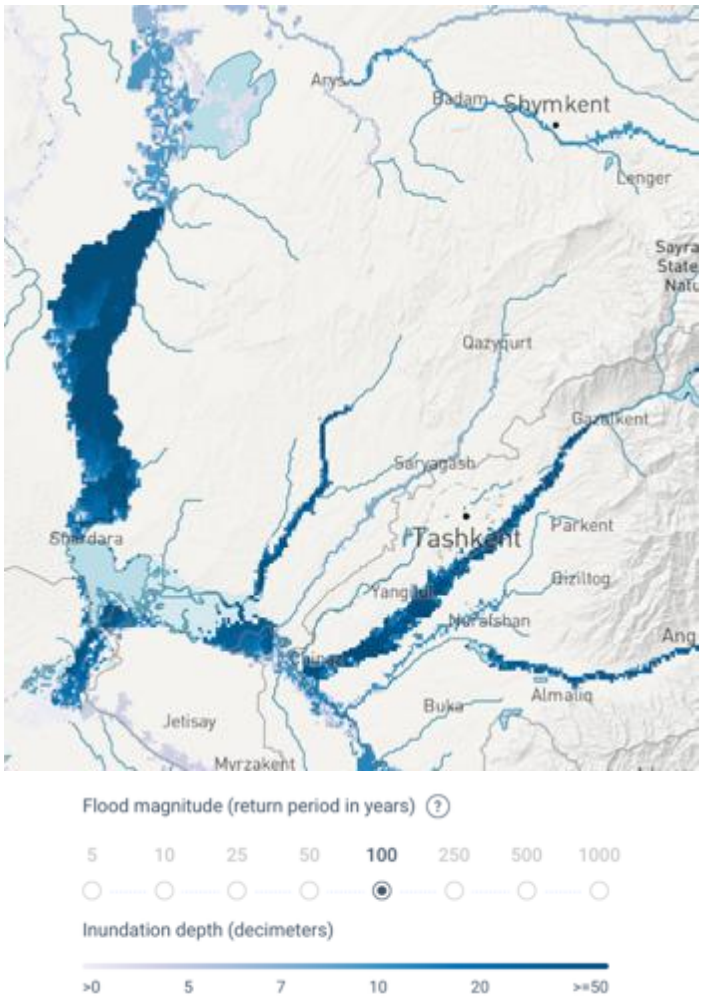
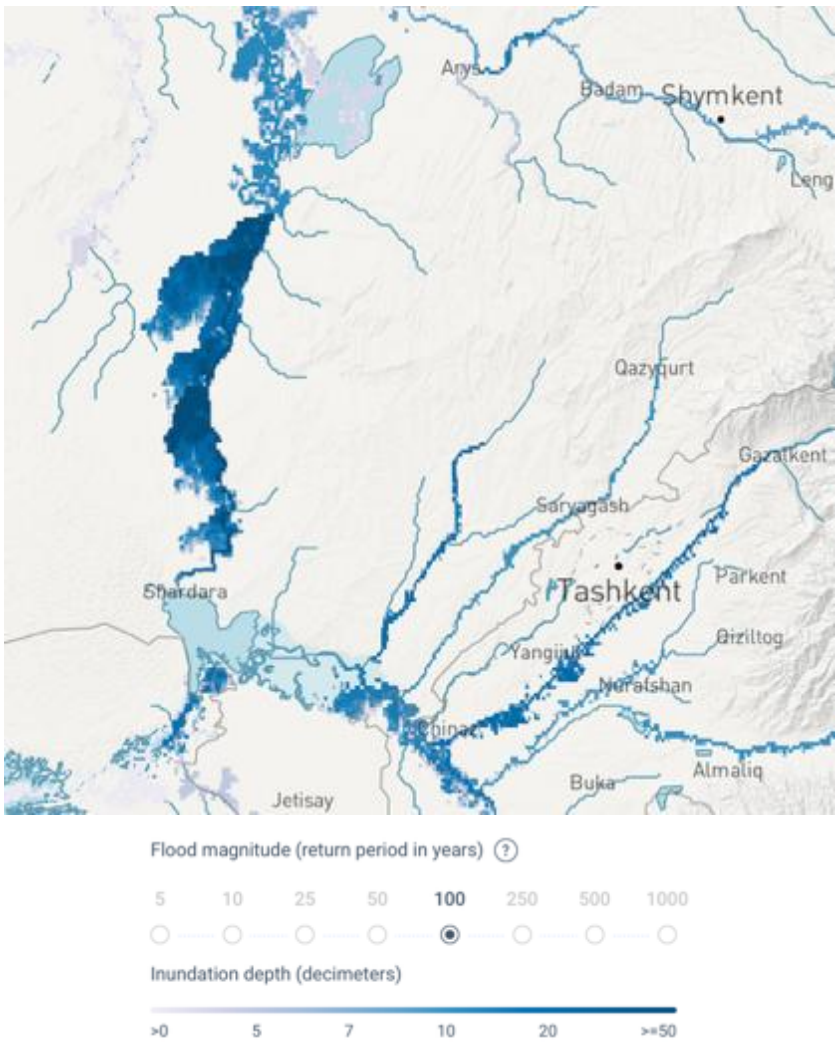


Figure 64: River Flood Hazard Map — Syr Darya Corridor (2050 Projection, Business as Usual/Pessimistic Scenario, Riverine Flooding, 100-Year Return Period, MIROC-ESM-CHEM model). Source: WRI Aqueduct Floods v2 (2020).



D. Asset Vulnerability Assessment

D.1. Vulnerability Framework

The asset vulnerability assessment provides an indicative qualitative review of how key project components may be affected by identified climate hazards over the project lifecycle. The assessment is intended to support identification of higher-risk and climate-sensitive infrastructure components requiring additional resilience consideration during remaining works, operations, and long-term maintenance planning.

The Syr Darya River bridge and associated embankments are among the most climate-sensitive project components due to combined exposure to flooding and hydraulic variability over the rail design life. The Shardara Reservoir also requires consideration due to its dynamic hydrological conditions, ecological sensitivity, and proximity to IBA/KBA areas.

D.2. Asset-Level Vulnerability Ratings

Table 124: Asset-Level Vulnerability Assessment

Asset / Component	Exposure	Sensitivity	Adaptive Capacity	Vuln. Index	Risk Level	Notes
Track Formation & Embankments	High	High	Low	High	HIGH	120-yr design life; >8.4M m³ embankment; exposed to flood, landslide, temperature.
Syr Darya River Bridge	High	High	Low	High	HIGH	Critical single point of failure; flood exposure; major hydraulic structure.
Culverts & Drainage	Moderate	High	Low	Moderate–High	HIGH	Sized to current hydrology; climate change may require upsizing; blockage risk in extreme events.
Stations (Yerdaut, Promezhutochnaya, Maktaaral)	Moderate	Moderate	Moderate	Moderate	MODERATE	Station buildings and platforms; heat stress for workers/passengers; flood risk at Maktaaral.
Traction Substations & Power Lines	Moderate	High	Low	Moderate–High	HIGH	Sensitive to temperature extremes and flooding.
Shardara Reservoir Interface	High	Moderate	Low	Moderate–High	HIGH	IBA/KBA; dynamic seasonal water levels; climate change reducing inundation extent; complex hydraulics.

Asset / Component	Exposure	Sensitivity	Adaptive Capacity	Vuln. Index	Risk Level	Notes
Worker Camps (construction phase only)	Moderate	Moderate	Moderate	Moderate	MODERATE	Heat stress, flooding and dust are key risks; temporary structures; removable post-construction.

The Syr Darya River bridge and track embankments carry the highest vulnerability given their combined exposure to flood hazards across a 120-year design life. Electrical infrastructure (substations, power lines) is highly sensitive to temperature extremes and heat stress.

The Shardara Reservoir interface requires particular attention due to its ecological sensitivity, dynamic hydrological conditions, and proximity to internationally recognized biodiversity features.

E. Adaptation Options and Resilience Measures

E.1. Overview

Given the high overall risk rating, additional targeted climate resilience review and integration of adaptation measures into remaining design, construction, and operational planning is recommended, particularly for high-risk assets such as the Syr Darya crossing and major embankment sections. The measures below provide an initial structured framework to inform that process and guide immediate integration into project design documents and ESMPs.

Priority is given to measures that can still be integrated into remaining works, commissioning activities, operations, and long-term maintenance planning.

Recommended Adaptation Measures

Table 125: Adaptation Measures

Adaptation Measure	Hazard(s)	Category	Effectiveness	Timeframe	Indicative Cost
Complete targeted technical studies/design checks for remaining works and operational resilience	All hazards	Non-structural (Information /Planning)	High	Immediate	Moderate
Ensure embankment and bridge protection measures account for flood and scour risks	River Flood	Structural (Grey)	High	Construction	High
Review hydraulic capacity of culverts and drainage structures against projected climate conditions	River Flood, Landslide	Structural (Grey)	High	Remaining works / operations	Moderate
Install flood monitoring and early warning systems at key watercourse crossings	River Flood	Non-structural (Warning systems)	Moderate	Short-term	Moderate
Integrate slope stabilisation and retaining walls on embankments near Shardara Reservoir	Rainfall-Induced Landslide	Structural (Grey)	High	Short-term	High
Specify elevated Stress-Free Temperature (SFT) for all CWR sections. SFT must be set with reference to SSP5-8.5 P90 projected maximum rail surface temperatures to at least 2050 (rail surface temperatures typically 20–30°C above air temperature in direct sun). Design engineer to confirm SFT specification with climate-adjusted temperature basis.[29]	Temperature Increase	Structural (Grey)	High	Design / Construction	High
Establish temperature-triggered train speed restriction protocol for operations. Protocol to define staged speed restrictions at defined exceedances above SFT (standard practice: first restriction at SFT+10°C, suspension of operations at SFT+20°C or per KTZ network rules, whichever is more conservative). Rail temperature thresholds and monitoring method to be specified in Operating Rules and incorporated into the O&M manual prior to commissioning.	Temperature Increase	Non-structural (Operations)	High	Pre-commissioning	Low

[29] KTZ network average SFT of 27°C, derived from historical data, is likely insufficient given projected air temperature maxima of 44–46°C for comparable southern Kazakhstan sites by 2050.

Adaptation Measure	Hazard(s)	Category	Effectiveness	Timeframe	Indicative Cost
Integrate projected climate scenarios into future maintenance and operational planning	Temperature Increase	Non-structural (Policy /Planning)	High	Remaining works / maintenance	Low
Develop and implement OHS heat action plan for construction workers, including: work rescheduling away from peak WBGT hours (typically 11:00–16:00 when WBGT exceeds 28°C); mandatory work-rest ratios scaled to WBGT level; site-level WBGT monitoring; hydration provisions; acclimatisation protocols for new and returning workers; and heat illness recognition and first response procedures. Plan to be in place before construction phase peak summer season.	Heat Stress	Non-structural (Practice & Behaviour)	Moderate	Construction phase (immediate)	Low
Develop drought/water management plan for construction and operations	Drought, Water Scarcity	Non-structural (Management)	Moderate	Ongoing	Low
Plant roadside vegetation and windbreaks for cooling, erosion control, and biodiversity co-benefits. Species selection must prioritise low-flammability native species; high-biomass or resinous species must be avoided given FWI >60 baseline fire weather conditions. A minimum cleared firebreak zone must be maintained between any planted vegetation and the running rail.	Heat Stress, Drought, Wildfire	Green infrastructure	Moderate	Short-term	Low
Apply fire-resistant materials to at-risk components (cable insulation, signaling equipment housings, etc) and establish cleared firebreaks along the right-of-way. For FWI >60 (extreme fire weather) conditions, a minimum 20–30 m cleared zone on each side of the track. Firebreak width and vegetation management frequency to be specified in the O&M manual and maintained through the operational phase.	Wildfire	Structural (Green/Grey)	High	Pre-commissioning	Moderate
Develop emergency response and service continuity plans for all high-rated hazards prior to commissioning. Plans must address contingency freight arrangements and define maximum restoration timelines for track, embankment, and bridge failures. Plans to be tested by tabletop exercise before commencement of revenue operations and reviewed annually thereafter.	All high-rated hazards	Non-structural (Management)	Moderate	Medium-term	Low

Source: ADB Climate and Disaster Risk Screening Report, Project No. 2242, 6 April 2026.

F. Institutional Capacity and Strategic Alignment

F.1. KTZ Institutional Arrangements

KTZ operates an Integrated Management System certified to ISO 9001, ISO 14001, and ISO 45001 standards, providing a corporate framework for environmental, health, and safety management. However, the ESCA Inception Report (December 2025) identified several areas requiring further strengthening in relation to climate resilience, including contractor and subcontractor management, OHS practices under high-risk construction conditions, emergency preparedness, biodiversity monitoring, and land acquisition governance.

At the corporate level, KTZ has established a climate governance framework aligned with IFRS S2 requirements. Strategic oversight of climate risks and opportunities is exercised by the Board of Directors through four committees: the Audit Committee, the Strategy and Finance Committee, the Safety and Environmental Protection Committee, and the Nominating and Remuneration Committee. Board competency assessments include climate risk awareness and management considerations.

At the executive level, the Chief Engineer holds primary responsibility for low-carbon development, environmental management, and energy efficiency programmes across the KTZ group of companies. Climate objectives are integrated into management KPIs. In 2024, KTZ exceeded its carbon reduction target, achieving an approximately 8.2% reduction in total GHG emissions relative to the previous year (total emissions fell from ~5,508 kt CO_2e to ~5,058 kt CO_2e per KTZ IFRS S2 data).

KTZ has also implemented several decarbonisation initiatives, including renewal of the locomotive fleet with EVOLUTION-series diesel locomotives, which are reported to reduce pollutant emissions substantially compared to older locomotive models. These measures contributed to a reduction in emissions intensity to 105.9 kg CO_2e/10,000 tkm gross in 2024, representing a 21% improvement since 2020.

This governance structure and operational track record provide an important institutional basis for implementation of the climate resilience measures recommended in this CRA. However, the Darbaza–Maktaaral railway will operate using non-electrified diesel traction, and the project's long-term GHG implications should therefore be considered within KTZ's broader decarbonisation planning and climate strategy.

Mainstreaming climate resilience within KTZ may require:

- designation of a Climate Resilience Focal Point within the KTZ;
- integration of climate risk considerations into operations and maintenance (O&M) procedures and asset management systems;
- training on climate-resilient engineering and infrastructure standards; and
- development of climate-informed emergency response procedures for flooding and extreme heat events.

F.2. Strategic Alignment

- Kazakhstan NDC (Paris Agreement): Kazakhstan's updated Nationally Determined Contribution includes an adaptation component requiring climate-proofing of critical transport infrastructure. The project corridor in Turkistan Oblast falls within the geographic scope of national adaptation priorities for southern Kazakhstan, where increasing

temperature extremes, drought intensification, and water stress are identified as key climate risks. This CRA supports NDC adaptation implementation by assessing physical climate risks over the full infrastructure lifecycle and recommending adaptation measures for integration into design and operations.

- National Adaptation Plan (NAP): Kazakhstan's NAP process identifies the transport sector as a priority adaptation area, with attention to climate-resilient infrastructure investment in southern regions subject to increasing temperature extremes, drought, and water stress. The HIGH overall risk rating confirmed by this CRA, and the recommended adaptation measures for the Syr Darya crossing and major embankments, are directly applicable to NAP implementation objectives for this corridor.
- ADB Climate Change Operational Framework 2017–2030: ADB's Climate Change Operational Framework requires that ADB-financed infrastructure projects assess physical climate risks and integrate adaptation measures proportionate to risk level. The HIGH risk screening outcome for this project confirms the need for a project-level CRA and supports integration of climate resilience into project design, construction supervision, and operations in line with ADB's commitment to increase climate finance and ensure climate resilience across its portfolio.
- AIIB Environmental and Social Framework (2024): AIIB's ESF requires assessment and management of physical climate risks over the full project lifecycle, including through environmental and social impact assessment and operational monitoring. This CRA fulfils the climate risk assessment requirement under the ESF and provides the adaptation measure framework for integration into the Supplementary ESIA and forthcoming lender-aligned ESMPs.
- IFC Performance Standards (PS1, 2012): IFC PS1 requires assessment of physical climate risk as part of environmental and social assessment, particularly for projects in sensitive locations or with long design lives. The HIGH overall climate risk rating, the project's 120-year design life, and its location adjacent to the Shardara Reservoir IBA/KBA in the chronically water-stressed Syr Darya Basin are consistent with PS1's requirements for enhanced assessment and adaptive management.
- CAREC Program: The project forms part of the Central Asia Regional Economic Cooperation (CAREC) Corridor 2 transport network linking Kazakhstan and Uzbekistan. CAREC's operational priorities include climate-resilient infrastructure investment across the region. The adaptation measures recommended in this CRA, particularly for the Syr Darya crossing and main embankments, are consistent with CAREC requirements for climate-resilient transport infrastructure investment.
- KTZ Corporate Climate Frameworks: At the corporate level, KTZ has adopted a Low-carbon Development Concept to 2060 targeting carbon neutrality, and publishes annual climate disclosures aligned with IFRS S2. This CRA is consistent with those corporate commitments and draws directly on KTZ's IFRS S2 physical hazard analysis for network sites in southern Kazakhstan. The project-level adaptation measures and monitoring framework recommended herein should be reported through KTZ's existing IFRS S2 and Board-level climate governance structures, ensuring alignment between project-level and corporate-level climate risk management.

G. Monitoring and Evaluation

G.1. Monitoring Framework

Climate resilience monitoring is proposed for integration into the project's environmental and social management structure once lender-aligned ESMPs are finalised pursuant to the ESCA Corrective Action Plan. Pending ESMP completion, the KTZ's Environmental and Social Specialists and OHS Officer carry day-to-day responsibility for environmental and social performance monitoring, including climate-related indicators. A dedicated Climate Resilience Focal Point is recommended for designation within the KTZ (see Section 8.1); until that role is established, climate monitoring responsibilities should be assigned explicitly to the existing Environmental and Social Specialist function.

Indicator	Target / Threshold	Frequency	Responsible Entity	Data Source
Hydraulic capacity review completed for key drainage and bridge structures	Hydraulic review report completed confirming all culverts, drainage structures, and the Syr Darya bridge have been assessed against SSP5-8.5 P90 projected peak discharge conditions; any structures requiring upsizing identified with remediation incorporated into remaining works or maintenance programme with defined completion date	Once, prior to construction completion of affected structures (milestone)	KTZ / KTZ	Design documentation
Track temperature monitoring system operational (high-senstive sections)	System installed and calibrated on all designated high-sensitivity CWR sections; capable of triggering speed restriction protocol at SFT+10°C threshold; system availability >95% during Jun–Sep peak temperature	Quarterly operational status check; data reviewed monthly Jun–Sep; annual calibration verification	KTZ Operations	Sensor logs / SCADA

Indicator	Target / Threshold	Frequency	Responsible Entity	Data Source
	season; any system outage during Jun–Sep resolved within 48 hours			
Flood-related service disruptions per year	Zero unplanned service closures exceeding 24 hours attributable to flooding; any flood water reaching track formation level triggers inspection and incident report regardless of service impact; any closure between 4–24 hours recorded and reviewed for pattern	Event-triggered: within 14 days of any qualifying flood event; annual summary in semi-annual E&S report	KTZ Operations	Operational records
Heat-related OHS incidents during construction	Zero heat-related incidents requiring medical evacuation or hospitalisation; WBGT >32°C at any active work site triggers mandatory rest schedule within 1 hour; any heat illness requiring medical attention (regardless of severity) triggers same-day incident report and corrective action review	Daily WBGT measurement at each active work site Jun–Sep; incident data compiled weekly Jun–Sep and monthly Oct–May; reported in each semi-annual E&S report	EPC / KTZ HSE	Incident reports
Embankment condition inspections completed	No deformation, piping, seepage, or surface erosion classified as	Twice annually (February pre-snowmelt; June post-	KTZ Maintenance	Inspection reports / GIS

Indicator	Target / Threshold	Frequency	Responsible Entity	Data Source
	moderate or above on inspection; any defect rated moderate triggers remediation plan within 30 days; critical defect triggers immediate works stoppage and lender notification within 14 days	snowmelt); additionally after any 24-hour rainfall >20mm or following any Syr Darya flood alert		
Targeted CRA completed	All adaptation measures from Section 5.2 assigned to named responsible parties with defined completion dates and incorporated into design documentation, construction supervision plan, and O&M manual; confirmed in writing by KTZ and design engineer; verified at subsequent semi-annual E&S report	Once	KTZ / Consultants	CRA report approval
CWR speed restriction events during operations	Number of temperature-triggered speed restriction events recorded per summer season (Jun–Sep); >5 events per season triggers review of SFT specification adequacy by design engineer; any unplanned suspension of operations due to	Event log maintained continuously; annual summary each October	EPC / KTZ	GHG inventory

Indicator	Target / Threshold	Frequency	Responsible Entity	Data Source
	rail temperature triggers incident report within 14 days			

G.2. Governance and Reporting

Climate resilience performance is reported through semi-annual Environmental and Social monitoring reports submitted to ADB, AIIB, and IFC, as applicable. The climate resilience section of each semi-annual report is compiled by the KTZ Environmental and Social Specialist, drawing on operational records, inspection reports, incident data, and embankment condition assessments from KTZ Operations and the EPC contractor. Where applicable, climate resilience findings should be reconciled with KTZ's corporate-level IFRS S2 annual climate reporting cycle to ensure consistency between project-level and network-level climate risk data and to avoid duplication of effort across reporting obligations. Where a monitoring threshold is exceeded — including any flood-related service disruption exceeding 24 hours, any heat-related severe OHS incident during construction, or any structural failure of embankments or drainage structures linked to a climate event — the incident is escalated to the KTZ project management team and notified to lenders within 14 days in accordance with lender event notification requirements. Corrective actions are documented and tracked to closure in the subsequent semi-annual report. Climate resilience reviews are conducted at the following intervals: (i) at substantial completion of construction; (ii) at the end of the defects liability period; and (iii) at five-yearly intervals during the operational phase, or following any significant climate event affecting the alignment. Each review assesses implementation of the adaptation measures set out in Section 5.2, benchmarks performance against the monitoring indicators in Section 7.1, and considers whether observed climate trends or infrastructure performance warrant revision of risk ratings or adaptation measures. Review findings are reported to lenders in the subsequent semi-annual E&S monitoring report.

H. Recommendations and Next Steps

H.1. Priority Recommendations

i. Immediate Actions and Remaining Works

- Conduct targeted climate resilience review and verification activities for remaining works and operational planning, focusing on high-risk flood, landslide, and heat exposure areas.
- Review hydraulic protection and drainage measures for key bridge, culvert, and embankment sections considering projected climate conditions.
- Consider heat resilience measures within rail maintenance and operational management procedures.

ii. Construction Phase

- Implement maintenances protocols for all construction workers, including mandatory rest periods, hydration provisions, and work rescheduling during peak heat hours.
- Install slope stabilisation measures where required, embankment sections adjacent to the Shardara Reservoir and flood-prone watercourses.
- Consider flood monitoring and warning measures at the Syr Darya crossing and key culverts, linked to site emergency response procedures.
- Establish a construction-phase water management plan to minimise consumptive use and avoid conflict with local agricultural water users in the water-stressed Syr Darya Basin.

iii. Operational Phase

- Designate a Climate Resilience Focal Point within KTZ Operations to oversee monitoring, maintenance scheduling, and hazard emergency response.
- Conduct annual embankment and drainage inspections, prioritising sections adjacent to watercourses and the reservoir.
- Develop and exercise flood and extreme heat emergency response plans on an annual basis.
- Periodically review climate resilience performance against the monitoring framework, benchmarking performance against Section 7 M&E indicators and updating adaptation measures based on observed climate trends.

H.2. Further Work Required

Additional technical studies and assessments are recommended to strengthen long-term climate resilience planning for the project:

- Detailed hydrological and hydraulic modelling for the Syr Darya River crossing and the Shardara Reservoir interface under future climate scenarios.
- A biodiversity–climate interaction assessment examining how projected reductions in reservoir inundation may affect IBA/KBA values and Critical Habitat conditions.
- An occupational health climate risk assessment to quantify worker heat exposure and inform heat stress management procedures.
- Development of a greenhouse gas accounting and climate finance alignment strategy, including assessment of potential climate finance opportunities and alignment with Kazakhstan's NDC commitments.

KTZ's climate targets, internal carbon pricing approach, and projected emissions trajectory are outlined in the Company's IFRS S2 Climate Reporting and Low-carbon Development Concept to 2060. Given that the Darbaza–Maktaaral railway will operate using diesel traction, the project-level GHG accounting strategy should assess the railway's contribution to KTZ's emissions profile and identify pathways for alignment with the Company's long-term decarbonisation objectives and relevant NGFS climate scenarios.

Vista
Environment

Vista Environment

Annex F – Draft Critical Habitat Assessment

Executive Summary

This report presents the Critical Habitat Assessment (CHA) for the Darbaza–Maktaaral Railway Expansion Project in southern Kazakhstan. Critical Habitat (CH) is defined as areas of particularly high biodiversity value, including those supporting threatened species or significant ecological processes, and which therefore require enhanced protection and strict impact management.

This CHA has been undertaken in accordance with the ADB Safeguard Policy Statement (SPS) as the primary standard, supplemented by the quantitative thresholds and guidance of IFC Performance Standard 6 (PS6), and aligned with the AIIB Environmental and Social Framework (ESF). This integrated approach reflects Good International Practice and ensures consistency across all lenders.

The assessment concludes that the Project is within Critical Habitat, specifically associated with the Syr Darya River and Shardara Reservoir. The following Criteria and species trigger CH:

Criterion 1: Critically Endangered and Endangered Specie

- Syr-Darya shovelnose sturgeon (CR – possibly extinct)
- Dalmatian pelican (NT globally; nationally listed)

Criterion 2: Endemic and Restricted-Range Species

- Syr-Darya shovelnose sturgeon

Criterion 3: Migratory and Congregatory Species

- Dalmatian pelican - wintering colony
- Pygmy cormorant – breeding colony

No CH is triggered under Criteria 4 (evolutionary processes), 5 (ecosystems), or 6 (social/cultural importance).

As CH is present, the Project must demonstrate net gain in biodiversity values through the development implementation of a Biodiversity Action Plan (BAP), including mitigation, long-term management, and likely biodiversity offsets, to ensure compliance with lender requirements and achieve NG.

Introduction

Kazakhstan Temir Zholy Joint Stock Company (KTZ) is developing the Darbaza-Maktaaral Railway Expansion (the "Project"), a greenfield railway infrastructure project in southern Kazakhstan. The Project is being considered for financing by the Asian Development Bank (ADB), together with co-financiers the International Finance Corporation (IFC) and the Asian Infrastructure Investment Bank (AIIB), collectively referred to as the "Lenders".

This Critical Habitat Assessment (CHA) has been prepared on behalf of KTZ to support the Project's compliance with the requirements of the Lenders. Critical Habitat is defined as habitat that holds particularly high biodiversity value and warrants particular attention and protection. It may include areas supporting rare or threatened species, ecosystems of high conservation significance, and areas where biodiversity is of particular importance to local communities. Importantly, the presence of Critical Habitat is determined solely by the biodiversity values present, not by the degree of human modification or the nature of any planned project activities and associated impacts.

The primary governing standard for this CHA is ADB's Safeguard Policy Statement (SPS), the objective of which is "to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process." The SPS requires that a CHA be undertaken where a project may affect ecological features that could trigger Critical Habitat (CH).

The assessment has been conducted to also align with the (IFC Performance Standard 6 (PS6) on Biodiversity Conservation and Sustainable Management of Living Natural Resources, and the AIIB Environmental and Social Framework (ESF). The methodology adopted ensures full compliance with the SPS as the primary standard whilst integrating the quantitative thresholds and additional criteria provided under IFC PS6, an approach consistent with Good International Practice (GIP) and accepted by all three Lenders. Further detail on this integrated methodological approach is set out in Section 3.

The reason for determining whether Critical Habitat is present is that the SPS requires that projects located within or affecting CH can only proceed where:

- there are no measurable adverse impacts on the critical habitat that could impair its ability to function;

- there is no reduction in the population of any recognised endangered or critically endangered species; and
- any lesser impacts are mitigated.

The purpose of this report is therefore to identify any ecological features that may trigger Critical Habitat.
Section 2 of this report provides the Project and biodiversity context, Section 3 describes the standards and guidance used to inform the assessment and the associated assessment methodology; Section 4 presents the Critical Habitat Assessment itself and Section 5 summarises the key findings. The appendices present the details from which this assessment has been derived and additional information, where relevant.

Project and Biodiversity Context

The Darbaza-Maktaaral Railway Expansion (the "Project") is a greenfield national railway infrastructure project being developed by KTZ in southern Kazakhstan. The Project comprises approximately 159 km of new single-track railway, including a 100 m protection zone on each side of the alignment, together with the reconstruction and extension of three stations, depots, maintenance and servicing facilities, workers' accommodation, and associated supporting infrastructure. The scheme also includes 17 bridges, 19 overpasses, 18 cattle crossings, 117 drainage culverts, power substations, overhead power lines, borrow pits, and access roads. Freight will be hauled by diesel locomotives, with an operational maximum of 22 trains per 24-hour period.
The Project is designed to address a bottleneck at the existing railway connection between Kazakhstan and Uzbekistan, which is currently operating at capacity, and to support growing freight flows across Central Asia. At the time of this assessment, construction of the railway was underway with more than 75% of the earth works completed. A map of the Project components is provided in Figure 65.
The Project is located in one of the most densely populated and agriculturally productive regions of southern Kazakhstan, a semi-arid landscape fed by the Syr Darya, Keles, and Arys rivers. The Syr Darya river is the dominant watercourse of the region, sourced from snowmelt in the Tian Shan mountains, with flows that vary considerably annually. It flows into and feeds the Shardara Reservoir (also referred to as Chardara Reservoir). The wider landscape is characterised by an intensively modified former steppe, where natural habitats have been largely converted to arable cultivation, irrigated horticulture, and livestock grazing. The region sits at the crossroads of the Afro-Eurasian and Central Asian bird migratory flyways, giving it particular ornithological significance despite the heavily modified nature of much of the land.

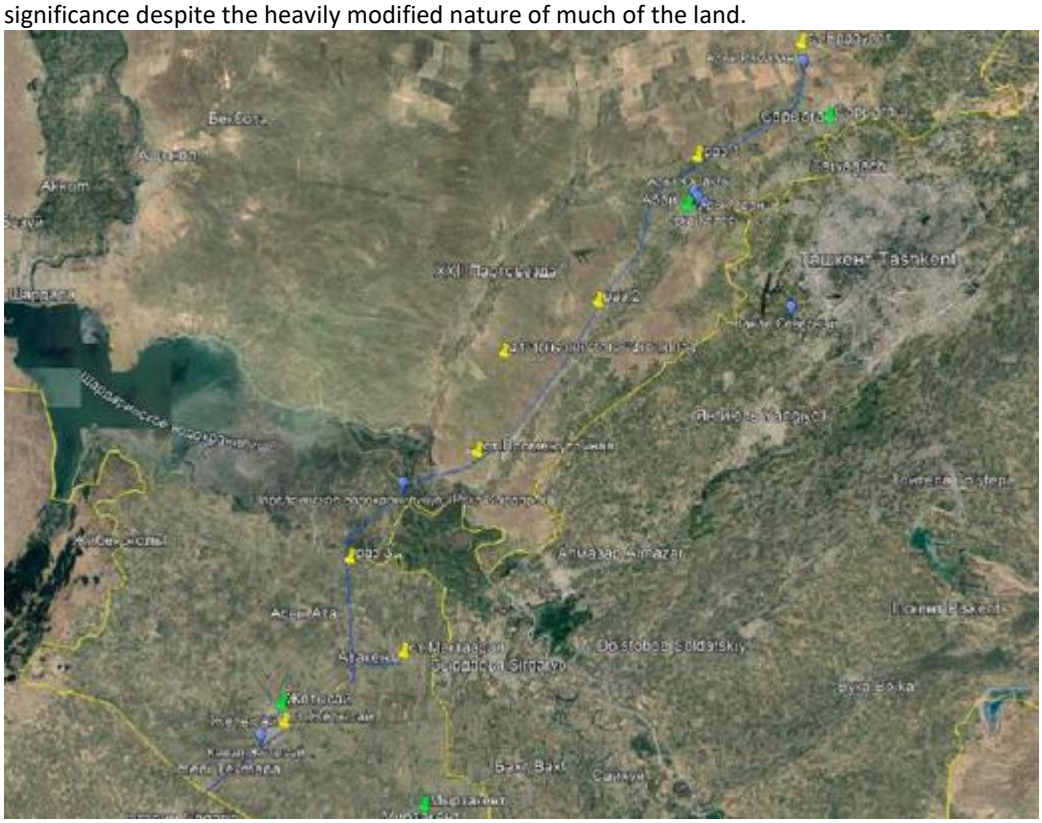


Figure 65: Indicative alignment of the proposed project
For the majority of the project's length, approximately the northern 80% of the alignment, the Project passes through a heavily modified landscape comrpising a mosaic of intensive arable and horticultural cultivation,

irrigated fields, dry degraded steppe, and scattered settlements. The terrain is generally flat to gently undulating. Scattered waterbodies and small rivers are present along the route, some supporting limited numbers of waterbirds, and areas of tamarisk-dominated scrub occur in wetter ground, providing habitat for a range of widespread and common species. Whilst the habitat along this northern section can support a range of wildlife, it is largely disturbed and is unlikely to be sufficiently diverse to support very rare species or populations in numbers that would trigger Critical Habitat thresholds.

The southern section of the Project alignment crosses the eastern end of the Shardara Reservoir and its associated wetland habitats, which represents the only likely area along the route with the potential for Critical Habitat. The reservoir is a large waterbody created in 1967 through the damming of the Syr Darya River at Chardara, constructed primarily to provide irrigation water and hydropower. The reservoir is approximately 80 km long and up to 25 km wide, covering an area of approximately 783 km², with water levels fluctuating by up to 11 metres between the wet period, October March, and drier period, April to September (Timirkhanov et al., 2010). The reservoir and its associated habitats cover 960 km² and are recognoised as an Important Bird Area (IBA) and Key Biodiversity Area (KBA). The railway crosses Shardara reservoir on a new c.17 km long embankment with bridges, including the 1km long bridge that spans the Syr Darya River.

The land north and south of the reservoir is predominantly agricultural and grassland, with livestock grazing on higher ground to the north-east and croplands and settlements in the lower-lying areas to the south-west. Large reedbeds occur along the north-eastern and south-eastern shorelines, with the south-western reedbed, located adjacent to an existing highway, identified during surveys as supporting substantial colonies of breeding bird. The eastern end of the reservoir, where the Project crosses, forms a complex mosaic of seasonally flooded land, pools and grazing areas, crossed by existing roads and power lines, and forms the border with Uzbekistan. The reservoir provides important habitat for migratory and wintering waterbirds lying at the intersection of two major flyways. A map of the study area is provided in Figure 65.

Standards & Methods

Assessment Standards

The Critical Habitat Assessment for the Darbaza-Maktaaral Railway Expansion Project has been prepared in accordance with the ADB Safeguard Policy Statement (SPS) as the primary governing standard, with the assessment framework and quantitative thresholds drawn from the International Finance Corporation's Performance Standard 6 (PS6) and its accompanying Guidance Note 6 (GN6). The AIIB Environmental and Social Framework (ESF) is also applicable; however, the AIIB does not prescribe a standalone biodiversity assessment methodology and instead accepts compliance with the standards of co-financing lenders. This integrated approach is consistent with Good International Practice and is accepted as compliant by all three Lenders.

The ADB SPS defines the overarching Critical Habitat requirements but it does not provide detailed quantitative thresholds for determining when those conditions are triggered. IFC PS6, by contrast, provides well-established and widely applied numerical thresholds and detailed criterion-level guidance that are recognised internationally as best practice. Applying PS6 thresholds to supplement the SPS-based assessment is standard practice on multi-financer projects of this kind.

The requirements of the ADB, IFC and AIIB are aligned in that, where CH is identified, projects must demonstrate net gain (NG) in the relevant biodiversity values. This is usually achieved through the preparation and implementation of a Biodiversity Action Plan (BAP), which sets out targeted enhancement or compensation measures. As such, the determination of Critical Habitat is a key step in establishing whether a BAP is required.

Critical Habitat Criteria

The Critical Habitat criteria defined under ADB SPS and IFC PS6 are broadly aligned but not identical, and a direct criterion-by-criterion comparison reveals two differences requiring careful management. First, ADB SPS includes a discrete criterion (SPS criterion 6) relating to biodiversity of significant social, cultural, or economic importance to local communities, for which there is no direct IFC PS6 equivalent. Secondly, PS6 includes a criterion (PS6 criterion 5) for highly threatened and/or unique ecosystems that has no standalone equivalent in ADB SPS (although it is partially captured in ADB SPS criterion 4 relating to unique assemblages of species and key evolutionary processes.

To address these differences and ensure full compliance with both standards, the criteria have been restructured for the purposes of this CHA, as set out in Table 126 below. Criteria 1 to 3 are substantively equivalent across both standards and require no modification. Criterion 4 presents a blended evolutionary processes and ecosystem services criterion consistent with both standards, adopting the broader ADB SPS framing. Criterion 5 makes the IFC PS6 unique ecosystems criterion explicit as a supplementary assessment, and Criterion 6 applies the additional ADB SPS social, cultural, and economic importance criterion. This structure ensures full compliance with ADB SPS as the primary standard whilst demonstrably incorporating all IFC PS6 criteria within the assessment framework.

Table 126: The Critical Habitat criterion adopted as part of this CHA and how they have adopted relevant criterion from both ADB's SPS and IFC's PS6.

Ref	Adopted Criterion	ADB SPS Development	IFC PS6 Requirement	Commentary
1	Critically Endangered & Endangered Species	Habitat required for the survival of critically endangered or endangered species	Habitat of significant importance to Critically Endangered (CR) and/or Endangered (EN) species	Substantively equivalent across both standards. No change for this criterion
2	Endemic & Restricted-Range Species	Areas with special significance for endemic or restricted-range species	Habitat of significant importance to endemic and/or restricted-range species	Substantively equivalent across both standards. No change for this criterion
3	Migratory & Congregatory Species	Sites that are critical for the survival of migratory species and areas supporting globally significant concentrations or numbers of individuals of congregatory species	Habitat supporting globally significant concentrations of migratory and/or congregatory species	Both standards address migratory and congregatory species. ADB SPS originally separates these; the IFC PS6 approach of merging them into a single criterion has been adopted here
4	Key Evolutionary Processes & Ecosystem Services	Areas with unique assemblages of species that are associated with key evolutionary processes	Areas associated with key evolutionary processes	Both standards address evolutionary processes. This assessment adopts the broader ADB SPS framing, which also includes key ecosystem

		or provide key ecosystem services		services and unique species assemblages
5	Highly Threatened & Unique Ecosystems	No direct equivalent	Highly threatened and/or unique ecosystems	IFC PS6 includes this as a discrete criterion with no direct standalone equivalent in ADB SPS. Assessed here to ensure full PS6 compliance
6	Biodiversity of Social, Cultural & Economic Importance	Areas with biodiversity that has significant social, cultural, or economic importance to local communities	No direct equivalent	This criterion is unique to ADB SPS

To facilitate decision-making, IFC GN6 provides indicative numerical thresholds for Criteria 1 to 4, derived from the globally standardised thresholds published in the IUCN's *A Global Standard for the Identification of Key Biodiversity Areas* and the Red List Categories and Criteria. These thresholds guide the assessment rather than an automatic formula, and the involvement of external experts and project-specific assessments remains essential, particularly where data are limited (GN56). Criterion 5 has no numerical threshold, and its assessment relies on the best available scientific information and expert opinion (GN57). Criterion 6 similarly relies on expert opinion and stakeholder engagement. The specific thresholds applied under each criterion are set out in the assessment in Section 4.

Data Collection and Assessment

The CHA was completed using a combination of stakeholder consultation, literature review, and field data. Consultation was undertaken with conservation organisations, government authorities, academic and scientific institutions, and recognised species specialists (see Table 127 below). Desktop review drew on international and national databases and literature including IBAT, the IUCN Red List, the Kazakhstan Red Data Book, CMS listings, and relevant scientific publications. Field data collected as part of the Project ESIA were reviewed and, where gaps were identified, supplemented by targeted surveys undertaken by qualified specialists during 2026. Together, this evidence was assessed against the Critical Habitat criteria and applicable numerical thresholds to determine whether the Project is situated within, or has the potential to affect, Critical Habitat.

Table 127: The Stakeholders consulted or approach as part of the Project ESIA and Critical Habitat Assessment process.

Ref	Organisation / Expert	Type	Date	Purpose
1	Shardara Reservoir Management Authority	Email correspondence and formal letter request - no response	February/March 2026	Reservoir operations; water levels; hydrology; aquatic habitat

2	Aral–Syrdarya Basin Inspection (Committee for Water Resources)	Email correspondence and formal letter request - no response	February/March 2026	Water management; basin ecology; fisheries regulation
3	Committee of Forestry and Wildlife (Ministry of Ecology and Natural Resources)	Email and meeting correspondence with Mr Musaliev - Regional Head	March 2026	Protected areas; wildlife regulation; habitat oversight
4	Kazakhstan Fisheries Research and Production Center (KazNIIRKh)	Email correspondence and formal letter request - no response	February/March 2026	Fisheries; aquatic ecology; reservoir fish populations and Sturgeon
5	RSE Kazhydromet	Email correspondence and formal letter request - no response	February/March 2026	Hydrology; water levels; climate and meteorological data
6	Institute of Geography and Water Security	Email correspondence and formal letter request - no response	February/March 2026	Hydrology; water balance; climate–water interactions
7	Al-Farabi Kazakh National University – Department of Zoology	Email correspondence - no response	February/March 2026	Herpetology -desert reptiles
8	Auezov South Kazakhstan University – Ecology Department	Email correspondence - no response	February/March 2026	Regional reptile knowledge
9	Ministry of Water Resources and Irrigation	Email correspondence and formal letter request - no response	March 2026	Water governance; basin management
10	ACBK	Email, meetings, site surveys and sharing of data	2025 and 2026 ongoing	Biodiversity data, particularly birds
11	Victoria Kovshar – professional ornithologist	Email and meeting correspondence and sharing of data.	2025 and 2026 ongoing	Bird data
12	Eurasian Regional Association of Zoos and Aquariums	Email and meeting correspondence and sharing of data.	March 2026	Syr Dara Shovelnose sturgeon

13	Tennessee Aquarium Conservation Institute (Bernie Kuhajda)	Email and meeting correspondence and sharing of data.	March and April 2026	Syr Dara Shovelnose sturgeon

It is noted that the Kazakhstan Red Databook historically used a five-category classification system (Disappearing, Rare, Reducing in Numbers, Little-Studied, and Restored) that was not directly aligned with the IUCN categories. As such, species listed in the Red Databook cannot automatically be assumed to be relevant to the Criterion 1(iii) assessment, which requires national Databooks to have adhered to IUCN guidance. However, recent updates to the Kazak Red Databook indicate a move towards alignment with IUCN criteria, this transition has not yet been completed for all taxonomic groups but many have been updated. Accordingly, all species recorded in the project area that are listed in the Kazakhstan Red Databook have been cross-referenced against the global IUCN Red List, and where discrepancies or uncertainties exist, a precautionary approach has been applied.

A key concept within the CH assessment is the Ecologically Appropriate Area of Analysis (EAAA). The EAAA is a spatial boundary within which a specific species may regularly occur relevant to the project landscape being assessed. It is therefore the area within which each species is evaluated against the relevant Critical Habitat criteria and thresholds. Rather than applying a fixed buffer distance, an EAAA is defined individually for those species considered likely to meet, or where it remains unclear whether they meet, the Critical Habitat thresholds and where more careful assessment is therefore required. Each EAAA is shaped by the ecological characteristics of the species in question, including its range, habitat requirements, movement patterns, and sensitivity to disturbance. Further details are provided in Section 4 and all EAAA's are presented in Appendix A.

Critical Habitat Assessment

Biodiversity Data

The data collation completed during the project ESIA and Critical Habitat Assessment confirmed the presence of two legally protected areas and three Key Biodiversity Area (KBA) within 50 km of the project. It also confirmed the presence or likely presence of 493 terrestrial and freshwater species within 50 km of the project. Of these species, 2 were listed as Critically Endangered, 8 as Endangered, and 15 as Vulnerable, see Table 128. Of the 493 species, 14 were Data Deficient and all have been included.

The two protected areas were Aydar-Arnasay Lakes system 40 km southwest of the project's southern-most point and the Sayram-Ugam State National Nature Park 50 km north-west of the project's northern-most point. The KBAs comprise the Sharara Reservoir, through which the project directly passes, the Balykchi Fish Farm, which is 50 km

west of the project in Kyrgyzstan and the Arnasay Lake System, as already referenced as it is both a protected area and a KBA.

Table 128: Terrestrial and freshwater species potentially present within 50 km of the project area

Group	Critically Endangered	Endangered	Vulnerable	Near Threatened, Least Concern, Data Deficient[30]	Total
Mammals	0	0	3	51	54
Birds	1	7	10	259	277
Reptiles	0	0	0	33	33
Amphibians	0	0	0	1	1
Invertebrates	0	0	1	42	43
Fish	1	1	0	21	23
Plants	0	0	1	60	61
Fungi	0	0	0	1	1
Total	**2**	**8**	**15**	**468**	**493**

Criterion 1: Critically Endangered & Endangered Species

Criterion 1 seeks to confirm if the project is within habitat that is integral to the survival of Critically Endangered (CR) and Endangered (EN) species, as listed on the IUCN's Red List of Threatened Species or the National Khazakshan Reddata Book list of threatened species. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction. It also gives due regard for habitat that is important to the conservation status of Vulnerable species. This assessment has adopted the IFC PS6 thresholds for determining critical habitat under criterion 1:

> Areas that support globally-important concentrations of a globally EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species);
>
> Areas that support globally-important concentrations of a globally Vulnerable (VU) species, the loss of which would result in the change of its status to EN or CR and meet the thresholds in 1 (i); or
>
> As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species, where national/regional assessments have adhered to IUCN guidance.

[30] Includes one species of fish that had to been assessed by IUCN

Research identified 2 globally Critically Endangered species, 8 Endangered species and 15 Vulnerable species that occur or are likely to occur within 50 km of the project. The Critically Endangered species comprised the Syr-Darya shovelnose Sturgeon *Pseudoscaphirhynchus Fedtschenkoi* and the sociable lapwing *Vanellus gregarius*. Details of all the species is provided in Appendices - Appendix B for Criterion 1 (a), Appendix C for Criterion 1 (b) and Appendix D for Criterion 1 (c). All 25 species were assessed against the three different thresholds for Criterion 1. The spatial EAAA used to determine the relevance of Criterion 1 are presented in Appendix A.

Two species meet the thresholds for Criterion 1. The Syr-Darya shovelnose Sturgeon and meets both Criterion 1(a) and Criterion 1(c) and the Dalmatian pelican meets the thresholds for Criterion 1(c).

The Syr-Darya shovelnose Sturgeon is assessed as CR (Possibly Extinct) on the IUCN Red List (2022) and is endemic to the Syr Darya River system. It is additionally listed as a Category I species, a very rare endemic relict on the brink of extinction, in the Kazakhstan Red Databook. The Red Databook further notes that it as the only representative of its genus in the Syr Darya basin and the rarest fish species in Kazakhstan. No quantitative global population estimate exists, and confirmed records have been absent for decades, with the most recent reliable sightings reported in the vicinity of the project area in 2017–2019 during targeted field surveys by the Tennessee Aquarium, the Eurasian Regional Association of Zoos and the Kazakh Fisheries Research and Production Centre. Suitable gravel-bed spawning habitat consistent with the species' reproductive requirements has been identified on the Keles River, a Syr Darya tributary located within approximately 50 km of the project area, in a fragmented inter-dam reach where any surviving population would likely be confined. While the ≥5 reproductive unit sub-threshold cannot be confirmed from available data, the species' single-river endemism and near-zero global population means that any reach within the Syr Darya system where individuals persist would, by definition, constitute a globally and nationally significant concentration. Applying the precautionary approach whereby absence of evidence cannot be treated as evidence of absence, the species is assumed present and therefore meets the thresholds under both Criterion 1(a) and Criterion 1(c). The Syr Darya River across which the project passes is Critical Habitat.

The Dalmatian Pelican is Near Threatened (NT) on the IUCN Red List, with a global population estimated at 11,400–13,400 individuals but it is listed as Rare in the Kazakhstan national Red Databook, with a national breeding population of approximately 2,000 pairs. The Shardara Reservoir is cited as being a nationally significant wintering site. Two decades of surveys by the Association for the Conservation of Biodiversity of Kazakhstan (ACBK) recorded wintering aggregations between 2003 and 2025 averaging 238–254 birds and peaking at 700 individuals in 2004, and with counts of 400 to 500 birds recorded during subsequent winters. The February 2025 project field survey recorded 88 Dalmatian Pelicans along the 15 km transect intersecting the proposed railway alignment within the eastern corner of the reservoir. The consistency of aggregations across two decades with varying weather and hydrological conditions confirms functional reliance on the site. On this basis, the Reservoir meets the threshold under Criterion 1(c) and is Critical Habitat.

Taken together the Syr Darya River and Shardara Reservoir qualify as Critical Habitat for Syr-Darya shovelnose Sturgeon and Dalmatian pelican. The EAAA maps for the species are presented in Appendix A and further supporting data and references are provided in Appendices B, C and D.

Criterion 2: Endemic & Restricted-Range Species

Criterion 2 seeks to confirm if the project is within habitat that is integral to the survival of geographically restricted species. Areas will meet the threshold for this Criterion if they regularly hold ≥ 10% of the global population size of a geographically restricted species and ≥ 10 reproductive units. The IFC PS6 GN provides the following guidance for different habitat types:

> For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an Extent of Occurrence (EOO) less than 50,000 square kilometres (km2).
>
> For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km2.
>
> For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart).

Research identified three known terrestrial and freshwater restricted-range species that occur or may occur within 50 km of the project, the Syr-Darya shovelnose Sturgeon, the Aral barbel *Luciobarbus brachycephalusm* and the plant *Salvia korolkowii.* The Syr-Darya shovelnose Sturgeon has been assessed as meeting the Criterion 2 thresholds, the other two species do not. The assessments are provided Appendix E.

The historical linear range of the Syr-Darya shovelnose Sturgeon in the Syr Darya river was probably greater than 2,000 km, technically exceeding the 500 km restricted-range threshold under Criterion 2. However, this distance reflects the original full river catchment rather than the current likely extent of river or functionally connected river that maybe occupied by the species. Extensive damming along the Syr Daraya has created impermeable and near-impermeable barriers along the river's length. If the species persists at all, it almost certainly does so in one or a very small number of isolated inter-dam river segments, with actual connectivity between any surviving locations effectively zero. Consultation with the research team that undertook the 2019 and 2025 expedition's confirmed that, if the species is still alive, '*an extremely small population…may still survive at least in the stretch of the Syr Darya from the confluence of the Angren River (also known as Akhangaran and Akhandjaran) down to the town of Yangi Chinaz in Uzbekistan, and further from the Uzbekistan–Kazakhstan border to the Shardara Reservoir, including the reservoir itself'.* The later referenced stretch of river is less than 500 km linear geographic span and can therefore be interpretated as being relevant to Criterion 2. For the same reasons set out under Criterion 1(a) and 1(c) therefore, any location where the species persists would by definition hold an extremely high proportion of the near-zero global

population, and the ≥10 reproductive unit threshold is considered plausible wherever suitable spawning habitat exists. Applying the precautionary approach required under ESS6, Criterion 2 is met.

The Syr Darya River and the connected Shardara Reservoir therefore qualify as Critical Habitat for Syr-Darya shovelnose Sturgeon under Criterion 2.

Criterion 3: Migratory & Congregatory Species

Criterion 3 identifies areas critical to migratory and congregatory species at any point in their life cycle. The IFC thresholds were adopted:

> *(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥1% of the global population of a migratory or congregatory species at any point of that species' lifecycle; or*
> *(b) Areas that predictably support ≥10% of the global population of a species during periods of environmental stress.*

As part of this assessment, it is important to recognise that migratory and congregatory species in the project landscape are not restricted to birds and may also include mammals and fish. For birds, the relevant congregatory assemblages are most likely to include spring and autumn passage migrants using the reservoir and surrounding wetlands as a stopover site, breeding bird colonies during the spring and summer, and wintering assemblages particularly for waterfowl. Each of these categories have been assessed, as have each constituent species. The EAAA used for the bird assessment (species and assemblages) is the Shardara Reservoir in its entirety (Appendix A), reflecting the functional ecological area within which congregatory and migratory populations are most likely to use the landscape, especially as water levels vary within year and between years. Characterising migratory and congregatory assemblages of an area some 1000 km^2 in extent and that is relative remote presents genuine methodological and assessment challenges, especially if data is intermittent or not available. In this case, the available data and assessment is, however, broadly sufficient given the availability of more than 20 years of bird survey counts, predominantly collected by the ACBK. The data covers the entirety of the reservoir and surrounding wetland. Annual surveys started in 2003 and 2004 and continued during most of the subsequent years. This historic data was supplemented by project specific surveys within the AoI (i.e. along the embankment alignment) during February, May and July 2025 and January, February, March and April 2026.

Wintering Birds and Dalmatian Pelican

The Shardara Reservoir is recognised as one of the most important wintering sites for waterbirds in the Central Asian region. Its significance at whole-reservoir scale is well documented with the ACBK long-term dataset. Mid-winter bird counts of around 150,000 have been recorded, with dominant species comprising Mallard *Anas platyrhynchos*, Gadwall *Mareca strepera*, Common Pochard *Aythya ferina*, Tufted Duck *Aythya fuligula*, Greylag Goose *Anser anser*, and Eurasian Coot *Fulica atra*, each in their thousands.

In accordance with the Criterion 1 and 2 assessments, the dalmatian pelican is of particular importance during the winter months. Global population estimates are between 11,400 and 13,400 and when using the precautionary lower estimate of 11,400, the population needed to meet the 1% threshold would be 114 individuals. During the February 2025 survey, 88 Dalmatian Pelicans were recorded within the project AoI and XX during the 2026 survey. Taken in isolation, this AoI-level count falls below the 1% threshold (representing approximately 0.66 to 0.77% of the global population) and would not alone trigger Critical Habitat. However, in acknowledgement that this species is not limited to the wetland habitat along the reservoirs eastern end and will use open water, and thus when assessed at the appropriate EAAA scale, the whole Shardara Reservoir, the ACBK long-term dataset records historical winter peaks of 444 to 500 birds for the full reservoir. This equates to approximately 3.9 to 4.4% of the global population, substantially exceeding the 1% threshold under Criterion 3(a). The species is migratory and winters at the reservoir on a regular and cyclical basis. On the basis of this evidence, **the Shardara Reservoir qualifies as Critical Habitat under Criterion 3(a) for Dalmatian Pelican**.

It is important to note that the Shardara Reservoir's IBA was originally designated for numerous wintering bird species, including the dalmatian pelican. It would therefore be reasonable to assume that other species would also meet the Criterion 3 thresholds. The reality is; however, not simple and further review is required.

The IBA was initially assessed using BirdLife International's 'A4i criterion', which qualifies a site where counts regularly meet or exceed 1% of a biogeographic population, which is much smaller than the global population requirements of ADB SPS and IFC PS6. Consequently, a species may qualify a site as an IBA under A4i whilst simultaneously failing to reach the 1% global population threshold required for Critical Habitat. Further, the updated KBA assessment (KBA Partnership 2026) only cites three trigger specie, the dalmatian pelican, greylag goose and smew, compared with the eight species in the original IBA designation, reflecting the observed declines in species populations.

Using the long-term ACBK dataset and the BirdLife datazone count records none of the other original IBA qualifying species currently meets, or is close to meeting, the 1% global population threshold under Criterion 3(a). Greylag Goose *Anser anser* provides a good example. Hunter-reported counts and the ACBK data indicate peak winter totals of between 18,000 to 30,000 in the early 2000s, which may have approached 1–3% of the global population at that time. However, the extreme cold winter of 2011 caused mass starvation at the reservoir, and Chalikova (2024) confirms that numbers have never fully recovered. The ACBK data indicating that the counts since 2011 have remained well below the 1% global threshold. Of note common teal *Anas crecca* met the 1% global criterion in both 2003 and 2013, but no other years, and numbers have subsequently continued to decline. Tufted Duck *Aythya fuligula* came closest to qualifying in 2004, when a peak count represented approximately 0.9% of the global population, but numbers have declined substantially since and the 2025 survey recorded only 35 individuals in the Priject's AoI. Smew *Mergellus albellus* and Goosander *Mergus merganser* did not reach the 1% global population threshold even at their respective peak ACBK counts (350 and 2,932 individuals), and both have shown marked declines in the most recent years, with zero Smew recorded during the 2025 survey. In summary, whilst these species

remain important components of the wider wintering waterbird assemblage, none triggers Criterion 3 Critical Habitat in their own right. Further survey data is available in the ESIA Appendices.

Spring & Autumn Bird Migration

The Shardara Reservoir is within the Central Asian Flyway (CAF), a major bird migratory corridor that includes more than 30 countries. It includes breeding grounds in western Siberia and the Russian Arctic, through Central Asia, to wintering areas in South Asia and the Persian Gulf. Although unlikely, it is acknowledged that the project area is close to the edge of the West Asian/East African Flyway (WAEF). The WAEF overlaps with the CAF in western Uzbekistan and southern Kazakhstan but follows a more westerly route toward the Arabian Peninsula and eastern Africa. Some species or assemblages are present in both flyways and could use the boundary of the two corridors, particularly in times of environmental stress or inclement weather, see Figure 66 for a high-level schematic of two flyways.

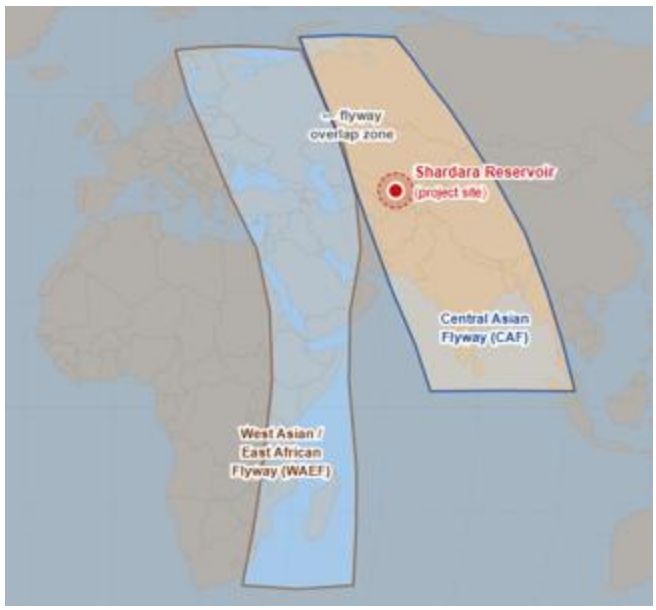


Figure 66: The approximate area of the Central Asian Flyway in comparison to the project area and the West Asian/East African Flyway.

Together, both corridors support several hundred migratory bird species, many of them threatened or in long-term decline. Surveys conducted in 2025 and 2026 confirm that project area (i.e. the wetlands immediately around the project) is an important multi-species stopover site during the spring migration, with a peak count of 77 species recorded, with multiple species often recorded in the hundreds or thousands. Observations included active passage of waterbirds, waders, and passerines, illustrating the project aera's importance in providing resting and feeding habitat. Details of the species and their abundances are available in the ESIA project Appendices.

Surveys in June and July 2025 recorded notable concentrations of migratory waders, particularly Black-tailed Godwit *Limosa limosa*, with counts reaching up to 1,640 individuals. Whilst this represents large and meaningful concentrations, it equates to between 0.2 to 0.3% of the global population, and therefore below the 1% threshold required under Criterion 3(a). It is acknowledged that these estimates are for the eastern end of the reservoir and

not the entirety of the IBA. Realistically therefore the numbers in the whole EAAA may be higher but given that the majority of the suitable habitat for this species is within the project AoI, it is very unlikely that total estimates for the entire reservoir would reach 1% (i.e. much of the reservoir comprises open water which is not suitable for Godwit). No other passage species recorded during spring or autumn surveys within the reservoir EAAA approaches the 1% threshold.

Therefore, although the reservoir and associated habitat is unquestionably an ecologically functioning and important stopover site for migratory species, it forms one component of a network of such habitats distributed across the flyway, and the bird species and assemblages recorded do not meet the Critical Habitat thresholds. Critical Habitat is therefore not triggered under Criterion 3 for migratory passage assemblages.

Breeding Bird Aggregations

Criterion 3 applies to congregatory species at any life stage, and breeding aggregations therefore require assessment. The most significant breeding colony identified in the wider project landscape is a mixed heronry and cormorant colony recorded in June 2025 in the reedbeds at the southern end of the project alignment, within the reservoir approximately 1 km north of the village of Azattyk (Figure 67 and Figure 68). The following species were observed nesting together is significant numbers: pygmy cormorant *Microcarbo pygmaeus*, great egret *Ardea alba*, little egret *Egretta garzetta*, grey heron *Ardea cinerea*, purple heron *Ardea purpurea*, spoonbill *Platalea leucorodia*, glossy ibis *Plegadis falcinellus*, squacco heron *Ardeola ralloides*, and cattle egret *Bubulcus ibis*. The most commonly recorded birds were pygmy cormorants with about 1,500 pairs, the glossy ibis with about 1,000 pairs, and little egrets with 300 to 400 pairs, while other species were present in smaller numbers. It is noted that these estimates were derived from drone footage subsequently assessed by professional ornithologists and compared with similar data from 25 years of aerial imagery from the Northern Caspian. The data is from one year only and population counts are extrapolated estimates only, but the comparative data is robust and the methodologies sound. The colony is therefore very large and of considerable regional significance.

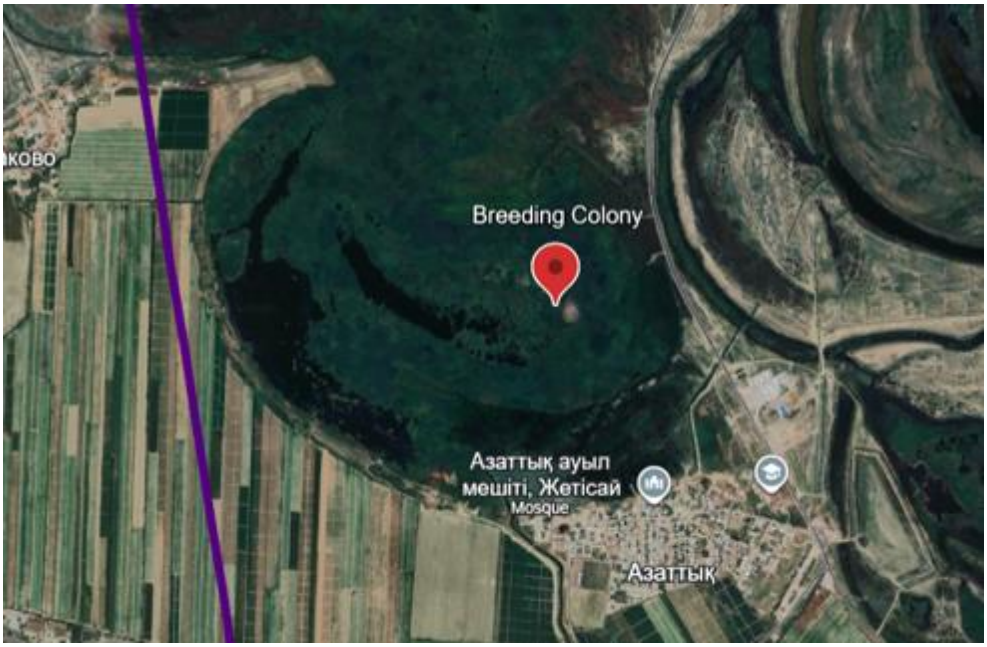


Figure 67: The location of the breeding bird colon at the southern end of the project alignment (show in purple to the east) at in the south-eastern corner of the reservoir, near the village of Azattyk, approximately 1 km to the south.



Figure 68: Ariel imagery of one of the breeding bird colonies in the reedbeds. Egrets can be seen on the left of the photo. This colony is one of several in the area and measures 100 m by 65 m in size. Photo taken from drone footage during project surveys in 2025.

The global pygmy cormorant population is estimated to be between 87,300 to 113,000 (IUCN) meaning the 1,500 breeding pairs recorded would be equal to between 2.6% to 3.4%. It is fully acknowledged that the population estimates were taken from a single day in June 2025 and extrapolated using comparative data but even if the estimates had an error range of 50% the local population of pygmy cormorants would still exceed the 1% threshold

for Criterion 3. The global population of ibis is between 119,000 and 860,000 meaning the breeding population would be equal to 0.1% to 0.8%. The little egret global population is between 430,000 and 2,100,000 meaning the breeding population would be well below 0.2%. On the basis of this evidence, the **Shardara Reservoir qualifies as Critical Habitat under Criterion 3(a) for the** pygmy cormorant.

Non-Avian Migratory and Congregatory Species

With regards to mammals and fish, no species recorded within the project area or EAAA meets Criterion 3 thresholds. Saiga Antelope *Saiga tatarica*, the most significant large migratory mammal in Kazakhstan, undertakes broad north–south movements across open steppe landscapes but their routes do not align with the wetland habitats of the project area, and no individuals have been recorded in the project landscape. Records of snow leopard *Panthera uncia* are present within 50 km of the project but it is confined to high-elevation mountain systems entirely absent from the project landscape. Bat species, including *Pipistrellus pipistrellus*, *Eptesicus serotinus*, and *Vespertilio murinus*, are widespread and seasonally mobile, and do not form large, site-concentrated migratory aggregations of the kind relevant to Criterion 3.

For fish, the Syr Darya system historically supported long-distance spawning migrations, most notably for Syr Darya Shovelnose Sturgeon but the Shardara Dam has effectively severed upstream migratory pathways for the species. Any remnant and localised populations that were once migratory are now restricted to the reservoir and the nearest reaches of the Syr Daraya to the east. The sturgeon will still rely on different habitats during its life-cycle but any population will not be truly migratory. Criterion 3 is not independently triggered by sturgeon at the EAAA scale, nor by any other fish species.

In summary therefore, critical habitat is triggered under Criterion 3(a) for dalmatian pelican on the basis of regular wintering concentrations at the Shardara Reservoir, and the pygmy cormorant based on regular congregatory breeding populations during the spring and summer. Both species are present in abundances that regularly exceed 1% of the global population. No other species recorded within the reservoir

Criterion 4: Key Evolutionary Processes & Ecosystem Services

Criterion 4 seeks to identify areas that act as spatial catalysts for evolutionary processes, that is, areas that drive speciation and generate genetically unique populations. Criterion 4 does not have numerical thresholds and is determined on a case-by-case basis, relying on robust data and expert opinion. It is most commonly triggered in areas already known or suspected to be associated with unique evolutionary processes, and the assessment is informed by IFC's PS6 GN82. GN82 introduces a series of spatial features that may be associated with key evolutionary processes, they include:

Landscape heterogeneity and speciation. The study area is characterised by a landscape that, whilst ecologically significant for its congregatory waterbirds, does not exhibit the kind of high spatial heterogeneity typically associated

with active speciation processes. The reservoir is an artificial waterbody and the surrounding landscape is dominated by intensive agriculture, irrigated cropland, and pastoral grazing, all heavily modified by decades of human activity. The ecological mosaic present today, including the seasonal pools, reedbeds, and floodplain grasslands around the project area, is largely a product of hydrological management rather than natural geomorphological or edaphic diversity. There is no evidence that the habitat diversity observed along the Project alignment is associated with active speciation or genetically distinct populations arising from landscape heterogeneity.

Environmental gradients and ecotones. The Syr Darya basin sits at a broad biogeographic transition zone. It comprises several major migratory flyways and is broadly at the interface between the semi-arid steppes of southern Kazakhstan and the more arid landscapes of Uzbekistan to the south. The reservoir's importance for birds is well recorded (Criterion 3) but the lake itself does not in constitute an ecotone, or environmental gradient that drives evolutionary change. The ecological importance to birds is down to the reservoir's open water resources that attract singificant numbers of birds rather than a structural landscape gradient generating genetic differentiation. There is no evidence in the research, surveys, or expert consultation that the ecotonal position of the Project has been associated with processes of speciation or the evolution of genetically distinct populations.

Edaphic interfaces. The Project area substrate consists primarily of clay and sandy soils on the reservoir margins and floodplain, with loess cliffs on the north-eastern shore, the feature through which the Project cutting passes. These are geologically and pedologically unremarkable in the context of evolutionary processes; they do not represent the kind of unusual soil types, such as serpentine outcrops, limestone pavements, or gypsum deposits, that are characteristically associated with unique plant communities and endemism. No edaphic endemism or associated rare plant communities have been identified in the study area.

Connectivity and gene flow. The most substantive consideration under Criterion 4 for this Project relates to the Syr Darya river as a corridor for species movement and gene flow. As the primary watercourse connecting the Tien Shan mountain headwaters with the former Aral Sea, the Syr Darya historically provided a longitudinal connectivity corridor for aquatic and semi-aquatic species. For the Syr Darya shovelnose sturgeon, assessed under Criterion 1 and 2, the river was the sole conduit for spawning migrations within the basin. However, as documented in the Criterion 2 assessment, the construction of multiple large dams, including the Shardara dam itself, severed the longitudinal connectivity. Any evolutionary connectivity function once performed by the river for endemic fish species has already been removed. For mobile species such as migratory waterbirds, the Project does not represent a meaningful disruption to connectivity processes.

Climate change adaptation. The World Bank and ADB climate risk profile (2021) identifies this part of Kazakhstan as being at high risk of climate disruption, primarily driven by accelerating glacial melt in the Tien Shan mountains and projected long-term decline in Syr Darya flows after approximately 2050. In this context, large wetland waterbodies such as the reservoir may provide important refugia for waterbird species as surrounding semi-arid landscapes deteriorate. However, the reservoir is an artificial structure subject to deliberate hydrological management for

hydropower and irrigation. Its continuity as a climate management tool is contingent on human management decisions rather than on the inherent ecological integrity of a natural system. There is no published evidence that the Project area has been formally identified as a site for climate change adaptation.

Evolutionary significance of the modified Syr Darya system. It is worth noting that the significant modification of the Syr Darya through damming and water abstraction has itself removed the evolutionary processes that were once associated with the river system, primarily those relating to the endemic fish fauna of the Aral Sea basin, most of which are now extinct or functionally extinct. The native fish community of the Syr Darya has been replaced almost entirely by introduced fish species following the hydrological, hydrochemical, and ecological transformation of the basin. The evolutionary processes these species represented are no longer active in the study area.

In summary therefore, **Criterion 4 is not met**. Whilst the Syr Darya river has historical evolutionary significance, particularly as the sole range of the shovelnose sturgeon and other endemic fish, the Project area, as it currently exists, does not demonstrate association with active key evolutionary processes. The area's importance for birds, assessed under Criterion 3, is a reflection of habitat resource rather than evolutionary process. The connectivity function of the Syr Darya has been irrecoverably severed by pre-existing dam infrastructure and no evidence of active speciation, edaphic endemism, functional ecotones, or formally recognised climate adaptation significance have been identified.

Criterion 5: Highly Threatened & Unique Ecosystems

The IUCN Red List of Ecosystems (RLE) is the most internationally recognised tool for identifying highly threatened ecosystems. To date, only two ecosystems globally have been assessed as Collapsed under the RLE: the Central Ayeyarwady palm savanna of Myanmar and the Aral Sea of Kazakhstan and Uzbekistan. The Aral Sea, once the fourth largest lake in the world collapsed after decades of water abstraction from its two feeder rivers, the Amu Darya and the Syr Darya. The Project area passes through the Shardara reservoir and crosses the associated Syr Darya river.

While the Project area is connected to the Aral Sea via the Syr Dara River, it is not part of or even close to the Aral Sea. The reservoir is an artificial waterbody created by the damming of the Syr Darya at Shardara. It is a substantially changed landscape that is physically and ecologically distinct from the Aral Sea system downstream. Therefore, while the creation of the reservoir and abstraction from the Syr Darya will have undoubtedly played a major part in the collapse of the Aral Sea, the Project area itself does not constitute a collapsed, highly threatened or unique ecosystem. Furhter, the IUCN's RLE has not been formerly completed for Kazakstahn. The Project areas does not therefore support 5% or more of the global extent of a formally assessed CR or EN ecosystem (as per the IUCN's RLE), which is the threshold for Criterion 5(a). Criterion 5(a) is therefore not met.

Criterion 5(b) applies to areas not yet formally assessed by the IUCN RLE but considered to be of high priority for conservation through the relevant national or regional planning processes. Two ecosystem types present within or adjacent to the Project area are of particular conservation interest, the Tugai riparian forest and wetlands.

Tugai forests are riparian forests dominated by poplar, principally *Populus euphratica* and *Populus pruinose.* They are widely recognised as a threatened and unique ecosystem type across Central Asia. They are associated with the floodplains of desert rivers, including the Syr Darya, where they form narrow strips of riparian woodland and wetland that support disproportionately high biodiversity within an otherwise arid landscape. *Populus pruinosa* is listed on the IUCN Red List of Threatened Species and in the Red Data Book of Kazakhstan, and the species' habitat has undergone severe reduction following the construction of dams, water abstraction, groundwater depletion, fire, and grazing. The Amudarya State Nature Reserve (a UNESCO World Heritage tentative list site) has been specifically recognised as containing the best remaining representation of the tugai floodplain ecosystem in Central Asia, with the Syr Darya floodplain in Kazakhstan identified as the only other significant location where these forests persist, albeit without formal protection. The Syrdarya–Turkestan State Regional Natural Park, located to the north of the Shardara reservoir, has been designated, in part, to protect the remaining ecosystems and species of the Syr Darya valley. The conservation value of Tugai forest is therefore recognised in Kazakhstan but it is only formally protected and recognised in a few specifical geographically limited locations rather than as a habitat. The habitat type itself is recognised in policy but not formerly protected.

Critically, the Project field surveys identified a large and ecologically significant reedbed within the southernmost reaches of the reservoir (Figure 67). This reedbed supports a substantial and previously undocumented breeding waterbird colony, including several Kazakhstan Red Data Book species, and represents a functionally important element of the remnant wetland mosaic in the Syr Darya floodplain. Reedbeds and associated emergent wetland vegetation in semi-arid Central Asia are recognised as scarce and ecologically valuable habitat types. The reedbed is not protected or cited under any conservation policy but its ecological importance seems to have only just been recorded.

In summary Criterion 4 is not triggered. The only formally assessed collapsed or critically endangered ecosystem in this part of the IUCN RLE, the Aral Sea, is ecologically and geographically distinct from the Project area, which is an artificial reservoir located upstream. No formal national or regional systematic conservation planning process has designated the reservoir or its associated wetlands as a high-priority threatened ecosystem, in alignment with Criterion 4b. The natural habitat features of conservation value, notably the reedbed breeding colony and the Tugai forest and wetlands, are noteworthy but do not meet the Criterion 5 thresholds.

Criterion 6: Biodiversity of Social, Cultural & Economic Importance

Criterion 6 for this assessment relates to areas of biodiversity having significant social, economic, or cultural importance to local communities. It requires that the biodiversity of the project area itself, not the associated infrastructure or managed systems are the primary reason for the importance. The most economically significant

services recorded include the irrigation of water to the Syr Darya basin, flood regulation, and the commercial fisheries that produce approximately 6,000 tonnes of fish annually across 28 large fish farms and three processing plants. These services are, however, functions of the Shardara Reservoir and its dam infrastructure and thus the wider areas hydrology, not with the habitats specifically in the Project area. Most of the Project alignment passes through modified and agricultural land that plays no significant role in delivering these high-value services, and whose loss would have no discernible effect on the provisioning, regulating or cultural services for which the broader area is recognised.

The terrestrial habitats within the Project area provide mainly locally-relevant provisioning services, e.g. livestock grazing and crops, which are characteristic of, and widespread across, wider landscape. The criterion requires not simply that ecosystems provide services, but that the *biodiversity* of those systems is of *significant* importance, implying a degree of dependence, irreplaceability or cultural specificity that cannot be demonstrated for generic grazed steppe and arable habitats. All of the habitat outside the reservoir is Modified habitat, further indicating the absence of the ecological integrity typically associated with biodiversity-driven cultural or social values. Approximately 13% of the project alignment is within the reservoir and therefore Natural habitat, arguably insufficient to meet the thresholds for this criterion.

Even when the assessment is extended beyond the project area to the wider reservoir itself, the biodiversity case for meeting this criterion remains broadly weak. The fisheries, the most economically significant and biodiversity-relevant service is dominated by approximately 33 introduced fish species, meaning the economic value is likely to be mostly sustained by stocked aquaculture. Further, cultural uses such as hunting and recreational fishing, whilst of local importance, are largely unregulated seasonal activities with no formal biodiversity management framework that would indicate a community dependence on specific biodiversity. On balance, and applying the precautionary approach, the importance to be both significant and demonstrably linked to biodiversity rather than to managed or introduced systems, Criterion 6 is not met.

Summary

This CHA identifies Critical Habitat within the Darbaza–Maktaaral Railway Expansion Project area based on internationally recognised criteria applied in accordance with ADB SPS and IFC PS6, and alignment with the AIIB ESF. The following Critical Habitat criteria are met:

Criterion 1: Critically Endangered and Endangered Specie

- Syr-Darya shovelnose sturgeon (CR – possibly extinct)
- Dalmatian pelican (NT globally; nationally listed)

Criterion 2: Endemic and Restricted-Range Species

- Syr-Darya shovelnose sturgeon

Criterion 3: Migratory and Congregatory Species

- Dalmatian pelican - wintering colony
- Pygmy cormorant – breeding colony

The **Syr Darya River and Shardara Reservoir system** is therefore Critical Habitat for the *Syr-Darya shovelnose sturgeon*, *Dalmatian pelican*, and *pygmy cormorant*.

Appendices

Appendix A: Ecological Areas of Assessment

Appendix B

Criterion 1(a): Critically Endangered and Endangered Species

Appendix B presents an assessment of the 2 Critically Endangered and 8 Endangered species that are likely to occur in the project's area of influence. In accordance with the precautionary approach the 14 Data Deficient terrestrial and freshwater species that were identified as being present or likely present in the project area have also been included.

Common Name	Scientific Name	IUCN Status	Critical Habitat	Justification
Syr-darya Shovelnose Sturgeon	*Pseudosca-phirhynchus fedtschenkoi*	CR	Yes	The sturgeon is Critically Endangered, Possibly Extinct (IUCN assessment 2022) and is entirely endemic to the Syr Darya. to the Syr Darya River system. No quantitative global population estimate exists in any published literature or assessment, and no known monitoring program has been identified. Given the decades-long absence of confirmed records and the severe degradation of the species' habitat through extensive damming (including the Syr Darya or Chardara dam), water abstraction, and the hypersalinity of the Aral Sea, any surviving fish is presumed to be extremely isolated and populations very small. The Kazakhstan Red Data Book documents that the species was observed in the upper part of the Shardara Reservoir in 1969, and anecdotal reports place individuals upstream of the reservoir into the mid-1980s. Gravel-bed river habitat of the type associated with the species' spawning requirements has been noted along the Keles River, a Syr Darya tributary located within approximately 50 km of the project area and situated between the major dams to the east and west, precisely the type of fragmented inter-dam reach where any surviving population would be confined. Field research expeditions were completed in 2017, 2019 and 2025 by the Tennessee Aquarium, the Eurasian Regional Association of Zoos and the Kazakh Fisheries Research and Production Centre. The surveys comprised consultation with local dishing communities, trammel net fishing and/or the collection of eDNA from within the Syr Darya reservoir and the river system in Kazakhstan, Uzbekistan and Kyrgyzstan. No evidence of the sturgeon was collected but consultation in 2017 and 2019 gave reliable sightings both up and downstream of the reservoir. Another field expedition is being scheduled for late 2026 or early 2027. The rarity of the species and the uncertainty regarding its existence means that any river within the Syr Darya system where individuals may still persist would, by definition, hold an extremely high proportion of the global population.

				Reproduction in this species occurs in spring (typically the second half of April), involving fish aggregating at gravel-bed reaches in the middle sections of the river systems. Sexual maturity is reached at 5 - 6 years, and fecundity ranges from 850 to 3,800 eggs per female. Any surviving population at a reach within the Syr Darya where suitable gravel-substrate spawning habitat exists would, if the population is sufficient to sustain any reproduction, necessarily involve a small number of mature individuals constituting reproductive units. Given the species is a single-river endemic with a near-zero population, the reproductive unit threshold cannot be confirmed. However, IFC PS6 GN14.1 explicitly requires that absence of evidence not be treated as evidence of absence, and that the precautionary approach applies where a CR species may be present. Taking all the above into consideration and adopting the precautionary approach required under IFC PS6 GN14.1, Criterion 1a is met. If any individuals of this CR (Possibly Extinct) species survive within the Syr Darya system, they would almost certainly represent a globally critical concentration. **This species meets the Critical Habitat threshold, albeit using the precautionary approach.**
Sociable Lapwing	*Vanellus gregarius*	CR	No	This is a migratory species with a global estimated population of around 11,200 mature individuals. The species breeds in the steppes of Kazakhstan but is strongly site-faithful to a small number of consistently used staging areas, the principal one on the eastern flyway being the Talimarzhan Reservoir in Uzbekistan, 400km south of the Project. The AoI is not documented as a staging site for the species, and is dominated by wetland, reedbed, and riparian habitat, which are inconsistent with the dry, open habitats the species selects at staging and wintering locations. Given the species' small global population, its use of a limited number of well-defined staging sites, and the absence of any recorded concentrations at the AoI, it is considered highly unlikely that the study area regularly supports ≥ 0.5% of the global population or ≥ 5 reproductive units. **Critical Habitat is not triggered.**
Pallas's Fish-eagle	*Haliaeetus leucoryphus*	EN	No	This species has a global population estimated to be less than 2,500 individuals. The species has a broad but sparse breeding range across central and eastern Asia, favouring large rivers, lakes, and marshes, habitats which are present within the AoI. However, the species has not been recorded at or near the Syr Darya reservoir in the past 20 years and is believed to have largely retracted from former strongholds in Kazakhstan. Its occurrence in the study area is therefore expected to involve occasional transient only or

				wintering individuals given its extremely sparse distribution across its range. Given the small global population, the lack of records and the species' known sparseness throughout Kazakhstan, it highly unlikely the site regularly holds a concentration of this significance. **Critical Habitat is not triggered.**
Egyptian Vulture	*Neophron percnopterus*	EN	No	This species has a global population estimated to be 12,400 to 36,000 mature individuals. In Kazakhstan, the species is at the northernmost limit of its breeding range, with an estimated 418 to 502 breeding pairs in the country. Breeding pairs nest almost exclusively on rocky cliffs and ledges, and the species forages across dry plains and lower hills, meaning the AoI doesnt have suitable breeding or foraging territory for the species. This indicates that any presence is likely to be transient rather than dependent. Further, the species has not been near the project area, particularly the reservoir in the past 20 years. It is therefore highly unlikely the study area regularly supports ≥ 0.5% of the global population or ≥ 5 reproductive units. **Critical Habitat is not triggered.**
White-headed Duck	*Oxyura leucocephala*	EN	No	This species has a global population estimated to be 8,700 to 20,000 individuals. The Eastern migratory population breeds mainly in northern Kazakhstan and southern Russia, wintering in western Asia and the Middle East, a route that passes to the north and west of the AoI in southern Kazakhstan. The species' preferred breeding habitat is open water with dense stands of aquatic vegetation, which the Syr Darya Reservoir could in principle provide, but the site lies well outside the documented northern Kazakhstan breeding heartland and there are no published breeding or significant staging records for the species at the reservoir. It was not recorded during the Project bird surveys. Given the global population size, the lack of presence at the reservoir, and the species' documented preference for staging and breeding sites in north-central Kazakhstan, it is very unlikely that the site regularly holds numbers approaching this threshold. **Critical Habitat is not triggered.**
Great Bustard	*Otis tarda*	EN	No	This species has a global population estimated to be 29,000 to 32,500 individuals. The species is a bird of open grassland and steppe, and is known to use agricultural land including cereal fields and alfalfa, actively avoiding wetlands and densely vegetated areas. Studies of the Central Asian population have estimated that 400 to 500 Great Bustards winter in southern Kazakhstan, encompassing Kyzylorda and Turkistan provinces, a range that geographically includes the AoI. Wintering populations are also known to be present west of Jizzakh, Uzbekistan, c.100km south of the Project. However, overwintering spots in this region tend to be dominated by desert steppe landscape, rather than the open water,

				reedbeds, and riparian habitats that dominate the AoI making the reservoir itself unsuitable. The open habitat north of the reservoir is dominated by agriculture or is very close to conurbanization (roads, settlements etc) which are not preferred by this species. While the winter count of 400 to 500 birds across the broader southern Kazakhstan region is significant, this encompasses a very large geographic area and no records or surveys document concentrations of this magnitude specifically within the AoI. **Critical Habitat is not triggered**, though the species' presence in the surrounding landscape warrants attention in the project's broader impact assessment.
Saker Falcon	*Falco cherrug*	EN	No	This species has a global population estimated to be 12,200 to 29,800 mature individuals. In Kazakhstan, the population has declined by 73–79% since 1990, with fewer than 650 breeding pairs estimated as of 2023. The species inhabits forested steppe, steppe, semi-deserts, and open grasslands, particularly near water, where it hunts rodents and medium-sized birds, and while individual birds may opportunistically exploit the prey-rich environment around the AoI, the wetland-dominated landscape of the IBA does not constitute core breeding or foraging habitat for this species. 3 birds were recorded in 2003 and none since, including the 2025 surveys for this project. While the species may occur as a transient or occasional visitor in the study area, there are no documented breeding territories or foraging concentrations at the IBA, and the extremely low breeding density of the species across its vast range makes such a concentration highly improbable. **Critical Habitat is not triggered.**
Great Knot	*Calidris tenuirostris*	EN	No	This species breeds exclusively on tundra in northeast Siberia, Russia, and is strongly migratory, wintering on coasts in southern Asia through to Australia. The reservoir lies entirely outside this flyway and outside the species' documented range; the species does not migrate through Central Asia and has no documented records from Kazakhstan or any surrounding inland Central Asian countries. It was not recorded on site during the recent project field surveys. The study area's freshwater, inland, and landlocked character is also incompatible with the species, which is dependent on intertidal mudflat habitats at staging and wintering sites. It is therefore highly unlikely that this species occurs within the AoI. **Critical Habitat is not triggered.**
Steppe Eagle	*Aquila nipalensis*	EN	No	This species has a global population estimated to be 50,000 to 75,000 individuals. Kazakhstan holds an estimated 68.5–82.2% of the world's population, with 16,750–28,070 breeding pairs recorded in 2023, breeding across steppes, semi-deserts, and deserts throughout central Kazakhstan. The species is a full migrant, with birds from northern

				Kazakhstan migrating primarily east of the Caspian Sea to wintering grounds on the Arabian Peninsula or northeastern Africa, passing across and around the AoI during autumn and spring movements. A small number of overwintering Steppe Eagles have been recorded unusually in southern Kazakhstan, including near the Shardara Dam. Two reports on eBird are noted from 2022 (March and December) at the western end of the reservoir and unconfirmed sightings near the reservoir from 2005, 2007 and 2018. However, these are documented as exceptional occurrences of individual or very small numbers of birds, not congregatory concentrations. While the study area lies within the species' broader migratory corridor, it is unlikely that the IBA regularly supports the 250 birds required to meet the threshold. **Critical Habitat is not triggered.**
Aral Barbel	*Luciobarbus brachycephalus*	EN	No	The species is represented in Kazakhstan by the Aral basin population, which is distributed along the Syr Darya river system, and stocks in the Aral–Syr Darya basin are described as catastrophically reduced, with artificial reproduction now considered the only viable means of population restoration. The AoI sits on the Syr Darya and therefore falls within the species' historical and current range, meaning encounters with individuals are plausible. However, given the highly reduced population in the basin, the heavily modified hydrochemical conditions of the reservoir, including pollution incidents, altered hydrology, and competition from 33 introduced fish species documented in the draft CHA, and the absence of quantitative population data that would allow a threshold assessment against the 0.5% global population criterion, it is considered highly unlikely that the AoI holds a concentration of individuals whose loss would trigger an uplisting. **Critical Habitat is not triggered.**
Striped Bystranka	*Alburnoides taeniatus*	DD	No	This fish species is Data Deficient (DD) on the IUCN Red List. It is distributed across Central Asia in the Amu Darya, Zeravshan, Syr Darya and Chu rivers. The Syr Darya within the AoI represents part of the species' documented range, and suitable flowing-water habitat is present, however, very little information is available for the southern Syr Darya section, and its range extends from the Aral Sea into the mountains of Kyrgyzstan and much of Uzbekistan, Turkmenistan and Tajikistan. While it is theoretically possible, it is unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered**.
Goroshek Misho	*Vicia michauxii*	DD	No	This plant species is listed as DD on the IUCN Red List. This species may occur in disturbed ground, steppe margins, and agricultural edges across the southern regions of Kazakhstan but also many neighbouring counties and further west to Syria and Turkey.

				Suitable low-lying semi-arid habitat is present within the AoI. However, little information is available. Given its wide transboundary distribution and the limited area of the AoI relative to its total range, it is very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered.**
Dot-winged Mantis	*Iris polystictica*	DD	No	This invertebrate species is listed as DD on the IUCN Red List. It is associated with arid and semi-arid open landscapes, and the desert and semi-desert habitats of the southern Syr Darya region within the AoI provide potentially suitable conditions. However, its range extends from Ukraine and Moldova in the west to Mongolia and eastern Russia in the east. Given the species' broad EOO and the small relatively small AoI, it is very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered.**
Turkestan pipistrelle	*Pipistrellus Aladdin*	DD	No	This bat species is listed as DD by the IUCN. It is associated with arid lowland habitats in the southern Central Asian region from western Iran to China. The riparian corridors, settlements and open habitats of the southern Syr Darya region within the AoI may provide suitable foraging and roosting habitat for pipistrelle bats. However, little information is available and the precise distribution of this taxon within Kazakhstan is poorly documented. Given the uncertain taxonomic status of the species and the small fraction of its overall range represented by the AoI, it is very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered.**
	Armene pusilla	DD	No	This insect species is listed as DD on the IUCN Red List. Insufficient data are currently available to assess the species' distribution, habitat associations or population status within Kazakhstan or the AoI. It is, however, assumed to be present from southern Russia, southern Kazakhstan, much of Turkmenistan and into Tajikistan and Afghanistan. Where the AoI provides open, disturbed or semi-desert habitats, the species may potentially occur, but no records from the wider Syr Darya region have been identified through desk-based research or field surveys. It is considered very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered**.
	Rivetina nana	DD	No	This insect species is listed as DD on the IUCN Red List. The arid clay and sandy desert habitats of the southern Syr Darya region within the AoI represent potentially suitable habitat for this ground-dwelling mantis. However, its range is similar to that of the *Armene pusilla* (above). Given the species' broad Central Asian distribution and the small

				area of the AoI relative to its total range, it is very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered.**
Conehead Mantis	*Empusa pennicornis*	DD	No	This insect species' documented range does not extend to Kazakhstan or the wider Central Asian region; its easternmost records are from Turkey and the eastern Mediterranean. The flat desert and semi-desert habitats of the southern Syr Darya AoI lack the warm Mediterranean scrubland habitat this species requires. This species is therefore highly unlikely to occur in the AoI. **Critical Habitat is not triggered.**
Bokhara Whiskered Bat	*Myotis bucharensis*	DD	No	This species is listed as DD by the IUCN. The species is known only from Central Asia but the project is at the very northern reaches of its estimated extant (and the IUCN Redlist indicates that it is possible extinct in southern Kazakhstan). No records of this species have been recorded in Kazakhstan, and the southern Syr Darya lowlands of the AoI are geographically distant from the only confirmed localities. This species is therefore highly unlikely to occur in the AoI. **Critical Habitat is not triggered.**
	Euglesia gurvichi	DD	No	This fish species is listed as DD by the IUCN. Information is extremely limited, and its precise range within Central Asia is poorly characterized. No records from the southern Syr Darya region have been identified in the available literature. Given the absence of site-specific data and the very limited information available on this species, it is not possible to determine whether the species is present in Kazakhstan or specifically in the project aera. Given the data available and the frequency and intensity of fishing in the Syr Dayra and the Shardarya reservoir, it is assumed presence would have been confirmed. **Critical Habitat is not triggered.**
	Aegilops juvenalus	DD	No	This plant species is listed as DD by the IUCN. It occurs in disturbed habitats, grasslands, and steppe margins. As an annual grass of open and disturbed habitats, the species may potentially occur within the agricultural margins, disturbed ground and semi-steppe habitats of the southern Syr Darya region within the AoI. However, given the species' broad distribution and the small area of the AoI relative to its total range, it is very unlikely that the AoI supports ≥0.5% of the global population. **Critical Habitat is not triggered.**
	Segmentina servaini	DD	No	This snail species is listed as DD by the IUCN. The genus is associated with still or slow-moving freshwater habitats including ditches, marshes, ponds and vegetated river margins. The slow-moving channels, backwaters and riparian wetlands of the Syr Darya corridor within the AoI may provide potentially suitable shallow-water habitat for this species. However, IUCN cite its range as most of Europe, Russia and China. Therefore, it is

				very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered.**
Bolivar's Short Winged Mantis	*Bolivaria brachyptera*	DD	No	This species is listed as DD by the IUCN. It is associated with arid and semi-arid open habitats across its range. The open desert, semi-desert and steppe habitats of the southern Syr Darya region within the AoI are broadly consistent with the habitat preferences of this ground-dwelling mantis, and the species may potentially occur within the AoI. However, its range extends from the Ukraine and Moldva to the west into much of Kazakhstan to the east, and south to the Persian Gulf and Gulf of Oman. Given the species' broad Central and Western Asian distribution and the small area of the AoI relative to its total range, it is very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. **Critical Habitat is not triggered.**
	Kolhymorbis dildorae	DD	No	This species is listed as DD by the IUCN. Information is extremely limited, and its precise range and habitat associations within Central Asia remain poorly characterised. It is however, most likely to be present east of, and outside of the project area. Therefore, it is not possible to determine whether the AoI could support a population at all but it is very unlikely that the AoI supports ≥0.5% of the global population or ≥5 reproductive units. Critical Habitat is not triggered.

Appendix C

Criterion 1(b): Vulnerable Species

15 Vulnerable terrestrial and freshwater species that occur or may occur in the project's area of influence were identified and assessed. The assessment determined whether their loss would result in the change of the IUCN Red List status of VU to either EN or CR and meet the IFC PS6 Criterion 1(b) threshold.

Common Name	Scientific Name	IUCN Status	Critical Habitat	Justification
Marbled Polecat	*Vormela peregusna*	VU	No	In Kazakhstan, the species is found in shifting dune country, salt marshes overgrown in saxaul, clay steppes, and semi-arid habitats where it preys on ground squirrels, gerbils, and other small rodents, habitats and prey communities that are largely absent from the heavily modified, wetland-dominated AoI. While the species' range encompasses southern Kazakhstan and it may occur in the dry agricultural and

				steppe habitats, the open water, reedbeds, riparian vegetation, and floodplain habitats that dominate the AoI are incompatible with its ecological requirements. It is highly unlikely that this species occurs within the AoI. **Critical Habitat is not triggered.**
Grey Plover	*Pluvialis squatarola*	VU	No	This species is an Arctic-breeding, long-distance migrant with a nearly worldwide but almost exclusively coastal distribution during the non-breeding season, foraging on tidal flats, beaches, and intertidal mudflats. Satellite tracking of the species confirms that neither flyway routes pass through inland Central Asia nor the IBA. The species has no documented history of occurring inland at freshwater reservoirs in southern Kazakhstan, and the study area's habitats are incompatible with species' ecology. It is therefore highly unlikely that this species will be present in the AoI. **Critical Habitat is not triggered.**
Goitered Gazelle	*Gazella subgutturosa*	VU	No	The species is restricted to arid deserts and desert-steppe habitats, where it undertakes seasonal migrations, requiring shallow snow cover in winter, broken terrain, and sparse vegetation cover. Surveys along Kazakhstan's southwestern border confirm transboundary populations are associated with the Kyzylkum desert, the arid dryland landscape that lies to the west of the Syr Darya river, beyond the Chardara Reservoir. The study area itself is dominated by open water, reedbeds, riparian floodplain, and heavily modified agricultural land, none of which constitutes suitable gazelle habitat. It is therefore highly unlikely that this species is present within the AoI. **Critical Habitat is not triggered.**
Broad-billed Sandpiper	*Calidris falcinellus*	VU	No	The species is migratory and breeds in wet taiga bogs in Arctic northern Europe and Siberia. During migration, the species uses inland wetlands, meaning the Chardara Reservoir cannot be entirely excluded as a potential transient stopover location. However, the species is documented as scarce and dispersed along this inland corridor, occurring in very small numbers at any individual site. Therefore, it is highly unlikely that any loss of population from the AoI will trigger a change in status for the species. **Critical Habitat is not triggered.**
Curlew Sandpiper	Calidris ferruginea	VU	No	The species breeds in Arctic Siberia and is a confirmed passage migrant through Kazakhstan. During migration it uses intertidal mudflats and estuaries primarily, but can also be found at inland wetlands, meaning individual birds may pass through the Chardara Reservoir during spring and autumn. However, the species migrates across an extremely broad front through Central Asia in very dispersed, small groups

				rather than concentrating at discrete inland stopover sites. Given the size of the global population, it is highly unlikely that any loss of population from the AoI will trigger a change in listing status for the species. **Critical Habitat is not triggered.**
Snow Leopard	Panthera uncia	VU	No	The species inhabits alpine and subalpine zones at elevations of 3,000–4,500 m across the mountain ranges of Central and South Asia, including the Aksu-Zhabagly Nature Reserve represents the sole documented protected area for the species within the country. The AoI consists of flat, semi-arid lowlands, landscapes of open water, reedbeds, irrigated agriculture, and modified steppe There is no credible pathway by which the project area could support or impact Snow Leopard populations, and its occurrence in the study area is highly unlikely. **Critical Habitat is not triggered.**
Greater Spotted Eagle	Clanga clanga	VU	No	The species strongly favours riparian zones, bogs, lakes, and other bodies of water surrounded by woodland for breeding, and in Kazakhstan its primary habitat is riparian forest in lowland steppes and forest-steppe mosaics. The eastern flyway carries birds from breeding sites southward through Central Asia to wintering grounds in southern Asia, a route that passes through or close to the AoI. The Chardara Reservoir, with its riparian Tugai vegetation, open water, and associated floodplain habitats, could support occasional wintering or passage individuals, and the species has a documented but isolated breeding presence in southern Kazakhstan. However, the global population is very small and highly dispersed; any individuals present within the Chardara IBA would represent a negligible fraction of the global population. Therefore, any loss in population within the AoI could not plausibly contribute to a change in the species' global listing status. **Critical Habitat is not triggered.**
Waved Pincertail	Onchogomphus flexuosus	VU	No	The species inhabits rivers of Central Asia, with adults characteristically found on partly dry riverbeds covered with cobblestones. The species is a specialist of fast-flowing, well-oxygenated rivers with coarse substrates. The habitat requirements for this species are incompatible with the slow-flowing, heavily modified, and sediment-laden conditions of the Chardara Reservoir and its impounded section of the Syr Darya. The AoI provides none of the riverine coarse-substrate conditions on which this species depends on for reproduction. It is therefore highly unlikely that this species occurs within the AoI. **Critical Habitat is not triggered.**

Eastern Imperial Eagle	Aquila heliaca	VU	No	The species breeds primarily in forest-steppe mosaics, river valleys, and open woodlands with scattered trees, and during migration and winter it often forages in wetlands and agricultural areas. Breeding populations in northern Kazakhstan are associated with trees adjacent to grasslands, a habitat type largely absent from the Chardara IBA, which is dominated by open water, reedbeds, and heavily modified irrigated land without the mature riparian or steppe woodland required for nesting. Any individuals present would represent a small fraction of the large Kazakhstan population. **Critical Habitat is not triggered.**
European Turtle-dove	Streptopelia turtur	VU	No	The species' breeding range extends from central and southern Britain to Kazakhstan. However, all documented migration has no flyways through the interior of Central Asia towards the study area. Any breeding or passage of individuals occurring within or near the Chardara IBA would represent a small, peripheral fraction of the global population. Therefore, any loss of individuals from the AoI would be unlikely to trigger a change in the species' listing. **Critical Habitat is not triggered.**
Yellow-eyed Pigeon	Columba eversmanni	VU	No	This species has a predominantly Central Asian distribution and is documented as nesting in the valleys of the Syr Darya and Ili Rivers in Kazakhstan, with the Chardara Reservoir situated directly within the species' mapped breeding range. The species inhabits steppes and other lowland habitats including semi-arid and arid areas, nesting in cliff holes, hollow trees, and ruined buildings, before migrating southward. The loess cliffs on the north-eastern shore of the reservoir represent the type of cliff-face nesting substrate used by this species in the Syr Darya valley. The species' documented association with habitats present within the AoI indicates that breeding individuals may occur in the project area. However, the AoI represents only a small fraction of the overall Chardara Reservoir and its surrounding suitable habitat, and any potential impacts would therefore be limited to a very small proportion of the local population. As such, impacts within the AoI are not expected to be significant at the population level. **Critical Habitat is not triggered.**
Asian Houbara	*Chlamydotis macqueenii*	VU	No	The species is a desert and steppe specialist native to the arid and semi-arid regions of Asia, breeding across Central Asia including Kazakhstan. The areas most frequented by the species in Kazakhstan are semi-desert landscapes located to the west and north of the Syr Darya. The habitat within the AoI is entirely incompatible with the species' strict requirement for open, arid steppe and semi-desert with

				sparse scrub vegetation. Therefore, it is highly unlikely that this species will be present within the AoI. **Critical Habitat is not triggered.**
Lesser White-fronted Goose	*Anser erythropus*	VU	No	Northern Kazakhstan and adjacent areas of Russia host vitally important autumn staging sites for this species, where the entire Western Main subpopulation is believed to congregate. The Shardara Reservoir is documented as a site where the species occurs during migration and winter, with annual counts of 200–2,000 individuals reported, utilizing submerged and bank vegetation as well as adjacent cereal fields. During these periods, the species frequents agricultural fields, wetlands, and grasslands, all of which are present within and around the AoI. While these counts could represent a notable proportion of the global population at the reservoir scale, the AoI represents only a very small fraction of the overall reservoir and associated habitats. Numbers recorded during the field surveys were also low. As such, any impacts within the AoI would likely affect only a limited number of individuals and would not be expected to meaningfully influence the species' population at either the reservoir or global scale. **Critical Habitat is not triggered.**
Common Pochard	*Aythya ferina*	VU	No	The species breeds primarily in steppe wetlands of the Palearctic, including Kazakhstan, and is strongly migratory, with the Chardara Reservoir falling within its Central Asian breeding and migration corridor. The large, productive open water and reedbed habitats of the AoI are well suited for breeding and staging, and it is likely to be a regular and possibly abundant visitor. However, given the very large global population, even locally significant concentrations would represent a small fraction of the global total and would be unlikely to contribute to a change in the species' global listing status. **Critical Habitat is not triggered.**
Корольков мармараги	Salvia korolkowii	VU	No	The species occurs primarily in Uzbekistan with a single locality confirmed as a new country record in Kazakhstan, and a confirmed occurrence in Kyrgyzstan, all within the foothill and montane zone of the Western Tian-Shan, a geological and ecological context entirely absent from the AoI which doesnt constitute rocky outcrops or support the petrophytic flora of the Tian-Shan foothills. Therefore, this species is highly unlikely to be present within the AoI. **Critical Habitat is not triggered.**

Vista Environment

Appendix D

Criterion 1(c): Areas Containing Important Concentrations of Nationally or Regionally listed Endangered or Critically Endangered Species

The following provides a detailed assessment of the 50 Nationally Red Listed terrestrial and freshwater species that may occur in the project's area of influence determines whether any meet the IFC PS6 Criterion 1(c) threshold.5

Common Name	Scientific Name	Kazakh Red List Status	IUCN Status	Critical Habitat	Justification
Syr Darya Shovelnose Sturgeon	*Pseudoscaphirhynchus fedtschenkoi*	I	CR	Yes	The sturgeon is formally listed in the Redbooks of Kazakhstan, Tajikistan, and Uzbekistan as a Category I species, a very rare endemic relict species on the brink of extinction. The Kazakhstan Red Data Book characterises it as the only species of its genus in the Syr Darya basin and notes that all representatives of the genus are threatened with extinction. National listing as the rarest fish species within Kazakhstan's territory provides a clear basis for the application of Criterion 1c, independent of international IUCN thresholds. The project's crossing of the Syr Darya River, and its potential effects on the hydrological regime and water quality of the river system within the Shardara reservoir and upstream, places it within the only river system where the species is known to have occurred. Any surviving individuals in the project's AoI would by definition represent an important concentration of this nationally critically endangered species. The same precautionary logic applied under Criterion 1a applies with equal force here: given the extreme rarity and near-extinction status of the species nationally, any concentration of individuals within the Syr Darya in the vicinity of the project must be treated as nationally important in the absence of evidence to the contrary. **Criterion 1c is met.**
Dalmatian Pelican	*Pelecanus crispus*	II	NT	Yes	The dalmatian pelican is a large, fish-eating waterbird with a fragmented global range spanning parts of Europe, Central Asia, and South Asia. The

					global population is estimated at 11,400–13,400 individuals (BirdLife International), and the species is classified as Near Threatened on the IUCN Red List. In Kazakhstan, the species is listed as **Rare** under the national Reddata Book, with a breeding population of approximately 2,000 pairs concentrated in the Ural region, along the Caspian coast, and in the Torgai and Naurzum Reserves. The drivers of decline include habitat loss, disturbance at breeding colonies, overfishing of prey species, and direct persecution, the 2006 winter survey at Shardara documented active poaching of pelicans from motorboats during the survey period itself. The Shardara Reservoir (IBA 76) has been documented as a nationally significant wintering site for the species across more than two decades of survey effort. Long-term count data compiled by the Association for the Conservation of Biodiversity of Kazakhstan (ACBK) record wintering aggregations in every survey year between 2003 and 2025, averaging 238–254 birds (c.2%) with a peak of 700 individuals (6%) in 2004 and counts of 400–500 birds (4%) recorded across multiple subsequent winters. The February 2025 field survey recorded 88 Dalmatian Pelicans (0.8%) along the 15 km transect directly crossing the Syr Darya floodplain section of the IBA, the specific area intersected by the proposed railway alignment. The reservoir provides year-round access to abundant coarse fish prey, and the regularity of aggregations across years of varying weather and hydrological conditions indicates consistent functional use of the site rather than opportunistic occurrence. In conclusion, the Dalmatian Pelican is nationally listed as Rare in Kazakhstan and the Shardara Reservoir study area supports regular and substantial wintering concentrations of the species. On this basis, the area qualifies as Critical Habitat under Criterion 1c, and **Critical Habitat is triggered.**

Sociable Lapwing	*Vanellus gregarius*	I	CR	No	This species breeds almost exclusively in Kazakhstan. However, the core breeding population is concentrated in the central and northern steppes, well to the north of the AoI. The southern Syr Darya region does not support suitable breeding habitat for this species, and records within the AoI are occasional migrants only. Given that the national breeding distribution is centred far from the AoI, the area is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
White-headed Duck	*Oxyura leucocephala*	I	EN	No	This species is highly aquatic and associated with fresh and slightly saline lakes. Kazakhstan holds key concentrations recorded at the Tengiz-Korgalzhyn lake system and lakes in the Kostanay province, in central and northern regions. Locally it historically bred across the country but is now only occasionally found in central and western areas; it has not been recorded breeding in the lower reaches of the Syr Darya river. The AoI therefore lies outside the core breeding and staging range of this species. Whilst passage migrants may occur, the AoI is unlikely to hold a meaningful proportion of the national population. **Critical Habitat is not triggered.**
Steppe Eagle	*Aquila nipalensis*	I	EN	No	This species is the national bird of Kazakhstan. More than 85% of the global population nests in the country. Locally, the species breeds across the steppe, semi-desert and desert zones of the central part of the country, and occurs more widely on dispersal and migration. The AoI lies at the periphery of the species' breeding range. A small number of overwintering Steppe Eagles have been recorded in the Syr Darya valley and near the Shardara Dam, indicating that the AoI may be used irregularly outside the breeding season. However, given that the core breeding population is concentrated in the central and western steppe zones well to the north of the AoI, the area is unlikely to hold a

					significant proportion of the national population. **Critical Habitat is not triggered.**
Pallas's Fish-eagle	*Haliaeetus leucoryphus*	I	EN	No	This species is closely associated with freshwater systems such as lakes, marshes, and large rivers. Kazakhstan may no longer support a breeding population, with records suggesting the species has declined significantly. The Syr Darya river corridor within the AoI provides the type of habitat with which this species is associated, and the species has been recorded as a migratory and wintering visitor along river systems in the broader region. However, given the very small and declining population locally, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
White Stork (Turkestan population)	*Ciconia Ciconia asiatica*	I	LC	No	Locally, only one known active nest remains in Kazakhstan, located in the Zhambyl region. Recent surveys have, however, documented a tentative recovery in the Zhambyl and Turkestan Regions in the south of the country. Given that the AoI's closeness, individual birds may be encountered foraging or nesting in association with irrigated agricultural land, wetlands and riparian areas along the river corridor. However, with the total population estimated at around 1,450 individuals across the entire subspecies' range, the AoI is unlikely to hold a significant proportion of the national or regional population. **Critical Habitat is not triggered.**
Osprey	*Pandion haliaetus*	I	LC	No	This species is associated with water bodies that provide an adequate supply of fish. In Kazakhstan, the species is a scarce breeding resident and passage migrant. The Syr Darya river corridor within the AoI represents one of the documented breeding areas locally, and the associated riparian habitats provide suitable foraging and nesting habitat. While the AoI falls within the known breeding range, the Osprey nests at very low densities and the national population is small. The area

					is therefore unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Peregrine Falcon	*Falco peregrinus*	I	LC	No	Locally, this species breeds in the mountain forests of the Altai and occasionally in the Naurzum Reserve and the Tien Shan. It is therefore confined to the mountainous northeast, and the forested steppe reserves of northern Kazakhstan. The *calidus* subspecies occurs across Kazakhstan on migration almost everywhere. The AoI does not encompass any known breeding habitat, as the species does not breed in the lowland desert and semi-desert landscapes. Individual birds may pass through. Given the very limited and geographically distant breeding population locally, the AoI is unlikely to hold a significant proportion of the national population at any time of year. **Critical Habitat is not triggered.**
Ferruginous Duck	*Aythya nyroca*	I	NT	No	This species is associated with fresh waterbodies with rich submerged and floating vegetation and dense stands of emergent vegetation on the margins. The AoI falls at the southern fringe of the species' breeding range locally. The habitat in the Syr Darya corridor is suitable for breeding and foraging, and the species is known to occur in comparable wetland habitats in the broader region. However, the species has a wide national distribution across Kazakhstan's wetlands and its breeding density within any single area is generally low. The AoI is therefore unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Lehmann's Tulip	*Tulipa lehmanniana*	I	NT	No	This species grows in foothill belt semi-savanna deserts, on sandy hammada and outcrops of variegated rocks. Its distribution within Kazakhstan is concentrated in the southern part of the country, including the Kyzylkum and adjacent desert regions, which overlap with or adjoin the AoI in the Syr Darya region. While the AoI may contain suitable habitat for this species, the species has a broad distribution, therefore

					the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Marbled Teal	*Marmaronetta angustirostris*	I	VU	No	This species is associated with shallow, vegetated wetlands. It was historically more widespread, but drainage of wetlands around the Syr Darya river caused loss of suitable habitats. The AoI contains residual wetland habitats that could provide suitable breeding or staging habitat for this species. However, given the dramatic population reduction in Kazakhstan and the very small and fragmented nature of any remaining population in the country, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Great Bustard	*Otis tarda*	I	VU	No	This species inhabits open steppe and grassland. Critically, the AoI in southern Kazakhstan falls within one of the most important remaining areas for this species in Central Asia. Surveys encompassing Kyzylorda, Turkistan and Zhambyl provinces estimate that a total of 50–70 Great Bustards currently occupy southern Kazakhstan during the breeding and migratory season, and 400–500 in winter, making it the only region in Central Asia consistently hosting the species during all four seasons. ResearchGate Conservation guidance specifically identifies southern Kazakhstan as a priority area, as the species occurs there during breeding, passage and wintering seasons. However, consultation with ACBK and the absence of any sightings during the surveys prvides high confidence that the Project is not located in habitat suitable for this species. **Critical Habitat is not triggered.**
Squacco Heron	*Ardeola ralloides*	II	LC	No	This species is associated with warm, vegetated freshwater wetlands. The riparian and wetland habitats of the Syr Darya corridor within the AoI may provide suitable breeding and foraging habitat for this species during the summer months, and individual birds are likely to be encountered on passage. However, Kazakhstan represents the very

					margin of the species' global breeding range, and its occurrence within the country is sparse. The AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Greater Flamingo	*Phoenicopterus roseus*	II	LC	No	This species is associated with shallow, saline or alkaline wetlands. The species breeds irregularly at a small number of saline lakes in the central part of the country, including the Tengiz and Chelkar-Teniz lake systems, and occurs more widely across the plains on dispersal and migration. The AoI does not encompass any of the known breeding sites for this species; therefore, it is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Short-toed Snake Eagle	*Circaetus gallicus*	II	LC	No	This species is associated with open landscapes with low vegetation. Kazakhstan represents the north-eastern limit of the species' range, where it is a scarce breeding migrant. The open semi-desert and dry steppe habitats of the southern Syr Darya region within the AoI may provide suitable foraging habitat for this species, and individual birds may be encountered during the breeding season or on passage. However, given its wide national distribution across Kazakhstan and its very broad global range, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
White-tailed Eagle	*Haliaeetus albicilla*	II	LC	No	This species is associated with large bodies of open water, including lakes, rivers, wetlands, and coastal areas. In Kazakhstan, it occurs as a breeding resident and wintering visitor along major river systems and lake complexes. The riparian habitats and reservoirs of the Syr Darya corridor within the AoI provide potentially suitable foraging and wintering habitat for this species, and it has been recorded along river valleys in the broader southern region but the numbers have declined in recent years. It has a wide national distribution and nests at low densities. The AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Eurasian Eagle-owl	*Bubo bubo*	II	LC	No	This species occupies a wide range of habitats from coniferous forests to warm deserts, with rocky landscapes and cliff faces being particularly favoured for nesting. In Kazakhstan, it is a resident breeder found across

					diverse habitats, including desert and semi-desert landscapes. The rocky outcrops, cliff escarpments and riparian tugai woodlands associated with the AoI provide potentially suitable nesting and foraging habitat for this species. However, given its wide national distribution across Kazakhstan and its broad habitat tolerance, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Little Bustard	*Tetrax tetrax*	II	NT	No	This species is associated with open steppes, grasslands, and cereal farmland. The AoI in the southern Syr Darya region lies at the southern fringe of the species' steppe breeding range in Kazakhstan, where open semi-desert and agricultural habitats may provide marginal breeding or foraging habitat. No individuals were recorded during the field surveys. However, given the species' wide national distribution and the large size of the local population, the area is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Borshchov's Tulip	*Tulipa borszczowii*	II	NT	No	This species is endemic to Kazakhstan and grows in sandy, clay and gypsum deserts, occurring in the Torgai, Prearal, Kyzylorda and Kyzylkum floristic regions. The Kyzylorda region within the AoI falls within the known distribution of the species, and the desert and semi-desert habitats of the Syr Darya corridor may contain suitable substrates for this species. However, given its broad distribution across Kazakhstan, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Korolkow's Tulip	*Tulipa korolkowii*	II	NT	No	This species grows on dry gravel and stony surfaces, sandy substrates, slopes and plains, and in the lower mountain belt up to 1,800 m above sea level. The foothills and rocky slopes of the Karatau range and the Turkestan region, which adjoin the southern Syr Darya corridor of the AoI, represent the most likely areas of suitable habitat within or near the AoI. However, given its distribution across, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Lesser White-fronted Goose	*Anser erythropus*	II	VU	No	The steppes of northern Kazakhstan are crucial for migrating individuals each autumn as they stop to refuel on stubble fields and roost on nearby lakes. The key staging sites are concentrated in the Kostanay region, well

					to the north of the AoI. The Syr Darya region does not encompass the known key staging areas for this species and is unlikely to be visited by significant numbers during migration. The AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Aral barbel	*Barbus brachycephalus brachycephalus*	II	CR	No	This species is endemic to the Aral basin. It was a migratory fish that travelled far upstream for wintering and spawning, with mass migrations coinciding with peak water levels in the Syr Darya and Amu Darya rivers. Dam construction and subsequent salinisation of the Aral Sea contributed greatly to its decline. The Syr Darya river within the AoI represents part of the species' historical and residual range, and the lower and middle reaches of this river may still support small remnant populations. However, the species is sharply reduced in numbers. Given the very small and fragmented nature of the remaining population, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Spoonbill	*Platalea leucorodia*	II	LC	No	This species was not included in the IBAT report but was reported during field surveys done on site. It is associated with shallow wetlands, reed-rich lakes and river channels with adjacent trees or shrubs for nesting. In Kazakhstan it is a rare breeding migrant, with known breeding sites distributed irregularly across the plains of the country, including steppe lakes. The reed-fringed wetlands and river channels of the Syr Darya corridor within the AoI provide potentially suitable breeding and foraging habitat, and the species has been recorded at the Chardara reservoir near the AoI. However, given its sparse and irregular distribution as a breeding locally, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Glossy Ibis	*Plegadis falcinellus*	II	LC	No	This species was not included in the IBAT report but was reported during field surveys done on site. It is associated with wetlands with tall emergent vegetation, shallow margins of lakes and rivers, and adjacent bushes or trees for nesting. In Kazakhstan it is a rare or accidental breeding migrant. Recent records indicate the species occurs regularly on passage through the southern part of the country. The riparian and

					wetland habitats in the AoI provide potentially suitable foraging and staging habitat during migration. However, given its very sparse and irregular breeding presence in Kazakhstan, it is unlikely that the AoI holds a significant proportion of the national population. **Critical Habitat is not triggered.**
Egyptian Vulture	*Neophron percnopterus*	III	EN	No	In Kazakhstan, the species is a summer migrant that breeds during the warmer months. Its nesting distribution is split into two distinct areas: the desert plateaus of the Aral-Caspian region, and the semi-desert mountains of southern and southeastern Kazakhstan. The rocky escarpments and desert plateaus of the Aral-Caspian region adjacent to the AoI fall within the known breeding range of this species, and suitable cliff and rocky outcrop nesting habitat may be present within or near the AoI. However, given its wide distribution across southern Kazakhstan and its relatively stable national population, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Little Egret	*Egretta garzetta*	III	LC	No	This species is associated with shallow wetlands, river margins, lakes and coastal areas. In Kazakhstan, the species occurs primarily as a passage migrant and rare breeding visitor, with records concentrated in the southern and western parts of the country. The riparian wetlands, reed-fringed channels and shallow water bodies in the AoI provide suitable foraging and potential breeding habitat for this species. However, given its predominantly migratory status locally, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Black Stork	*Ciconia nigra*	III	LC	No	In Kazakhstan, this species is a rare breeding migrant, occupying the mountains of the Tien Shan, Dzhungar Alatau, Tarbagatay, Saur and Altai ranges. It breeds in wooded areas close to water, nesting high in trees and foraging in marshy wetlands and rivers. Locally, its known breeding range is concentrated in the eastern and southeastern mountain ranges, well to the east of the AoI. The species may occur in the AoI as a passage migrant, and the riparian tugai woodlands and wetlands of the river corridor provide potentially suitable foraging habitat. However, the AoI is

					unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Booted Eagle	*Hieraaetus pennatus*	III	LC	No	This species breeds in wooded, hilly countryside with some open areas, and winters in the tropics of Africa and South Asia. In Kazakhstan it is a scarce breeding migrant, occurring primarily in the forested mountain ranges and broken terrain of the south and east of the country. The habitat within the AoI is not suitable for this species, though individual birds may be encountered on passage. Given its wide national distribution and the lack of breeding habitat, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Golden Eagle	*Aquila chrysaetos*	III	LC	No	In Kazakhstan this species is a locally common resident, breeding in northern Kazakhstan, the Altai, the Ustyurt plateau, the Kyzylkum desert and the southern mountains, and occurring on migration across the whole country. It inhabits mountains up to 3,000 m, riparian forests in deserts, and small forest patches and groves in the steppe zone. The rocky escarpments, desert plateaus and riparian habitats of the southern Syr Darya region within the AoI fall within the known breeding range of this species. However, the species nests at very low densities, and given its wide distribution across Kazakhstan, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Ibisbill	*Ibidorhyncha struthersii*	III	LC	No	This species occurs on the shingle riverbanks of high plateaus. Within Kazakhstan, the species is recorded along the valleys of rivers including the Bolshaya and Malaya Almatinka, Chilik, Issyk, Karkara, Bayankol and Dzhungar Alatau, all concentrated in the southeastern mountain ranges of the country. The AoI in the southern Syr Darya lowlands does not encompass the high-altitude, stony riverbed habitat required by this species, therefore it is highly unlikely that this species occurs within the AoI. **Critical Habitat is not triggered.**
Black-bellied Sandgrouse	*Pterocles orientalis*	III	LC	No	This species occupies dry open plains, clay sagebrush deserts and semi-arid habitats. In Kazakhstan, the species breeds and occurs on migration across the southern part of the country, and is common on the Ustyurt

					plateau, inhabiting flat and slightly hilly clay sagebrush deserts, crushed stone or pebbly areas, and sandy sagebrush-grass deserts. The desert and semi-desert habitats of the AoI fall squarely within the breeding range of this species locally. However, given its wide distribution, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Pin-tailed Sandgrouse	*Pterocles alchata*	III	LC	No	This species inhabits open areas of stony land, semi-arid areas at the edge of deserts and treeless plains, and does not occur above 1,000 m. The open desert and semi-desert landscapes of the southern Syr Darya region within the AoI fall within the breeding range of the eastern subspecies in Kazakhstan, and suitable habitat is present. However, given its wide distribution, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Tian Shan Brown Bear	*Ursus arctos isabellinus*	III	LC	No	This subspecies occurs in the West and North Tian Shan mountains and the Dzhungar Alatau and inhabits elevations from 1,000 to 4,700 m. The AoI in the southern Syr Darya lowlands does not encompass suitable high-altitude mountain habitat for this species, therefore, it is unlikely that this species is present within the AoI. **Critical Habitat is not triggered.**
Beech Marten	*Martes foina*	III	LC	No	In Kazakhstan, this species is associated with rocky terrain, mountain foothill zones and riparian habitats in the south and southeast of the country, including the Tien Shan and adjacent ranges. The southern Syr Darya region within the AoI may provide marginal habitat in the form of rocky outcrops, cliffs and tugai woodland along the river corridor. However, given its wide national distribution, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Turkestan lynx	*Lynx lynx isabellinus*	III	LC	No	In Kazakhstan, this species' distribution is concentrated in the Tien Shan mountain ranges of the south and southeast of the country. The high-altitude mountain habitat required by this subspecies is entirely absent from the southern Syr Darya lowlands of the AoI. Therefore, it is highly unlikely that this species will be present within the AoI. **Critical Habitat is not triggered.**

Grieg's Tulip	*Tulipa greigii*	III	LC	No	In Kazakhstan, this species grows in detrital and loamy steppes and foothill slopes, and is found only in the western Tien Shan, in the valley of the Syr Darya River and the lands between the Aral and Caspian Sea. The Kyzylorda and Turkestan regions within the AoI fall within the species' documented distribution, and the foothill and stony slope habitats of the Karatau range adjacent to the Syr Darya corridor may support populations of this species. However, given its distribution across multiple protected areas and floristic regions in southern Kazakhstan, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Bearded Vulture	*Gypaetus barbatus*	III	NT	No	This species is associated with the high mountain ranges of the south and southeast of Kazakhstan, particularly the Tien Shan and Altai, where it nests on cliff ledges and forages over open terrain for carcasses and bones. The lowland desert and semi-desert habitats of the southern Syr Darya region within the AoI do not constitute suitable breeding habitat for this species, though occasional wandering individuals may be encountered on foraging flights over the wider landscape. Therefore, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Yellow-eyed Pigeon	*Columba eversmanni*	III	NT	No	This species nests in the valleys of the Syr Darya and Ili rivers in Kazakhstan. In its breeding area it inhabits steppes and other lowland habitats including semi-arid and arid areas, and at one time flocks were numbered in thousands of individuals, but numbers have dwindled sharply. The AoI in the southern Syr Darya region falls directly within the documented breeding range of this species in Kazakhstan, and the riparian and arid lowland habitats of the river corridor provide suitable nesting and foraging conditions. The range is however, vast covering large areas of Kazakstahan, Uzbekistan, Afghaistan, Pakistan, India and China. The AoI may hold a locally important proportion of species but is unlikely to be significant. **Critical Habitat is not triggered. But it should be further assessed for impacts given the breeding population potentially near the project.**

Kaufmann's Tulip	*Tulipa kaufmanniana*	III	NT	No	In Kazakhstan, this species occurs in the Kyzylorda and Turkestan regions within and adjacent to the AoI, and foothill and stony slope habitats in the Karatau range bordering the Syr Darya corridor may support populations of this species. However, given its distribution across multiple floristic regions and protected areas in southern Kazakhstan, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Eastern Imperial Eagle	*Aquila heliaca*	III	VU	No	Kazakhstan hosts approximately half of the species' global breeding population, with 2020 estimates of 3,420–4,260 breeding pairs, making it one of the most important countries for this raptor globally. It breeds widely across plains and foothills, inhabiting small forests and groves in the steppe zone, riparian forests, and sandy deserts with scattered trees. Breeding records are documented from the Aral-Caspian region, and riparian tugai woodland and saxaul groves associated with the Syr Darya corridor within the AoI represent potentially suitable nesting habitat at the southern margin of the species local range. However, the species' core breeding areas lie to the north and centre of the country and given the wide national distribution with a large and relatively stable population, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Marbled Polecat	*Vormela peregusna*	III	VU	No	This species occurs across the desert, semi-desert and steppe habitats of southern Kazakhstan, and the open arid landscapes, desert plateaus and semi-desert plains of the southern Syr Darya region within the AoI represent suitable habitat. However, given its wide distribution locally, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Snow Leopard	*Panthera uncia*	III	VU	No	In Kazakhstan, this species is found in the mountainous regions of the east, primarily in the Altai and Tien Shan mountain ranges, favouring steep and highly rugged terrain with rocky outcrops at elevations generally above 3,000 m. The AoI in the southern Syr Darya lowlands does not encompass any of the high-altitude mountain habitat on which this species depends. Therefore, it is highly unlikely that this species is found within the AoI. **Critical Habitat is not triggered.**

Goitered Gazelle	*Gazella subgutturosa*	III	VU	No	The species occurs across the desert and semi-desert regions of southern Kazakhstan, with key populations documented in the Kyzylkum desert of Kyzylorda region and the northern part of the Turkestan region. The open desert and semi-desert habitats of the southern Syr Darya region within the AoI fall within the documented range of this species in Kazakhstan, and suitable habitat is present. However, given its wide distribution across southern Kazakhstan, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Central Asian Racerunner	*Eremias vermiculata*	IV	LC	No	In Kazakhstan, records are largely associated with the arid desert and semi-desert habitats of the east and southeast of the country, linked to the sandy and gravelly basins of the broader Zungarian and adjacent regions. The flat desert and semi-desert habitats of the southern Syr Darya region within the AoI are geographically distant from the documented Kazakhstani range of this species. Therefore, this species is unlikely to occur within the AoI. **Critical Habitat is not triggered.**
Pallas's Sandgrouse	*Syrrhaptes paradoxus*	IV	LC	No	This species inhabits plain and hilly deserts and semi-deserts with sparse vegetation, and winters in small numbers in the Kyzylkum desert and near the Syr Darya valley. It is a partial migrant, especially from the northern parts of its range, with the extent and distance of southerly winter movement depending on snowfall. The habitats of the southern Syr Darya region within the AoI fall within the species' documented breeding and wintering range. However, given its wide distribution across the steppe and desert zones, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Indian Crested Porcupine	*Hystrix indica*	IV	LC	No	This species' documented local range is concentrated in the southeastern and south-central mountain foothills and is geographically distant from the southern Syr Darya lowlands of the AoI, where the flat desert terrain does not provide the rocky hillsides, foothill topography and suitable burrowing substrate that this species prefers. Therefore, this species is highly unlikely to occur within the AoI. **Critical Habitat is not triggered.**

Red-striped racer	*Platyceps rhodorachis*	IV	LC	No	This species inhabits the steppe and lowland regions of the south, including the Chuy and Talas river valleys and adjacent areas. The rocky escarpments, clay deserts, semi-desert habitats and riparian cliffs of the southern Syr Darya region within the AoI lie within the northern margin of this species' documented range in Kazakhstan, and suitable habitat may be present. However, given its wide distribution across the south of the country, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Demoiselle Crane	*Anthropoides virgo*	V	LC	No	In Kazakhstan this species breeds widely across the steppes and semi-deserts from north to south, and occurs on migration everywhere across the country, with mass movements recorded through the western Tien Shan foothills. The open semi-desert and steppe habitats of the southern Syr Darya region within the AoI fall within the species' breeding and migratory range locally. However, given its very wide distribution across Kazakhstan, the AoI is unlikely to hold a significant proportion of the national population. **Critical Habitat is not triggered.**
Blue Whistling-trush	*Myophonus caeruleus*	V	LC	No	Locally, this species breeds only in the Tien Shan mountain ranges, inhabiting mountain gorges with trees and scrub thickets near rivers or waterfalls at elevations of 1,100–2,700 m. The AoI in the southern Syr Darya lowlands does not encompass the montane habitat required by this species. Therefore, this species is very unlikely to occur within the AoI. **Critical Habitat is not triggered.**

Appendix E

Criterion 2: Endemic and Restricted Range Species

The following provides the assessment of the 3 Endemic or Restricted Range terrestrial and freshwater species that occur or may occur in the project's area of influence and determines whether any meet the Criterion 2 thresholds.

Common Name	Scientific Name	IUCN Status	Critical Habitat	Justification

Syr Darya Shovelnose Sturgeon	*Pseudoscaphirynchus fedtschenkoi*	CR	Yes	The fish species is entirely endemic to the Syr Darya River system and is the sole representative of its genus in this basin. On a simple linear reading, the species' historical range, from the Kara Darya confluence to the lower Syr Darya and formerly the Aral Sea, extends across a total river length of approximately 2,212 km, which technically exceeds the 500 km restricted-range threshold. The IUCN range polygon is, however, drawn around the entire river catchment rather than representing a linear measure of occupied or suitable habitat between any surviving locations. Several critical considerations suggest a different conclusion under a precautionary application of Criterion 2. The Syr Darya has been extensively dammed and these structures have created near-impermeable barriers. If the species persists at all, it almost certainly does so in only one or a very small number of isolated river segments, with the actual linear distance between any surviving populations very likely to be well within the 500 km threshold, and with negligible or no dispersal connectivity between them. During consultation, the IUCN experts stated '*I can say that an extremely small population of the Syr Darya shovelnose sturgeon may still survive at least in the stretch of the Syr Darya from the confluence of the Angren River (also known as Akhangaran and Akhandjaran) down to the town of Yangi Chinaz in Uzbekistan, and further from the Uzbekistan–Kazakhstan border to the Shardara Reservoir, including the reservoir itself*'. This situation is precisely the scenario accommodated by IFC PS6 GN Table 1, which explicitly recognises that freshwater species confined to highly fragmented, insular freshwater systems with limited dispersal potential, and occurring in very few locations, may qualify as restricted-range even where the linear distance between sites technically exceeds 500 km. Regarding the population thresholds, for the same reasons set out under Criterion 1a, any location within the Syr Darya system where the species may still persist would hold an extremely high proportion of a global population that is near-zero or unknown. Therefore, given the near-certain confinement of any surviving population to a single inter-dam river reach, meeting this threshold wherever reproduction occurs is highly plausible.

				The project crosses the Syr Darya River at a location that falls within the inter-dam segment of the river cited by the IUCN experts as one of the last two likely locations. **Therefore, although the species has not been recently scientifically recorded the precautionary approach has been adopted and, Criterion 2 is met,** under the explicit accommodation of IFC PS6 GN Table 1, footnote (c), on grounds of the species' extreme ecological isolation due to river fragmentation, its single-river endemic status, and the near-certainly of any surviving individuals being confined to a very small number of inter-dam river reaches within or adjacent to the project's AoI.
Aral Barbel	*Luciobarbus brachycephalusi*	EN	No	The AoI falls within the core of the only remaining Aral basin population of this species. Surveys of the Aral–Syr Darya basin confirmed its presence at the Basykara Dam, where the species displayed the highest genetic diversity of all sampled sites, suggesting a demographically significant local concentration typical of migratory barbels aggregating at dam structures. However, no site-specific population count exists. The most recent targeted survey captured only 25 individuals across the entire lower Syr Darya, covering a much larger area and none south of the Syr Dara dam, where is now considered extinct. Further, the majority of its range is in the west of Turkmenistan. **Critical Habitat is not triggered.**
Корольков мармараги	*Salvia korolkowii*	VU	No	This species global range spans a narrow area in the Chirchiq River drainage system in Uzbekistan with a single locality documented in Kazakhstan. The Kazakhstan locality represents a single, geographically isolated occurrence at the extreme northern edge of the species' range and does not constitute a significant proportion of the global population. It is highly unlikely that this species will be found within the AoI. **Critical Habitat is not triggered.**

Annex G – Impact Assessment Supporting Tables

This Annex provides the supporting VER sensitivity assessments and impact magnitude scoring used in Chapter 8. The assessment criteria and methodology are presented in Section 5.

Vista Environment

G1 – Design Stage

G1.1 Purpose

This register provides the audit trail for the design-stage ratings in Table 85. Each impact is linked to its VER and sensitivity, the six magnitude factors are shown in plain language with their numerical scores, and significance is then determined from the ESIA significance matrix. Pre-mitigation and residual assessments are shown separately.

G1.2 Significance matrix

Magnitude	Low sensitivity	Moderate sensitivity	High sensitivity	Extreme sensitivity
Negligible	NS	NS	NS	NS
Minor	Low	Low	Medium	Medium
Moderate	Low	Medium	High	High
Major	Medium	High	High	High

Significance determination: calculated magnitude × impact-specific VER sensitivity → significance category from the matrix above.

G1.3 Design-stage impact register

AF001 – Agricultural access and land connectivity

ID	VER	Receptor	Sensitivity
AF001	3	Agricultural access and land connectivity	Moderate

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total score	Magnitude	Significance determination	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	Continuous (7)	High (5)	Irreversible (5)	34	Moderate	Moderate × Moderate	Medium
Residual	Low (3)	Local (2)	Long-term (7)	Infrequent (3)	Low (2)	Reversible (1)	18	Minor	Minor × Moderate	Low

Basis for scoring: Permanent severance is localised to affected agricultural and livestock movement routes but can persist for the life of the railway. Embedded crossing provision substantially reduces the barrier effect, while as-built access verification and practicable corrective measures address remaining location-specific connectivity deficiencies. Some localized increases in journey distance may remain.

AF002 – Irrigation and drainage infrastructure

ID	VER	Receptor	Sensitivity
AF002	4	Irrigation and drainage infrastructure	Moderate

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total score	Magnitude	Significance determination	Significance
Pre-mitigation	Medium (5)	Local (2)	Long-term (7)	Infrequent (3)	Low (2)	Reversible (1)	20	Minor	Minor × Moderate	Minor by score; Moderate precautionary
Residual	Low (3)	Local (2)	Long-term (7)	Infrequent (3)	Low (2)	Reversible (1)	18	Minor	Minor × Moderate	Low

Basis for scoring: The numerical assessment produces a Minor magnitude because potential irrigation disruption is localised, infrequent and reversible through restoration or corrective works. However, a precautionary Moderate magnitude is retained because interruption of irrigation supply during a critical stage of the cropping season could materially affect agricultural production and income for affected land users. This results in **Medium pre-mitigation significance** for a Moderate-sensitivity receptor.

AF007 – Groundwater resources / hydrogeological regime

ID	VER	Receptor	Sensitivity
AF007	28	Groundwater resources / hydrogeological regime	Moderate (impact-specific)

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total score	Magnitude	Significance determination	Significance
Pre-mitigation	Medium (5)	Local (2)	Long-term (7)	Continuous (7)	Low (2)	Reversible (1)	24	Minor by score; Moderate precautionary	Moderate	Medium
Residual	Medium (5)	Local (2)	Long-term (7)	Continuous (7)	Low (2)	Reversible (1)	24	Minor by score; Moderate precautionary	Moderate	Medium

Basis for scoring: The six-factor numerical score produces a Minor magnitude. However, the ESIA applies a precautionary override to Moderate magnitude because site-specific verification of potential shallow-groundwater and agricultural-drainage impedance remains outstanding. Moderate precautionary magnitude × Moderate sensitivity

results in Medium significance. The same rating is retained residually pending completion of the targeted assessment and confirmation of the effectiveness of any required corrective measures.

AR001 – Known archaeological sites and associated protection zones

ID			VER			Receptor		Sensitivity		
AR001			9			Known archaeological sites and associated protection zones		High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	Medium (5)	Very local (1)	Permanent (10)	Frequent (5)	Low (2)	Irreversible (5)	28	Moderate	High	High
Residual	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC

Basis for scoring: Direct physical loss or disturbance of known archaeological resources would be permanent and irreversible. The six-factor assessment gives Moderate magnitude which, combined with High receptor sensitivity, results in High pre-mitigation significance. Residual magnitude and significance remain TBC pending receptor-by-receptor verification of avoidance, archaeological investigation or excavation, authority clearance and any realised irreversible loss.

AR002 – Known archaeological sites and associated protection zones

ID			VER			Receptor		Sensitivity		
AR002			9			Known archaeological sites and associated protection zones		High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	Continuous (7)	High (5)	Reversible (1)	30	Moderate	Moderate × High	Medium
Residual	Low (3)	Local (2)	Long-term (7)	Infrequent (3)	Moderate (3)	Reversible (1)	19	Minor	Minor × High	Medium*

Basis for scoring: Setting effects remain possible after design mitigation. Under Table 43, Minor magnitude × High sensitivity gives Medium significance. *This does not reproduce the Low residual significance currently shown in Table 85 and requires close-out.

HG001 – Hydrological regime / flood-risk receptors

ID			VER			Receptor		Sensitivity	
HG001			13			Hydrological regime / flood-risk receptors		Moderate	
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	Continuous (7)	Moderate (3)	Reversible (1)	28	Moderate	Moderate × Moderate	Medium
Residual	Low (3)	Local (2)	Long-term (7)	Infrequent (3)	Low (2)	Reversible (1)	18	Minor	Minor × Moderate	Low

Basis for scoring: The permanent embankment can alter or impede surface-water flow, potentially causing localized ponding, increased flood extent, erosion or scour. Embedded culverts, bridges and other hydraulic openings substantially maintain cross-corridor connectivity. As-built hydraulic verification, climate-adjusted capacity checks and corrective measures where required reduce remaining effects to localized and remediable impacts.

LV001 – Landscape character

ID			VER			Receptor		Sensitivity	
LV001			14			Landscape character		Moderate	
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	Medium (5)	Regional (3)	Permanent (10)	Continuous (7)	High (5)	Reversible (1)	31	Moderate	Moderate × Moderate	Medium
Residual	Medium (5)	Regional (3)	Permanent (10)	Continuous (7)	High (5)	Reversible (1)	31	Moderate	Moderate × Moderate	Medium

Basis for scoring: The railway introduces a permanent and continuous engineered feature across the corridor, with greater landscape contrast in the open steppe and Shardara Reservoir sections. The principal landscape change is now largely a realized design outcome. Treatment of permanent facilities can reduce local prominence but cannot remove the fundamental landscape change; therefore Moderate magnitude and Medium significance are retained residually.

LV002 – Residential visual receptors / public views

ID			VER			Receptor		Sensitivity	
LV002			14			Residential visual receptors / public views		Moderate	
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	Continuous (7)	High (5)	Reversible (1)	30	Moderate	Moderate × Moderate	Medium
Residual	Medium (5)	Local (2)	Permanent (10)	Continuous (7)	High (5)	Reversible (1)	30	Moderate	Moderate × Moderate	Medium

Basis for scoring: Visual effects at settlements and other sensitive viewpoints are permanent. Local design and reinstatement measures reduce prominence but do not remove the new railway from views.

PG001 – Shardara Reservoir IBA/KBA

ID			VER			Receptor		Sensitivity	
PG001			33			Shardara Reservoir IBA/KBA		Extreme	
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	High (8)	Regional (3)	Permanent (10)	Continuous (7)	High (5)	Irreversible (5)	38	Major	Major × Extreme	High
Residual	High (8)	Regional (3)	Permanent (10)	Continuous (7)	High (5)	Irreversible (5)	38	Major	Major × Extreme	High

Basis for scoring: The Project results in a permanent footprint and fragmentation effect within the internationally recognized Shardara Reservoir IBA/KBA and associated Critical Habitat. Embedded footprint minimization and additional bridge openings reduce the extent and fragmentation effect but do not remove the permanent interaction; Major magnitude and High significance are therefore retained residually. Achievement of No Net Loss for the IBA/KBA and Net Gain for the Critical Habitat values remains conditional on implementation and verification of the BAP measures.

TE064 – IUCN-listed mammals

ID			VER			Receptor		Sensitivity		
TE064			77			IUCN-listed mammals		High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	Low (3)	Local (2)	Long-term (7)	Infrequent (3)	Moderate (3)	Reversible (1)	19	Minor	Minor × High	Medium
Residual	Negligible (1)	Very local (1)	Medium-term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × High	NS

Basis for scoring: The permanent railway may restrict mammal movement, but cross-corridor structures provide movement opportunities and reduce the residual barrier effect to negligible magnitude.

TE079 – IUCN-listed reptiles

ID			VER			Receptor		Sensitivity		
TE079			78			IUCN-listed reptiles		High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total score**	**Magnitude**	**Significance determination**	**Significance**
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	Frequent (5)	High (5)	Reversible (1)	28	Moderate	Moderate × High	Medium
Residual	Low (3)	Local (2)	Long-term (7)	Infrequent (3)	Moderate (3)	Reversible (1)	19	Minor	Minor × High	Medium*

Basis for scoring: Residual fragmentation remains Minor after connectivity measures. Under Table 43, Minor magnitude × High sensitivity gives Medium significance. *This does not reproduce the Low residual significance currently shown in Table 85 and requires close-out.

CS007 – Community safety design risk

ID		VER		Receptor		Sensitivity	
CS007		23		Local communities within the Project Area of Influence		High	
Assessment	**Method**	**Risk basis**		**Significance determination**		**Significance**	
Pre-mitigation	Risk-based	Potential serious injury or fatality at an unmanaged public/rail interface.		Likelihood–consequence / professional risk judgement		High	
Residual	Risk-based	Permanent crossing standards, fencing and access controls		Likelihood–consequence / professional risk judgement		Medium	

ID	VER	Receptor	Sensitivity
		reduce but do not eliminate public/rail interface risk.	

CS007 is not forced through the six-factor environmental-change magnitude equation because the assessment concerns a safety-risk pathway with potentially severe consequences.

G2.4 Close-out items before final issue

- AR001 – confirm residual magnitude and significance after receptor-by-receptor archaeological verification.
- AR002 – Minor residual magnitude × High sensitivity gives Medium under Table 43; reconcile with the Low residual rating currently shown in Table 85.
- TE079 – Minor residual magnitude × High sensitivity gives Medium under Table 43; reconcile with the Low residual rating currently shown in Table 85.
- AF007 – retain the precautionary Moderate magnitude / Medium significance override only while targeted groundwater/drainage verification remains outstanding.

Vista Environment

G2 – Land Take, Construction, and Operations & Maintenance

G2.1 Purpose and status

This register extends the design-stage assessment register to the remaining impact tables in Chapter 8. It links each impact to its VER, shows the six magnitude factors in plain language with their scores, and verifies significance by combining magnitude with VER sensitivity using Table 43. The register is a QA working annex for finalisation of the ESIA.

Important: Where Chapter 8 does not explicitly state a separate post-mitigation magnitude, the residual factor set below is a matrix-equivalent reconstruction used to test whether the reported residual significance can be reproduced. It must not be presented as an original specialist calculation unless confirmed during final QA. Rows marked REVIEW require reconciliation before final issue.

G2.2 Significance matrix

VER sensitivity	Negligible	Minor	Moderate	Major
Extreme	NS	Medium	High	High
High	NS	Medium	High	High
Moderate	NS	Low	Medium	High
Low	NS	Low	Low	Medium

Significance is determined from the matrix; it is not calculated by adding another numerical score.

G2.3 Land Take

AF004 – Existing land uses adjacent to the alignment

ID			VER			Receptor			Baseline sensitivity		
AF004			16			Existing land uses adjacent to the alignment			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate	Medium	OK
Residual	Medium (5)	Local (2)	Long term (7)	Frequent (5)	High (3)	Irreversible (5)	27	Moderate	Moderate ×	Medium	OK

Impact pathway / basis: Permanent acquisition for the railway Right of Way and associated infrastructure results in irreversible loss of residential, commercial and productive agricultural land from its existing use, while temporary construction occupation results in time-limited loss of use. Compensation, livelihood restoration and other LARP

measures address effects on affected persons but do not reverse permanent land acquisition. The residual physical land-use impact therefore remains Moderate magnitude and Medium significance.

SE001 – Agricultural livelihoods and income

ID			VER			Receptor			Baseline sensitivity		
SE001			24			Agricultural livelihoods and income			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Moderate	Medium	OK
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Moderate	Low	OK

Impact pathway / basis: Loss or interruption of income and livelihood activities may arise from acquisition of productive land and assets, temporary occupation, residual-plot fragmentation, irrigation constraints and altered access. Although the underlying acquisition of land may be permanent, the SE001 impact concerns livelihood and income consequences rather than physical land loss. Replacement-cost compensation, targeted livelihood restoration and monitoring provide mechanisms to restore income sources and productive capacity, supporting a reduction from Moderate magnitude / Medium significance to Minor magnitude / Low residual significance.

TE001 – Shardara IBA/KBA

ID	VER	Receptor	Baseline sensitivity
TE001	33	Shardara IBA/KBA	Extreme

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High
Residual	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High

Impact pathway / basis: Permanent loss of approximately 150 ha of habitat within the Shardara IBA/KBA beneath the permanent Project footprint. Footprint minimisation and biodiversity management do not reverse the permanent habitat loss; Moderate magnitude and High significance are therefore retained residually.

TE006 – Dalmatian Pelican

ID	VER	Receptor	Baseline sensitivity
TE006	46	Dalmatian Pelican	Extreme

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High
Residual	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High

Impact pathway / basis: Permanent loss of habitat within the approximately 150 ha IBA/KBA footprint used by Dalmatian Pelican. The physical habitat loss remains permanent and irreversible; residual biodiversity outcomes are addressed through the BAP and associated NNL/Net Gain measures.

TE018 – Migratory bird assemblage

ID	VER	Receptor	Baseline sensitivity
TE018	64	Migratory bird assemblage	Extreme

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High
Residual	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High

Impact pathway / basis: Permanent loss of habitat within the IBA/KBA used by the migratory bird assemblage. The permanent physical loss is not reversed by subsequent biodiversity management or offset action.

TE024 – Other threatened bird species

ID	VER	Receptor	Baseline sensitivity
TE024	83	Other threatened bird species	Extreme

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Extreme	Medium

Impact pathway / basis: Permanent loss of wetland habitat potentially used by other threatened bird species results in Moderate pre-mitigation magnitude and High significance. The detailed biodiversity assessment supports Minor residual magnitude following mitigation, giving Medium residual significance.

TE028 – Overwintering waterbird assemblage

ID	VER	Receptor	Baseline sensitivity
TE028	37	Overwintering waterbird assemblage	Extreme

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Extreme	Medium

Impact pathway / basis: Permanent habitat loss within the IBA/KBA affects habitat used by the overwintering waterbird assemblage. Following the mitigation response described in the biodiversity assessment, residual magnitude is Minor and significance Medium.

TE032 – Breeding bird assemblage

ID	VER	Receptor	Baseline sensitivity
TE032	38	Breeding bird assemblage	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × High	Medium

Impact pathway / basis: Permanent loss of wetland and foreshore habitat used by breeding birds gives Moderate magnitude and High pre-mitigation significance. Following mitigation, Minor residual magnitude × High sensitivity gives Medium significance.

TE036 – Other bird species of conservation significance

ID	VER	Receptor	Baseline sensitivity
TE036	75	Other bird species of conservation significance	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × High	Medium

Impact pathway / basis: Permanent habitat loss within the IBA/KBA affects other bird species of conservation significance. Moderate × High gives High pre-mitigation significance; Minor × High gives Medium residual significance.

TE040 – Lesser White-fronted Goose / other threatened bird receptors

ID	VER	Receptor	Baseline sensitivity
TE040	83	Lesser White-fronted Goose / other threatened bird receptors	Extreme

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × Extreme	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Extreme	Medium

Impact pathway / basis: Permanent habitat loss affects Lesser White-fronted Goose and other relevant threatened bird receptors. Moderate × Extreme gives High pre-mitigation significance; Minor × Extreme gives Medium residual significance.

TE058 – Reedbed, floodplain grassland, scrub and other Natural Habitat associated with Shardara Reservoir

ID	VER	Receptor	Baseline sensitivity
TE058	65	Reedbed, floodplain grassland, scrub and other Natural Habitat associated with Shardara Reservoir	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × High	Medium

Impact pathway / basis: Permanent loss of Natural Habitat occurs within the approximately 150 ha IBA/KBA footprint. Moderate magnitude × High sensitivity gives High pre-mitigation significance. Following the mitigation response, Minor residual magnitude × High sensitivity gives Medium significance.

TE069 – IUCN- and Kazakhstan Red Data Book-listed flora

ID	VER	Receptor	Baseline sensitivity
TE069	76	IUCN- and Kazakhstan Red Data Book-listed flora	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × High	High
Residual	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC

Impact pathway / basis: Permanent loss of suitable terrestrial habitat within the permanent railway footprint may affect flora of conservation significance. Moderate magnitude × High sensitivity gives High pre-mitigation significance. Residual magnitude and significance require reconciliation with the detailed biodiversity assessment before the currently reported Low residual significance can be retained.

TE078 – IUCN-listed reptiles

ID	VER	Receptor	Baseline sensitivity
TE078	78	IUCN-listed reptiles	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Moderate × High	High
Residual	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC

Impact pathway / basis: Permanent loss of approximately 650 ha of suitable steppe/semi-desert pasture and scrub habitat within the permanent railway footprint. Moderate magnitude × High sensitivity gives High pre-mitigation significance. Residual magnitude

G2.4 Construction

AF002 – Interruption or modification of irrigation infrastructure

ID			VER			Receptor			Baseline sensitivity		
AF002			4			Irrigation and drainage infrastructure and agricultural land users dependent on irrigation supply			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Medium (5)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	21	Moderate	Moderate × Moderate	Medium	OK
Residual	Low (3)	Local (2)	Short term (3)	Infrequent (3)	Low (2)	Reversible (1)	14	Minor	Minor × Moderate	Low	OK

Impact pathway / basis: Construction at canal crossings, embankment works and relocation or reconstruction of irrigation and drainage infrastructure may temporarily interrupt irrigation supply, alter flows, damage infrastructure or restrict access for operation and maintenance, with potential effects on crop production and agricultural livelihoods. Historical concerns and reported impacts require verification through the Irrigation and Access Impact Assessment. Following verification, restoration or alternative supply arrangements and implementation of any required corrective measures, remaining effects are expected to be localized, short-term and reversible.

AF003 – Irrigation and drainage infrastructure

ID			VER			Receptor			Baseline sensitivity		
AF003			4			Irrigation and drainage infrastructure			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	OK
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × Moderate	NS	OK

Impact pathway / basis: Accidental release of fuels, oils or chemicals from storage, refueling, maintenance or construction plant may contaminate agricultural land or enter irrigation channels, potentially transporting contaminants downstream to multiple agricultural holdings. With bunded storage, controlled refueling, plant maintenance, spill-response provision and routine inspection, the probability and extent of contamination are reduced such that no significant residual impact is expected.

AF005 – Intensive agricultural production infrastructure, including polytunnels and covered cultivation

ID			VER			Receptor			Baseline sensitivity		
AF005			5			Intensive agricultural production infrastructure, including polytunnels and covered cultivation			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	OK
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × Moderate	NS	OK

Impact pathway / basis: Soiling of crops, polytunnels and other intensive agricultural infrastructure by fugitive construction dust.

AQ001 – Ambient air quality at communities adjacent to the new alignment

ID			VER			Receptor			Baseline sensitivity		
AQ001			8			Ambient air quality at communities adjacent to the new alignment			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × Moderate	NS	OK
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × Moderate	NS	OK

Impact pathway / basis: Dust and gaseous emissions associated with concrete batching and related construction activities, with potential localized effects on ambient air quality at nearby communities and other sensitive receptors.

AQ002 – Ambient air quality at communities adjacent to the new alignment

ID			VER			Receptor			Baseline sensitivity		
AQ002			8			Ambient air quality at communities adjacent to the new alignment			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	REVIEW: matrix = Low
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Moderate	Low	OK

Impact pathway / basis: Combustion emissions from diesel-powered mobile construction plant, machinery and vehicles may temporarily affect ambient air quality at communities close to active work fronts, haul routes and construction compounds.

AQ003 – Ambient air quality at communities adjacent to the new alignment

ID			VER			Receptor			Baseline sensitivity		
AQ003			8			Ambient air quality at communities adjacent to the new alignment			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	REVIEW: matrix = Low
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Moderate	Low	OK

Impact pathway / basis: Fugitive dust from earthworks, excavation, stockpiles, material handling, vehicle movements and exposed surfaces may temporarily affect ambient air quality at nearby communities. Although the IAQM assessment identifies a High Risk construction-dust management classification, effects at individual community receptors are localized, temporary and reversible.

AQ004 – Ambient air quality at communities adjacent to the new alignment

ID			VER			Receptor			Baseline sensitivity		
AQ004			8			Ambient air quality at communities adjacent to the new alignment			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	REVIEW: matrix = Low
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × Moderate	NS	OK

Impact pathway / basis: Criteria-pollutant emissions from stationary construction equipment, including generators and other combustion sources, with potential localized effects on ambient air quality at nearby communities.

AR003 – Previously unidentified archaeological resources / chance finds

ID	VER	Receptor	Baseline sensitivity
AR003	10	Previously unidentified archaeological resources / chance finds	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance	QA
Pre-mitigation	Medium (5)	Very local (1)	Permanent (10)	Rare (2)	Low (2)	Irreversible (5)	25	Moderate	Moderate × High	High	OK
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × High	NS	OK

Impact pathway / basis: Potential discovery and inadvertent disturbance or irreversible loss of previously unidentified archaeological material during excavation and other ground-disturbing works. An uncontrolled impact on an archaeological find could be permanent and irreversible, but the occurrence of such a find is uncertain and expected to be localized. Implementation of the Archaeological Chance Finds Protocol, including immediate cessation of works, notification, assessment, appropriate recovery or in-situ preservation, and authority clearance before works resume, reduces the residual impact to Negligible magnitude and Not Significant (NS).

CS001 – Local communities within the Project Area of Influence

ID	VER	Receptor	Baseline sensitivity
CS001	23	Local communities within the Project Area of Influence	High

Assessment	Method	Impact / risk pathway	Reported significance	QA
Pre-mitigation	Risk-based / parallel likelihood-consequence assessment	Injury or other community-safety incidents caused by public encroachment into active work fronts, storage areas or construction compounds.	Medium	OK
Residual	Risk-based after committed controls	Residual risk after implementation of committed mitigation and operational controls.	Low	Risk conclusion – verify against narrative

Uncontrolled public access to active construction areas may expose community members to moving plant, excavations, construction materials and other physical hazards. Risk is elevated where works occur close to settlements or intersect established pedestrian or informal vehicle routes. Physical access controls, community notification, alternative access arrangements and construction supervision reduce the residual community-safety risk.

CS002 – Residents along construction access and haul routes

ID	VER	Receptor	Baseline sensitivity
CS002	12	Residents along construction access and haul routes	High

Assessment	Method	Impact / risk pathway	Reported significance	QA
Pre-mitigation	Risk-based / parallel likelihood-consequence assessment	Increased road-traffic accident risk to communities arising from Project construction vehicles and material haulage.	Medium	REVIEW – baseline matrix gives High
Residual	Risk-based after committed controls	Residual risk after implementation of committed mitigation and operational controls.	Low	Risk conclusion – verify against narrative

CS003 – Local communities within the Project Area of Influence

ID	VER	Receptor	Baseline sensitivity
CS003	23	Local communities within the Project Area of Influence	High

Assessment	Method	Impact / risk pathway	Reported significance	QA
Pre-mitigation	Risk-based / parallel likelihood-consequence assessment	Community consequences of construction emergencies, including fires, major spills and Project-related transport incidents requiring effective emergency response.	Medium	REVIEW – baseline matrix gives High
Residual	Risk-based after committed controls	Residual risk after implementation of committed mitigation and operational controls.	Low	Risk conclusion – verify against narrative

Impact pathway / basis: Major construction emergencies are expected to be infrequent but could have significant consequences for nearby communities if incidents are not rapidly contained or emergency-response arrangements are inadequate. A Construction Emergency Response Plan, coordination with external responders, community-notification procedures and periodic drills reduce the likelihood of escalation and the residual community-safety risk.

MR001 – Regional construction material resources

ID			VER			Receptor			Baseline sensitivity		
MR001			18			Regional construction material resources			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	OK
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × Moderate	NS	OK

Impact pathway / basis: Project demand for aggregate, gravel, soil and other construction materials potentially placing pressure on existing local supply capacity or inducing additional extraction and transport impacts.

NO002 – Noise-sensitive human receptors

ID	VER	Receptor	Baseline sensitivity
NO002	20	Noise-sensitive human receptors	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance	QA
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × High	Medium	OK
Residual – general corridor	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × High	NS	OK
Residual – Maktaaral & Erdaulet station areas	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × High	Medium	OK

Impact pathway / basis: Construction noise from earthworks, piling, compaction plant, concrete batching and construction traffic may cause nuisance and amenity disturbance at noise-sensitive human receptors. Effects are temporary and geographically mobile as works progress. Implementation of source, pathway and receptor controls reduces impacts to Negligible/NS at the majority of locations, while Minor/Medium residual impacts are retained at Maktaaral and Erdaulet station areas due to receptor concentration and the longer duration of station construction.

NO004 – Buildings and structures sensitive to vibration

ID			VER			Receptor			Baseline sensitivity		
NO004			72			Buildings and structures sensitive to vibration			High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Medium (5)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	21	Moderate	Moderate × High	High	OK
Residual	Low (3)	Local (2)	Short term (3)	Infrequent (3)	Low (2)	Reversible (1)	14	Minor	Minor × High	Medium	OK

Impact pathway / basis: Perceptible ground-borne vibration from earthworks, embankment compaction, piling and other heavy construction activities may cause annoyance and disturbance at nearby noise- and vibration-sensitive human receptors. Effects are concentrated at receptors close to vibration-generating works and cease when the relevant activities are completed. Condition surveys, real-time vibration monitoring, trigger/action levels, alternative working methods, restrictions on high-vibration activities and community notification reduce the frequency, intensity and duration of residual disturbance.

SG001 – Soil resources

ID			VER			Receptor			Baseline sensitivity		
SG001			29			Soil resources			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	OK
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Moderate	Low	OK

Impact pathway / basis: Compaction, mixing and deterioration of soil physical, chemical and biological structure during construction and temporary land use.

SG002 – Other watercourses, canals, drains and ditches

ID	VER	Receptor	Baseline sensitivity
SG002	43	Other watercourses, canals, drains and ditches	Moderate

Assessment	Method	Impact / risk pathway	Reported significance	QA
Pre-mitigation	Risk-based / parallel likelihood-consequence assessment	Diffuse and point-source pollution of watercourses and drainage features from spills, sediment and runoff from construction areas.	Low	OK
Residual	Risk-based after committed controls	Residual risk after implementation of committed mitigation and operational controls.	NS	Risk conclusion – verify against narrative

Impact pathway / basis: Construction may introduce sediment, hydrocarbons, chemicals, cementitious material or other pollutants to watercourses, irrigation channels and drainage systems through runoff, spills or uncontrolled discharges. Pollution-prevention measures, prohibition of untreated discharges, watercourse-specific sediment controls and monitoring at the Syr Darya/Shardara system reduce the residual pollution risk to Not Significant.

SG003 – Land affected by existing contamination

ID			VER			Receptor			Baseline sensitivity		
SG003			31			Land affected by existing contamination			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Moderate	Low	OK
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × Moderate	NS	OK

Impact pathway / basis: Mobilisation of pre-existing soil or groundwater contamination during excavation and the associated requirement for appropriate handling and disposal.

TE002 – Shardara IBA/KBA

ID	VER	Receptor	Baseline sensitivity
TE002	33	Shardara IBA/KBA	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance	QA
Pre-mitigation	Medium (5)	Regional (3)	Medium term (5)	Frequent (5)	Certain (5)	Reversible (3)	26	Moderate	Moderate × High	High	OK
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × High	Medium	OK

Impact pathway / basis: Temporary loss of at least approximately 20 ha of wetland habitat for construction compounds, spoil storage and working areas. Although temporary and reversible, habitat loss may displace breeding waterbirds and reduce available foraging and roosting habitat during ecologically sensitive periods.TE003 – Shardara IBA/KBA

ID	VER	Receptor	Baseline sensitivity
TE003	33	Shardara IBA/KBA	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance	QA
Pre-mitigation	Medium (5)	Regional (3)	Medium term (5)	Frequent (5)	Certain (5)	Reversible (3)	26	Moderate	Moderate × High	High	OK
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × High	Medium	OK

Impact pathway / basis: Construction disturbance from earthworks, piling, noise, artificial lighting, vehicle movements and human activity affecting waterbirds and other wildlife within and adjacent to the IBA/KBA. Seasonal restrictions, control of construction areas, lighting controls and noise-management measures reduce the intensity and frequency of disturbance but do not eliminate it during remaining construction activities.

TE004 – Shardara IBA/KBA

ID	VER	Receptor	Baseline sensitivity
TE004	33	Shardara IBA/KBA	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance	QA
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × High	Medium	OK
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Negligible × High	NS	OK

Impact pathway / basis: Pollution of water, soil and habitat within the IBA/KBA from sediment-laden runoff, fuels, chemicals and other construction-related releases. Sediment controls, bunded storage, controlled refuelling, spill-response measures, erosion controls and restrictions on potentially polluting activities reduce the likelihood and extent of residual pollution effects

TE005 – Shardara IBA/KBA

ID	VER	Receptor	Baseline sensitivity
TE005	33	Shardara IBA/KBA	High

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Magnitude × sensitivity	Significance	QA
Pre-mitigation	Medium (5)	Regional (3)	Medium term (5)	Frequent (5)	Certain (5)	Reversible (3)	26	Moderate	Moderate × High	High	OK
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × High	Medium	OK

Impact pathway / basis: Temporary hydrological fragmentation caused by embankment construction, potentially affecting approximately 500 ha of reservoir habitat and approximately 3.25 million m^3 of active water storage west of the embankment, with potential secondary effects on waterbirds, fish movement and wetland vegetation. Hydrological connectivity is substantially restored through the bridge openings incorporated into the embankment.

TE007 – Dalmatian Pelican

ID			VER			Receptor			Baseline sensitivity		
TE007			46			Dalmatian Pelican			High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Extreme	Medium	OK
Residual	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	Low	REVIEW

Impact pathway / basis: Construction disturbance to Dalmatian Pelican through noise, lighting, machinery and human activity. QA note: REVIEW – Residual: cannot reproduce Low from baseline sensitivity without impact-specific sensitivity or further justification

TE008 – Dalmatian Pelican

ID			VER			Receptor			Baseline sensitivity		
TE008			46			Dalmatian Pelican			Extreme		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Magnitude × sensitivity**	**Significance**	**QA**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Minor × Extreme	Medium	OK
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Minor × Extreme	Medium	OK

Impact pathway / basis: Temporary hydrological fragmentation affecting habitat used by Dalmatian Pelican.

TE009 – Dalmatian Pelican

ID	VER	Receptor	Baseline sensitivity
TE009	46	Dalmatian Pelican	Extreme

Assessment	Method	Impact / risk pathway	Reported significance	QA
Pre-mitigation	Risk-based / parallel likelihood-consequence assessment	Risk of direct injury or mortality during site clearance and construction.	Medium	OK
Residual	Risk-based after committed controls	Residual risk after implementation of committed	Low	Risk conclusion – verify against narrative

ID	VER	Receptor	Baseline sensitivity
		mitigation and operational controls.	

Site clearance and construction activities create a localized risk of direct injury or mortality to individual Dalmatian Pelicans where birds occur within or immediately adjacent to active work areas. The pre-mitigation impact is assessed as Minor magnitude and Medium significance. Following implementation of committed biodiversity controls, including restriction of works to defined areas, pre-clearance checks where relevant, ecological supervision and responsive controls where birds are present, the probability of direct harm is substantially reduced. For this residual direct-harm pathway, impact-specific susceptibility is assessed as Moderate, giving Low residual significance. The Extreme baseline conservation value of the Dalmatian Pelican is unchanged.

TE010 – Raptors and vultures of conservation significance

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Extreme	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Construction noise, lighting, machinery and human activity may temporarily displace raptors and vultures from active work areas and could result in disturbance of breeding birds where active nests occur close to construction. VER 74 retains its Extreme baseline conservation sensitivity. Following implementation of the committed controls, including pre-construction nest surveys of suitable habitat within 500 m of the alignment, protection of active nests and continuing construction monitoring, the spatial and temporal exposure of birds to material disturbance is substantially reduced. For the residual disturbance pathway, impact-specific susceptibility is therefore assessed as Moderate. Minor residual magnitude × Moderate impact-specific sensitivity gives Low residual significance, consistent with the biodiversity assessment and Table 87

TE011 – Raptors and vultures of conservation significance

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Extreme	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

VER 74 retains its Extreme baseline conservation sensitivity. Direct mortality during site clearance is considered very low probability due to raptor mobility and sensitivity to human approach. Following pre-construction nest surveys, active-nest avoidance/protection and construction monitoring, Moderate impact-specific sensitivity is applied to the residual direct-harm pathway.

TE012 – Overwintering waterbird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Medium term (5)	Continuous (7)	Certain (5)	Reversible (3)	27	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Construction activity during the wintering period may displace significant numbers of waterbirds from areas close to the embankment through plant and vehicle movements, earthworks, piling, human presence, noise and artificial lighting. Monitoring during active construction in February 2026 confirmed continued use of the reservoir adjacent to construction, indicating some tolerance, although counts were substantially lower than in February 2025. The pre-mitigation disturbance pathway is therefore assessed as Moderate magnitude, reflecting the narrative description of the effect as moderate to high, certain and continuous. Following seasonal controls, regular waterbird monitoring and responsive modification of disruptive activities where material displacement is identified, the residual disturbance pathway is reduced to Minor magnitude and Moderate impact-specific susceptibility, giving Low residual significance.

TE016 – Migratory bird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Construction activity may temporarily displace migratory birds from feeding and resting areas during spring and autumn passage. VER 64 has High baseline sensitivity, consistent with the biodiversity narrative. The pre-mitigation impact is explicitly assessed in the narrative as Minor magnitude and Medium significance. Following seasonal controls, regular waterbird counts and responsive modification of construction activities where material displacement is identified, Moderate impact-specific susceptibility is applied to the residual disturbance pathway. Minor × Moderate = Low, consistent with the narrative.

TE017 – Migratory bird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Temporary damming and associated changes in water levels and hydrological connectivity may alter shallow-water and foreshore habitat used by migratory birds during passage. The biodiversity narrative identifies the effect as temporary and largely reversible once hydraulic connectivity is established and explicitly

assesses the impact as Minor magnitude and Medium significance before mitigation, reducing to Low following mitigation. VER 64 has High baseline sensitivity. Following implementation of the construction controls, Moderate impact-specific susceptibility is applied to the residual fragmentation pathway. Minor × Moderate = Low.

TE019 – Migratory bird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Site clearance and construction create a localized risk of direct injury or mortality to migratory birds, particularly where birds settle on newly cleared areas, exposed ground or temporary waterbodies during peak passage. The narrative specifically identifies the probability of direct mortality as low for most migratory species. VER 64 has High baseline sensitivity. Following seasonal controls, restriction of works to defined areas, construction monitoring and responsive controls during migration periods, Moderate impact-specific susceptibility is applied to the residual direct-harm pathway. Minor × Moderate = Low, consistent with the Section 8 narrative.

TE021 – Raptors and vultures of conservation significance

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Extreme	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: TE021 concerns localized risk of direct injury or mortality to raptors and vultures during site clearance and construction. As with TE011, the Section 8 narrative identifies direct mortality during site clearance as very low probability because of raptor mobility and sensitivity to human approach. VER 74 retains its Extreme baseline conservation sensitivity. Pre-construction nest surveys, active-nest avoidance/protection and construction monitoring reduce exposure to the direct-harm pathway. Moderate impact-specific susceptibility is therefore applied to the residual pathway, giving Minor × Moderate = Low.

TE022 – Other threatened bird species

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Extreme	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Construction noise, lighting, machinery and human activity may temporarily disturb threatened bird species occurring within or adjacent to active work areas. VER83 retains its Extreme baseline conservation sensitivity. Following the biodiversity construction controls, including restriction of works to defined areas, seasonal/pre-clearance checks where applicable, ecological monitoring and responsive controls where threatened birds are identified, exposure to material disturbance is reduced. For the residual disturbance pathway, Moderate impact-specific susceptibility is applied. Minor × Moderate = Low.

TE023 – Other threatened bird species

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Extreme	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Temporary damming during embankment construction may alter water levels and hydrological connectivity and consequently affect wetland, shallow-water and foreshore habitats potentially used by threatened bird species. VER83 retains its Extreme baseline conservation sensitivity. The effect is temporary and reversible following restoration of hydraulic connectivity. Following implementation of the committed construction and biodiversity controls, exposure of threatened bird species to the fragmentation pathway is reduced. Moderate impact-specific susceptibility is therefore applied to the residual pathway, giving Minor × Moderate = Low.

TE025 – Other threatened bird species

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Extreme	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Site clearance and construction create a localized risk of direct injury or mortality to threatened bird species where individuals occur within or immediately adjacent to active work areas. VER83 retains its Extreme baseline conservation sensitivity. Following restriction of works to defined areas, appropriate pre-clearance checks, ecological supervision and responsive controls where threatened species are identified, exposure to the direct-harm pathway is substantially reduced. Moderate impact-specific susceptibility is applied to the residual pathway, giving Minor × Moderate = Low.

TE026 – Overwintering waterbird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Medium term (5)	Continuous (7)	Certain (5)	Reversible (3)	27	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Construction between October and March can displace significant numbers of wintering waterbirds through plant and vehicle movements, earthworks, piling, human presence, noise and artificial lighting. Section 8 explicitly describes the pre-mitigation effect as moderate to high magnitude, certain and continuous, while the assemblage itself is assessed as High sensitivity. The Moderate matrix category is therefore the appropriate conservative representation of that narrative, producing High pre-mitigation significance. KTZ_DM 260926

Mitigation includes scheduling the most intensive open-water works outside October–March wherever possible, continual waterbird counts, and adaptive changes to timing, intensity or spatial extent where monitoring identifies material displacement. Section 8 then explicitly concludes that temporary disturbance is Low residual significance following mitigation.

TE027 – Overwintering waterbird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (3)	23	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Temporary damming and associated changes to reservoir hydrology may reduce the area and quality of shallow foraging habitat available to wintering birds in the western basin. Section 8 states that the effect depends on the timing and method of embankment construction relative to the winter period and the duration of temporary changes in water level and connectivity, and explicitly calls this a Moderate-magnitude impact. Annex_G_Consolidated_All_Phases…

With the assemblage's High baseline sensitivity, Moderate × High gives High pre-mitigation significance. Following seasonal scheduling, waterbird monitoring, restoration of hydraulic connectivity and adaptive controls, Section 8 concludes that fragmentation and other temporary impacts are manageable and have Low residual significance.

TE029 – Overwintering waterbird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Site clearance and construction within wetland and foreshore habitats may cause direct injury or mortality to individual wintering birds, particularly where birds are resting or sheltering in vegetation or where clearance coincides with periods of high bird use. The narrative characterises the risk as localized and explicitly concludes Minor magnitude / Medium adverse significance before mitigation and Low following implementation of controls.

TE030 – Breeding bird assemblage

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Construction noise, lighting and human activity during the breeding season may disturb breeding birds, particularly during incubation and chick-rearing. The identified colony is approximately 1.2 km from the alignment, beyond the normal 100–500 m significant disturbance range cited in the assessment, although higher-intensity activities such as piling and blasting could affect birds at this distance. Uncertainty also remains regarding the colony's foraging areas and movements within the wetland. Section 8 consequently assesses the impact as Minor / Medium before mitigation and Low residual.

Mitigation includes scheduling the most intensive works near the colony outside the peak breeding period where possible, continual breeding-bird counts and nest surveys within 500 m, species-specific exclusion buffers around active nests, and adaptive management informed by monitoring of colony movements and foraging areas.

TE031 – Breeding bird assemblage: Hydrological Fragmentation

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Temporary damming and associated changes in water level and hydrological connectivity during embankment construction could alter the extent and quality of wetland and shallow-water habitat used by breeding birds for feeding. The effect is principally indirect, because the identified breeding colony lies approximately 1.2 km from the alignment and outside the direct construction footprint. Its importance therefore depends on the extent to which birds from the colony use the western basin and other habitats affected by temporary hydrological changes. Section 8 explicitly concludes Minor magnitude / Medium significance, reducing to Low following mitigation.

TE032 - Breeding bird assemblage: permanent habitat loss

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium

Impact pathway / basis: Approximately 9 ha of reedbed is lost, together with wider wetland/foreshore habitat providing foraging habitat for the breeding assemblage, including pygmy cormorant. The identified breeding colony itself is approximately 1.2 km away and outside the direct footprint, but the habitat loss reduces the reservoir's carrying capacity and available foraging habitat.

TE033 – Breeding bird assemblage: Direct Site Clearance

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: The likelihood of direct mortality at the identified colony is very low because it lies outside the construction footprint. The remaining risk concerns birds, nests and young in areas subject to vegetation clearance. Mitigation includes nest surveys within 500 m of the alignment, species-specific exclusion buffers and scheduling intensive works near the colony outside March–July wherever possible.

TE035 – Other bird species of conservation significance: Hydrological Fragmentation

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Table 87 identifies TE035 as temporary hydrological fragmentation affecting other bird species of conservation significance and gives Minor / Medium / Low.

TE036 – Other bird species of conservation significance – Permanent Habitat Loss

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium

Impact pathway / basis: Permanent habitat loss within the IBA/KBA affects other bird species of conservation significance.

TE037 – Other bird species of conservation significance: direct harm during site clearance

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Direct injury or mortality could occur during clearance and earthworks, particularly where nesting birds are present. The narrative states that mortality risk is very low overall. Mitigation requires pre-construction nest surveys within 500 m, species-specific exclusion buffers around active nests and delaying potentially damaging works until young have fledged or nests are no longer active.

TE039 – Lesser White-fronted Goose / other threatened bird species: hydrological fragmentation

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Extreme	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Temporary damming during embankment construction changes water levels and hydrological connectivity in the reservoir west of the embankment, potentially affecting habitat used by Lesser White-fronted Goose and other threatened bird receptors.

TE040 – Lesser White-fronted Goose / other threatened bird receptors: permanent habitat loss

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	Extreme	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Extreme	Medium

Impact pathway / basis: TE040 forms part of the approximately 150 ha permanent habitat loss within the Shardara IBA/KBA. The ESIA explicitly includes Lesser White-fronted Goose among the receptors affected and states that TE040 has Medium residual significance prior to offset action.

TE041 – Other bird species of conservation significance: direct harm during site clearance

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Section 8 states that construction impacts on Little Bustard and Yellow-eyed Pigeon include possible mortality at foraging and nesting sites. Direct mortality is considered very low risk for Little Bustard, while the likelihood of direct loss of Yellow-eyed Pigeon is also described as relatively low.

Mitigation comprises pre-construction nest surveys within 500 m, species-specific exclusion buffers around active nests, avoidance of vegetation clearance until breeding is complete, and continuing construction monitoring. Section 8 concludes that implementation of these measures will reduce temporary construction impacts to Low residual significance

TE042 – construction disturbance to other bird species from noise, lighting and human activity.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: TE042 covers disturbance from construction noise, lighting and human activity. The detailed narrative does not identify TE042 separately, but it states that construction impacts on Little Bustard and Yellow-eyed Pigeon are primarily associated with disturbance and possible mortality at foraging and nesting sites.

Mitigation includes pre-construction nest surveys within 500 m, exclusion buffers around active nests, avoidance of damaging works until young have fledged, and continuing construction monitoring. The narrative explicitly concludes that these measures reduce the residual significance of temporary construction impacts to Low.

TE043 – direct injury/mortality during site clearance.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Section 8 describes possible mortality of Little Bustard and Yellow-eyed Pigeon during construction. It considers direct mortality very low for Little Bustard and relatively low for Yellow-eyed Pigeon, with the latter risk principally associated with potential nesting along the reservoir cliffs.

Following nest surveys, exclusion buffers, avoidance of damaging works around active nests and construction monitoring, Section 8 explicitly concludes that residual temporary construction impacts are Low.

TE050 – ecosystem services: temporary loss of reservoir water-storage capacity.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Regional (3)	Medium term (5)	Frequent (5)	Certain (5)	Reversible (3)	26	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: The western-basin storage reduction could locally affect irrigation abstraction, fisheries, grazing regimes and waterbird habitat during construction. However, the narrative stresses that the reduction represents less than 0.06% of total reservoir capacity. KTZ_DM 260926

Mitigation includes maintaining water and fish connectivity through the embankment/hydraulic structures, sediment and pollution controls, water-quality protection, footprint controls, reinstatement and monitoring. For irrigation, the LARP adds restoration/bypass arrangements, compensation and continuing verification.

TE051 – effects on fish populations and fishery-related ecosystem services.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Section 8 identifies in-channel works, sedimentation and reduced western-basin storage as potentially affecting fish populations. Importantly, it says the effect is localised to the western basin and immediate Syr Darya crossing, medium-duration, approximately the construction period, and reversible once water levels and water quality recover. No permanent loss of the reservoir fishery or its productive capacity is predicted.

Mitigation specifically assigned to TE051 includes early bridge commissioning to restore/maintain connectivity and rescue/translocation of stranded fish where feasible, in consultation with fisheries authorities.

The ecosystem-services residual assessment then states that construction effects on fisheries are expected to be temporary and localised, with no permanent reduction in productive capacity, and concludes residual ecosystem-service impacts are Low adverse.

TE052 – disturbance to IUCN-listed fish from bridge and in-channel construction.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	High (7)	Local (2)	Medium term (5)	Frequent (5)	Medium (3)	Reversible (3)	25	High	Extreme	High
Residual	Medium (5)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (3)	20	Moderate	Extreme	High

TE053 – pollution/water-quality effects on IUCN-listed fish.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	High (7)	Local (2)	Long term (7)	Frequent (5)	High (3)	Partially reversible (3)	27	High	Extreme	High
Residual	Medium (5)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (3)	20	Moderate	Extreme	Potentially High

Impact pathway / basis: Pollution controls include sediment/runoff management, controls on fuel and chemical storage/refuelling, spill preparedness and restrictions on potentially polluting activities near open water. TE053 specifically requires silt bunding/sediment traps, bunded storage at least 50 m from watercourses, designated washdown/refuelling areas, pre-positioned pollution-response equipment and upstream/downstream water-quality monitoring.

TE054 – direct injury/mortality to IUCN-listed fish during in-channel works.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	Rare (2)	Low (2)	Irreversible (5)	26	Moderate	Extreme	High
Residual	Low (3)	Local (2)	Permanent (10)	Rare (2)	Low (2)	Irreversible (5)	24	Moderate	Extreme	Potentially High

Impact pathway / basis: the event is unlikely, but mortality of an individual is inherently irreversible. The low probability therefore should not be allowed to turn this into a Minor impact when the ESIA itself describes the consequence as potentially extremely severe.

Mitigation includes spawning-period exclusion of in-water works, minimising in-channel working time through cofferdams/diversion, authority consultation and, specifically for TE054, rescue of stranded fish where feasible.

TE059 – temporary loss of Natural Habitat.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Medium (3)	Medium term (5)	One-off (5)	Certain (5)	Reversible (3)	26	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: temporary occupation removes Natural Habitat and can reduce breeding, foraging and roosting habitat during ecologically important periods. The detailed narrative expressly supports Moderate magnitude / High significance before mitigation.

TE059 mitigation requires a habitat restoration plan for all temporary works areas, reinstatement to the pre-construction habitat type using native species, and monitoring of vegetation establishment for at least two growing seasons.

TE060 – introduction/spread of invasive alien species.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	High (7)	Regional (3)	Long term (7)	Continuous (7)	High (3)	Low reversibility (5)	32	High	Moderate	High
Residual	Medium (5)	Regional (3)	Long term (7)	Frequent (5)	Medium (3)	Partially reversible (3)	26	Moderate	Moderate	Moderate

Impact pathway / basis: vegetation clearance, earthmoving, imported fill/aggregate and movement of plant/equipment provide dispersal pathways over the 115 km alignment. Disturbed bare ground creates opportunities for colonisation, while Hydrilla, tamarisk and zebra mussel are specifically identified as concerns.

Mitigation includes pre-construction IAS surveys, species-specific management protocols, strict equipment biosecurity, prohibition of non-native species in reinstatement/landscaping and sediment barriers to limit water-borne dispersal.

TE061 – pollution of other watercourses, canals, drains and ditches.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Short term (3)	Infrequent (3)	Low (2)	Reversible (1)	14	Minor	Moderate	Low
Residual	Very low (1)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	11	Negligible	Moderate	NS

TE062 – direct injury/mortality to IUCN-listed invertebrates.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: adult mortality is unlikely, but larvae are less able to avoid earthworks and substrate disturbance in wetland areas. The mitigation specifically restricts in-channel and in-wetland works to the minimum area and duration necessary, alongside strict pollution controls.

TE063 – construction disturbance to IUCN-listed mammals

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Regional (3)	Medium term (5)	Frequent (5)	High (3)	Reversible (3)	24	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: construction noise, lighting, machinery, personnel and activity may temporarily displace the two Vulnerable mammal species. Mitigation confines vehicles/personnel to designated areas, avoids unnecessary disturbance outside the footprint, reinstates temporary areas, maintains crossing opportunities and requires animals encountered near active works to be allowed to move away without obstruction.

TE065 – direct injury/mortality to IUCN-listed mammals

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	High	Medium
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS

Impact pathway / basis: mortality risk arises principally during site clearance and construction within potentially occupied steppe/desert habitat. However, the ESIA expressly describes the probability as very low. Mitigation restricts construction to designated work areas, avoids unnecessary habitat disturbance, uses phased/directional vegetation clearance, prohibits hunting/capture, and requires pre-clearance habitat/burrow checks.

TE069 – permanent habitat loss affecting IUCN/Kazakhstan Red Data Book flora

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: permanent occupation of the railway footprint removes suitable habitat that may support species including Merendera robusta, Salvia korolkowii and Eminium lehmannii. The ESIA notes that the permanent footprint cannot subsequently be returned to its pre-Project condition.

For mitigation, temporary areas are reinstated using locally sourced native seed, remaining undisturbed areas are subject to pre-clearance surveys, and the ESIA explicitly says it will not retrospectively assume notable flora were absent from areas already cleared. Biodiversity loss accounting and the BAP therefore remain relevant.

TE070 – direct loss/damage to conservation-significant flora during site clearance

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: direct loss/damage could occur where individual plants or localised populations fall within areas subject to vegetation clearance or earthworks. Particular concern is identified around loess-cliff and steppe habitats potentially supporting species such as Salvia korolkowii and Eminium lehmannii.

The ESMP makes the avoidance approach considerably more specific: spring botanical survey of the full alignment, priority surveys of loess-cliff and steppe sections, and rescue/translocation where Red-Listed populations are confirmed within the clearance footprint, with subsequent survival monitoring.

TE077 – construction disturbance to IUCN-listed reptiles

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: sustained construction vibration and ground disturbance can affect tortoise foraging and overwintering behaviour. This is distinct from TE080, where direct mortality is a substantially more serious issue.

Mitigation includes pre-clearance surveys, translocation of animals encountered, restricting plant and vehicles to designated areas, managing open trenches/excavations and reinstating temporary steppe/desert habitat.

TE078 – permanent habitat loss affecting IUCN-listed reptiles

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	One-off (5)	High (3)	Irreversible (5)	30	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: permanent occupation of the RoW irreversibly removes suitable steppe, semi-desert and scrub habitat. The Land Take narrative expressly states that areas stripped and built over within the permanent RoW cannot subsequently be returned to their pre-Project condition.

Mitigation includes minimising the permanent footprint, reinstating temporary works areas, leaving suitable areas uncompacted to facilitate recolonisation, pre-clearance surveys and translocation.

TE079 – fragmentation of IUCN-listed reptile habitat.

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Permanent (10)	Frequent (5)	High (5)	Reversible (1)	28	Moderate	High	High
Residual	Low (3)	Local (2)	Long term (7)	Infrequent (3)	Moderate (3)	Reversible (1)	19	Minor	Moderate – impact-specific	Low

TE080 – direct injury/mortality to IUCN-listed reptiles

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Irreversible (5)	25	Moderate	High	High
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Irreversible (5)	20	Moderate	High	High / unresolved pending BAP

TE081 – operational pollution affecting the Shardara Reservoir IBA/KBA

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Regional (3)	Long term (7)	Rare (2)	Low (2)	Partially reversible (3)	22	Moderate	Extreme	High
Residual	Low (3)	Local (2)	Medium term (5)	Rare (2)	Low (2)	Reversible (1)	15	Minor	Extreme	Medium

Impact pathway / basis: routine spills and drainage present an ongoing pollution pathway, while a hazardous-cargo derailment at the bridge or reservoir embankment represents the credible worst-case pathway. Potential consequences include contamination of the Syr Darya and reservoir and impacts on Critical Habitat species.

Mitigation includes a Pollution Emergency Response Plan, pre-positioned spill-response equipment, containment arrangements, cargo-specific response procedures, coordination with water-management/emergency authorities and joint exercises. The ESMP specifically applies these operational pollution measures to TE081.

WH001 – Construction workforce

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Poor worker-accommodation conditions, including sanitation, potable water, fire/life safety, hygiene and general welfare risks	Medium
Residual	Risk-based assessment following committed controls	Residual worker health, safety and welfare risk following implementation of accommodation standards, Camp Management Plans, inspections and corrective actions	Low

Impact pathway / basis: inadequate accommodation management can affect sanitation, potable-water quality, food hygiene, fire and life safety and general worker welfare. Accommodation includes purpose-built camps, converted rail wagons, rented private accommodation and commuting arrangements.

WH002 – Construction workforce: Working at height

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Falls from height during bridge construction and other elevated works, with potential for serious injury or fatality	Medium
Residual	Risk-based assessment following committed controls	Residual working-at-height risk following implementation of the OHS Management System, task-specific risk assessment, hierarchy of controls, competent supervision and permit-to-work arrangements	Low

Impact pathway / basis: WH002 addresses falls from height during bridge construction and other elevated works. Section 8 identifies this specifically as one of the Project's principal high-risk construction activities, for which the credible consequence of inadequate control includes serious injury or fatality.

The narrative requires Integra's OHS Management System to cover all contractors and subcontractors and to use documented site- and task-specific risk assessment. The wider OHS provisions include competent supervision, safe systems of work, permit-to-work arrangements and corrective actions arising. from the ESCA.

WH003 – Construction workforce: Lifting Operations

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Struck-by, dropped-object and other serious injury risks associated with lifting operations, with potential for serious injury or fatality	Medium
Residual	Risk-based assessment following committed controls	Residual lifting-operation risk following implementation of the OHS Management System, task-specific risk assessment, hierarchy of controls, competent supervision and safe systems of work	Low

Impact pathway / basis: Section 8 specifically identifies WH003 as lifting operations and associated struck-by or dropped-object risks. These form part of the high-risk construction activities for which inadequate control could result in serious injury or fatality. The narrative therefore applies a risk-based OHS management approach.

WH004 – Construction workforce: Excavation

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Collapse, fall or entrapment hazards associated with excavation and earthworks, with potential for serious injury or fatality	Medium
Residual	Risk-based assessment following committed controls	Residual excavation risk following implementation of the OHS Management System, task-specific risk assessment, hierarchy of controls, competent supervision and safe systems of work	Low

Impact pathway / basis: Section 8 specifically identifies WH004 as excavation work involving potential collapse, falls or entrapment. It groups this with WH002, WH003 and WH010 as high-risk construction activities for which the credible consequence of inadequate control includes serious injury or fatality.

The Contractor's OHS Management System is required to apply across Integra and its subcontractors and be based on documented site- and task-specific risk assessment. Section 8 then explicitly concludes that the residual significance of WH001–WH005 and WH010 is Low, subject to full implementation and verification of the OHS controls.

WH005 – Construction workforce: Emergency Response

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Worker injury or fatality associated with inadequate preparedness or response to construction emergencies	Medium
Residual	Risk-based assessment following committed controls	Residual emergency-response risk following implementation of the Construction Emergency Response Plan, trained personnel, appropriate emergency equipment, drills and site-specific OHS arrangements	Low

Impact pathway / basis: WH005 addresses inadequate emergency-response capability during construction incidents. Section 8 treats this as one of the principal construction OHS risks and requires a documented Construction Emergency Response Plan as part of the wider OHS management arrangements.

The construction-to-date provisions are particularly relevant: the ESCA corrective actions require site-level OHS supervision with stop-work authority, routine training, weekly toolbox talks, PPE enforcement and a documented emergency-response equipment inventory at each active work front. Deficiencies are to be corrected and tracked to closure.

WH006 – Construction workforce: Grievances

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based labour-management assessment	Inadequate access to an effective, confidential and accessible grievance mechanism for construction workers, including subcontracted and migrant workers	Medium
Residual	Risk-based assessment following committed controls	Residual labour-management risk following establishment and effective operation of the dedicated workers' GRM	NS

Impact pathway / basis: Section 8 requires a dedicated workers' GRM covering all categories of Project worker, including subcontracted and migrant labour. It must permit confidential and anonymous complaints, operate in languages understood by workers, protect against retaliation, and have documented grievance handling and KTZ oversight. KTZ_DM 260926

The ESMP also requires the GRM to be documented, a grievance register maintained, quarterly summary reporting undertaken and grievance handling independently reviewed by KTZ.

WH010 – Construction workforce: Others

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Other high-risk construction activities identified through site- and task-specific risk assessment, including work near/over water, vehicle and mobile-plant movements, electrical/energised systems, machinery, temporary works, hot work, confined spaces and multi-contractor interfaces	Medium
Residual	Risk-based assessment following committed controls	Residual risk following implementation of the OHS Management System, hierarchy of controls, task-specific safe systems of work, permit-to-work arrangements, competent supervision and monitoring	Low

Impact pathway / basis: WH010 was specifically introduced to avoid the OHS assessment becoming an incomplete list of individual hazards. Section 8 states that the credible consequence of inadequate control of these activities includes serious injury or fatality, and therefore expressly requires a risk-based OHS management system.

The required controls include task-specific risk assessments, permit-to-work systems, competent personnel and supervision, controls for work near water, separation from vehicles/mobile plant, lock-out/tag-out for electrical and energised systems, PPE, inspections, toolbox talks and stop-work authority.

WM001 – Local communities within the Project Area of Influence

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Very local (1)	Short term (3)	Infrequent (3)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Environmental and community effects arising from poor housekeeping and site-management practices.

WM002 – Local waste-management capacity

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	Moderate	Low
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Moderate	NS

Impact pathway / basis: The issue is the potential for the Project's construction waste volumes to exceed or place pressure on available authorised waste-management capacity. The national EIA forecasts approximately 84,613 tonnes of construction-stage waste, of which about 84,509 tonnes is mixed construction and demolition waste.

Mitigation requires the Construction Waste Management Plan to assess licensed capacity, match forecast waste streams to available capacity, apply the waste hierarchy, consider beneficial reuse, and establish alternative arrangements where local capacity is insufficient.

WM003 – Local communities: inappropriate disposal of construction and demolition waste

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Very local (1)	Short term (3)	Infrequent (3)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: WM003 concerns inappropriate storage, handling or disposal of approximately 84,509 tonnes of construction and demolition waste, with potential effects including soil/water contamination, ecological effects, visual degradation and risks to surrounding communities. Section 8 particularly identifies the risk of using existing unlicensed legacy waste sites.

Mitigation requires designated storage areas, segregation, authorised transport and receiving facilities, documented chain of custody, prohibition of unlicensed legacy sites, and appropriate containment of hazardous waste. Section 8 explicitly concludes that, subject to these measures, residual significance is Low.

GHG001 – Global and regional climate

Assessment	Method	Impact / emissions pathway	Significance
Pre-mitigation	GHG-specific assessment against IFC PS3 reporting threshold	Construction Scope 1 emissions from diesel-powered plant and vehicles; central estimate approximately 38,500 tCO_2e/year, exceeding the 25,000 tCO_2e/year threshold	Medium
Residual	GHG-specific assessment following committed emissions-efficiency measures	Remaining construction Scope 1 emissions following plant maintenance, Stage IIIA/Tier 3 equipment where available, anti-idling measures and fuel-consumption monitoring; emissions remain material but temporary and cease at construction completion	Medium

SE002 – Local workforce and employment market

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Regional (3)	Medium term (5)	Frequent (5)	Certain (5)	Reversible (3)	26	Moderate	Moderate	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate	Low

Impact pathway / basis: Section 8 identifies a potentially material but temporary employment effect. The current workforce is approximately 800 personnel, with specialist roles predominantly filled from outside the corridor because those skills have limited local availability. This creates a risk that Project employment benefits are captured principally outside affected communities.

Mitigation includes prioritising suitably qualified local workers for semi-skilled, unskilled and ancillary roles, transparent and non-discriminatory recruitment, communicating available opportunities, local procurement, monitoring local/non-local employment and, where appropriate, skills development. Section 8 explicitly concludes Low adverse residual significance for the risk of limited local benefit capture, alongside a beneficial local employment effect where the measures are successfully implemented.

GBV001 – Women, girls and other persons potentially exposed to SEA/SH or GBVH risks

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based GBVH/SEA/SH assessment	Risk of worker-to-worker and worker-to-community GBVH, SEA and SH associated with workforce influx and interaction with surrounding communities	Medium
Residual	Risk-based assessment following committed controls	Residual GBVH/SEA/SH risk following implementation of the Code of Conduct, training, confidential reporting and GRM arrangements, contractor screening, survivor referral pathways and GBVH focal points	Low

Impact pathway / basis: SEA/SH and GBVH risks associated with a predominantly male construction workforce and worker-to-worker and worker-to-community interactions.

CS006 – Worker accommodation/community interface

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Community disturbance and health-and-safety risks at the interface between worker accommodation and nearby communities	Medium
Residual	Risk-based assessment following committed controls	Residual community-interface risk following controlled access, separation of worker accommodation from adjacent settlements, workforce conduct requirements and controls on worker/community interaction	Low

SE003 – Vulnerable and disadvantaged households and individuals

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Frequent (5)	High (3)	Reversible (1)	19	Minor	High	Medium
Residual	Low (3)	Very local (1)	Short term (3)	Infrequent (3)	Low (2)	Reversible (1)	13	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Disproportionate exposure of vulnerable groups to construction noise, dust, access restrictions and barriers to information, consultation or grievance mechanisms.

G2.5 Operations and Maintenance

AF006 – Agricultural land users, livestock owners and grazing users

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Risk of injury or death to domesticated livestock entering the operational railway corridor, particularly where stock-proof fencing is absent, damaged or inadequately maintained	Medium
Residual	Risk-based assessment following committed controls	Residual livestock collision risk following installation and maintenance of stock-proof fencing, provision of livestock/agricultural crossings, community awareness, reporting arrangements and operational response procedures	Low

Impact pathway / basis: Section 8 states that the operational railway creates a permanent collision hazard for livestock entering the Right of Way. Given the frequency of train movements and the potential consequences, the narrative explicitly assesses the impact as Moderate magnitude / Medium significance before mitigation.

The controls are quite strong and specific: stock-proof fencing along the full RoW, routine inspection and defined repair times, agricultural/livestock crossings, community awareness, a mechanism for reporting fence breaches, an emergency telephone number for livestock on railway land, and procedures for warning train drivers and safely removing livestock.

AF007 – Productive agricultural land

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Long term (7)	Frequent (5)	Certain (5)	Reversible (3)	27	Moderate	Moderate	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate	Low

Impact pathway / basis: Section 8 describes the same pathway: culverts and railway drainage structures can concentrate flows, potentially causing downstream erosion, while blockage or inadequate hydraulic capacity can result in upstream ponding or localised flooding, affecting crops and agricultural soils. Importantly, the narrative says these effects would be localised around individual drainage structures, but could recur during the operational life if maintenance is inadequate.

The mitigation is also substantive: scheduled inspection and clearance of culverts, post-flood inspections, checks for ponding/scour/erosion, maintenance of outlet protection, prompt repair, investigation of farmer complaints and engineering corrective measures where recurrent problems occur

CS004 – Local communities within the Project Area of Influence

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Injury or fatality to members of the public through trespass, unauthorised crossing or other unauthorised access to operational railway infrastructure	Medium
Residual	Risk-based assessment following committed controls	Residual public-safety risk following perimeter fencing, authorised crossings, warning signage, community rail-safety awareness, security arrangements and operational monitoring	Low

Basis: Section 8 identifies the risk as members of the public entering the RoW, crossing at unauthorised locations or interfering with operational equipment. It identifies the southern settled section as particularly relevant because existing pedestrian access patterns predate the railway. The receptor is High sensitivity because interaction with moving trains can result in serious injury or fatality.

Mitigation comprises full-length perimeter fencing, safe authorised crossings, community and school rail-safety programmes, Kazakh/Russian warning signage, operational security, inspection and maintenance of fencing/crossings, and review of recurrent trespass locations to determine whether additional crossing provision or other corrective measures are needed. Section 8 explicitly concludes Low residual significance.

CS005 – Road users, pedestrians and other users of existing transport routes

Assessment	Method	Impact / risk pathway	Significance
Pre-mitigation	Risk-based likelihood–consequence assessment	Road-user, pedestrian, agricultural-vehicle and livestock collision risk at public and farm crossings, with potential for serious injury or fatality	Medium
Residual	Risk-based assessment following committed controls	Residual collision risk following appropriate crossing protection, arrangements for agricultural crossings, inspection, maintenance, awareness measures and incident/near-miss monitoring	Low

The ESIA identifies 13 at-grade crossings: nine agricultural and four public-road crossings. It recognises the potentially severe consequences of train collisions and specifically identifies slow agricultural machinery, long loads and livestock as requiring additional consideration. KTZ_DM 260926

Controls include reviewing protection at each public crossing against actual/forecast use and community risk; additional protection including barriers where warranted; conservative protection assumptions where road-use data are limited; specific arrangements for slow agricultural movements; community/school awareness; and operational testing, maintenance and review of incidents and near misses.

NO001 – Noise-sensitive human receptors

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Long term (7)	Frequent (5)	Certain (5)	Reversible (3)	27	Moderate	Moderate – impact-specific	Medium
Residual	Low (3)	Local (2)	Long term (7)	Frequent (5)	High (3)	Reversible (1)	21	Moderate	Moderate – impact-specific	Medium

Impact pathway / basis: Operational railway noise affecting residents and other sensitive receptors at the six identified locations, including sleep disturbance and loss of amenity from train pass-bys, horn use, locomotive idling, station operations and shunting.

NO003 – Vibration

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Medium (5)	Local (2)	Long term (7)	Frequent (5)	Certain (5)	Reversible (3)	27	Moderate	Moderate – impact-specific	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Human perception, annoyance and potential sleep disturbance from ground-borne vibration generated by operational freight and passenger train movements, principally at Maktaaral and Ushagash.

Mitigation includes EPC-stage confirmation of exposure, under-sleeper pads, ballast mats, resilient fastenings or equivalent trackform measures where required, rail/wheel maintenance, possible speed restrictions, monitoring at representative receptors and adaptive mitigation through the GRM.

TE082 – Dalmatian Pelican

ID			VER			Receptor		Baseline sensitivity		
TE082			46			Dalmatian Pelican		Extreme		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS

Impact pathway / basis: Operational disturbance from train movements, horn use, idling and lighting may cause localised avoidance of habitat close to the railway. The effect is intermittent and spatially limited relative to the available reservoir habitat, with habituation expected over time.

TE084 – Overwintering waterbird assemblage

ID			VER			Receptor		Baseline sensitivity		
TE084			37			Overwintering waterbird assemblage		Extreme		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS

Impact pathway / basis: Operational train movements, locomotive noise, horn use and lighting may reduce use of habitat immediately adjacent to the railway, but the disturbance footprint is small relative to the available wintering habitat and population-level effects are not expected.

TE087 – Raptors and vultures of conservation significance

ID			VER			Receptor		Baseline sensitivity		
TE087			74			Raptors and vultures of conservation significance		Extreme		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS

Impact pathway / basis: Operational train movements and associated railway activity may cause localised behavioural disturbance, but the material operational risk to this receptor is collision/electrocution, assessed separately.

TE089 – Other threatened bird species

ID			VER			Receptor		Baseline sensitivity		
TE089			83			Other threatened bird species		Extreme		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS

Impact pathway / basis: Operational train movements and railway activity may cause localised disturbance or displacement from habitat close to the alignment; material collision/electrocution risk is assessed separately.

TE091 – Overwintering waterbird assemblage

ID			VER			Receptor		Baseline sensitivity		
TE091			37			Overwintering waterbird assemblage		Extreme		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS

Impact pathway / basis: Operational train and locomotive activity may cause localised avoidance of habitat close to the alignment, but the disturbance footprint is limited relative to the wider available wintering habitat.

TE093 – Breeding bird assemblage

ID			VER			Receptor		Baseline sensitivity		
TE093			38			Breeding bird assemblage		High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS

Impact pathway / basis: Operational train movements, noise and lighting may cause localised disturbance to breeding birds close to the railway; the principal material operational risk is collision with the OHLs, assessed separately.

TE095 – Raptors and vultures of conservation significance

ID			VER			Receptor		Baseline sensitivity		
TE095			74			Raptors and vultures of conservation significance		Extreme		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Extreme	NS

Impact pathway / basis: Operational train movements and associated railway activity may cause localised disturbance, but the principal material operational risk is collision/electrocution with the OHL infrastructure.

TE097 – Other bird species of conservation significance

ID			VER		Receptor			Baseline sensitivity		
TE097			75		Other bird species of conservation significance			High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS

Impact pathway / basis: Operational train movements and associated railway activity may cause localised displacement from suitable habitat adjacent to the railway; collision risk is assessed separately.

TE099 – Other bird species of conservation significance

ID			VER		Receptor			Baseline sensitivity		
TE099			75		Other bird species of conservation significance			High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS

Impact pathway / basis: Operational train movements, horn use, lighting and associated activity may cause localised behavioural disturbance or displacement from habitat close to the railway.

TE122 – Other bird species of conservation significance

ID			VER		Receptor			Baseline sensitivity		
TE122			75		Other bird species of conservation significance			High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	High	NS

Impact pathway / basis: Operational train and locomotive noise may cause localised behavioural disturbance along the railway corridor; the effect is limited in extent and the material collision risk is assessed separately.

TE081 – Shardara IBA/KBA

ID	VER	Receptor	Baseline sensitivity
TE081	33	Shardara IBA/KBA	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Operational release of locomotive fuel, lubricants, cargo or contaminated track drainage to the Shardara Reservoir/Syr Darya, with potentially serious ecological consequences despite low-to-moderate likelihood under normal operations.	Medium
Residual	Risk-based assessment following committed controls	Residual pollution risk following the Pollution Emergency Response Plan, spill containment and isolation measures, controlled drainage, hazardous-cargo controls, pre-positioned response equipment and operational monitoring.	Low

Impact pathway / basis: Operational release of locomotive fuel, lubricants, cargo or contaminated track drainage to the Shardara Reservoir/Syr Darya, with potentially serious ecological consequences despite low-to-moderate likelihood under normal operations. The consequence of a major release can be substantial, so the pathway is retained as a risk-based assessment rather than reduced to a generic six-factor environmental score.

TE108 – Ecosystem services provided by Shardara Reservoir

ID	VER	Receptor	Baseline sensitivity
TE108	47	Ecosystem services provided by Shardara Reservoir	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Operational fuel or cargo spills and contaminated drainage may degrade reservoir water quality and associated ecosystem services, including fisheries and other human uses dependent on reservoir condition.	Medium
Residual	Risk-based assessment following committed controls	Residual pollution risk following the Pollution Emergency Response Plan, spill containment and isolation measures, controlled drainage, hazardous-cargo controls, pre-positioned response equipment and operational monitoring.	Low

Impact pathway / basis: Operational fuel or cargo spills and contaminated drainage may degrade reservoir water quality and associated ecosystem services, including fisheries and other human uses dependent on reservoir condition. The consequence of a major release can be substantial, so the pathway is retained as a risk-based assessment rather than reduced to a generic six-factor environmental score.

TE109 – IUCN-listed fish

ID	VER	Receptor	Baseline sensitivity
TE109	79	IUCN-listed fish	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Operational fuel, lubricant or cargo spills, including contaminated railway drainage, may degrade water quality and aquatic habitat used by IUCN-listed fish, including Critical Habitat receptors.	Medium
Residual	Risk-based assessment following committed controls	Residual pollution risk following the Pollution Emergency Response Plan, spill containment and isolation measures, controlled drainage,	Low

ID	VER	Receptor	Baseline sensitivity
		hazardous-cargo controls, pre-positioned response equipment and operational monitoring.	

Impact pathway / basis: Operational fuel, lubricant or cargo spills, including contaminated railway drainage, may degrade water quality and aquatic habitat used by IUCN-listed fish, including Critical Habitat receptors. The consequence of a major release can be substantial, so the pathway is retained as a risk-based assessment rather than reduced to a generic six-factor environmental score.

TE112 – IUCN-listed invertebrates

ID	VER	Receptor	Baseline sensitivity
TE112	80	IUCN-listed invertebrates	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Operational spills or contaminated railway drainage entering the reservoir or connected watercourses may degrade water quality and benthic habitat used by IUCN-listed invertebrates.	Medium
Residual	Risk-based assessment following committed controls	Residual pollution risk following the Pollution Emergency Response Plan, spill containment and isolation measures, controlled drainage, hazardous-cargo controls, pre-positioned response equipment and operational monitoring.	Low

Impact pathway / basis: Operational spills or contaminated railway drainage entering the reservoir or connected watercourses may degrade water quality and benthic habitat used by IUCN-listed invertebrates. The consequence of a major release can be substantial, so the pathway is retained as a risk-based assessment rather than reduced to a generic six-factor environmental score.

TE115 – Natural wetland habitat

ID	VER	Receptor	Baseline sensitivity
TE115	63	Natural wetland habitat	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Operational fuel/cargo spills or contaminated drainage may enter wetland habitat and cause localised deterioration of water, sediment and habitat condition.	Medium
Residual	Risk-based assessment following committed controls	Residual pollution risk following the Pollution Emergency Response Plan, spill containment and isolation measures, controlled drainage, hazardous-cargo controls, pre-positioned response equipment and operational monitoring.	Low

Impact pathway / basis: Operational fuel/cargo spills or contaminated drainage may enter wetland habitat and cause localised deterioration of water, sediment and habitat condition. The consequence of a major release can be substantial, so the pathway is retained as a risk-based assessment rather than reduced to a generic six-factor environmental score.

TE116 – IUCN- and Kazakhstan Red Data Book-listed flora

ID	VER	Receptor	Baseline sensitivity
TE116	76	IUCN- and Kazakhstan Red Data Book-listed flora	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Operational fuel, lubricant or cargo spills may contaminate trackside soils or adjacent habitat supporting flora of conservation significance.	Medium
Residual	Risk-based assessment following committed controls	Residual pollution risk following the Pollution Emergency Response Plan, spill containment and isolation measures, controlled drainage, hazardous-cargo controls, pre-	Low

ID	VER	Receptor	Baseline sensitivity
		positioned response equipment and operational monitoring.	

Impact pathway / basis: Operational fuel, lubricant or cargo spills may contaminate trackside soils or adjacent habitat supporting flora of conservation significance. The consequence of a major release can be substantial, so the pathway is retained as a risk-based assessment rather than reduced to a generic six-factor environmental score.

TE083 – Dalmatian Pelican

ID	VER	Receptor	Baseline sensitivity
TE083	46	Dalmatian Pelican	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	BAP-dependent / potentially offset	High
Residual	Risk-based assessment following committed controls	BFDs at ≤5 m spacing, bird-safe electrical design, at least three years of PCFM and proposed off-site BFD retrofitting materially reduce collision risk, but the narrative states that collision mortality cannot be eliminated and achievement of net gain remains subject to further assessment and the Final BAP.	Collision of Dalmatian Pelicans with the two parallel 10 kV OHLs, particularly where birds move between roosting and foraging areas over the reservoir/foreshore; mortality is long-term and irreversible.

Impact pathway / basis: BAP-dependent / potentially offset

Reconciliation note: Current summary Minor / Medium / Low does not reflect the detailed narrative, which describes a high-magnitude collision impact and does not yet support an unconditional Low residual.

TE085 – Overwintering waterbird assemblage

ID	VER	Receptor	Baseline sensitivity
TE085	37	Overwintering waterbird assemblage	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	BAP-dependent / not significant anticipated	High
Residual	Risk-based assessment following committed controls	BFDs, bird-safe electrical design and PCFM reduce collision/electrocution risk; additional conservation actions are	Collision/electrocution of wintering birds using the reservoir, including potential flock-scale collision events

ID	VER	Receptor	Baseline sensitivity
		to be developed through the BAP. The narrative anticipates that residual effects can be reduced sufficiently to avoid long-term adverse effects, but retains a requirement for further BAP assessment.	involving large species with poor manoeuvrability; mortality is long-term and irreversible.

Impact pathway / basis: BAP-dependent / not significant anticipated

Reconciliation note: Current summary Minor / Medium / Low understates the detailed narrative, which assesses direct mortality/harm as high magnitude.

TE086 – Migratory bird assemblage

ID	VER	Receptor	Baseline sensitivity
TE086	64	Migratory bird assemblage	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	BAP-dependent / not significant anticipated	High
Residual	Risk-based assessment following committed controls	BFDs, bird-safe electrical design and PCFM reduce risk, with additional conservation measures through the BAP. The narrative anticipates a non-significant residual but explicitly requires further assessment and the Final BAP.	Collision/electrocution risk to migratory birds crossing the reservoir, particularly large flocks and night migrants under poor visibility; internationally important migrant densities increase the potential consequence.

Impact pathway / basis: BAP-dependent / not significant anticipated

Reconciliation note: Current summary Minor / Medium / Low conflicts with the detailed narrative's high-magnitude operational collision assessment.

TE088 – Raptors and vultures of conservation significance

ID	VER	Receptor	Baseline sensitivity
TE088	74	Raptors and vultures of conservation significance	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Low	High
Residual	Risk-based assessment following committed controls	Bird-safe pole/OHL design, BFDs in the IBA/KBA, alignment-wide PCFM and retrospective BFD installation at any identified high-risk areas reduce residual collision mortality to Low significance.	Collision with OHLs and electrocution on electrical infrastructure, particularly for large raptors that perch on elevated structures or fly at low altitude in poor visibility.

Impact pathway / basis: Low

Reconciliation note: Detailed narrative explicitly describes this as a high-magnitude significant operational impact before mitigation and Low residual.

TE090 – Other threatened bird species

ID	VER	Receptor	Baseline sensitivity
TE090	83	Other threatened bird species	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Low / BAP controls apply	High
Residual	Risk-based assessment following committed controls	Bird-safe electrical design, BFDs and PCFM reduce residual collision/electrocution risk; any high-risk locations identified through monitoring require additional BFDs or other adaptive measures.	Collision/electrocution risk to threatened bird species using the Project area, including large or low-flying species susceptible to OHL collision and species using the reservoir crossing zone.

Impact pathway / basis: Low / BAP controls apply

Reconciliation note: The detailed operational narrative groups threatened birds with the bird-collision management framework; retain a conservative significant pre-mitigation rating.

TE092 – Overwintering waterbird assemblage

ID	VER	Receptor	Baseline sensitivity
TE092	37	Overwintering waterbird assemblage	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	BAP-dependent / not significant anticipated	High
Residual	Risk-based assessment following committed controls	BFDs, bird-safe electrical design, PCFM and BAP conservation actions reduce risk; the narrative anticipates no long-term adverse effect but retains further BAP assessment.	Collision/electrocution of wintering birds using the reservoir, including potential flock-scale events involving large, poorly manoeuvrable species.

Impact pathway / basis: BAP-dependent / not significant anticipated

Reconciliation note: This appears duplicative of TE085 in receptor and pathway and should be checked during final register rationalisation.

TE094 – Breeding bird assemblage

ID	VER	Receptor	Baseline sensitivity
TE094	38	Breeding bird assemblage	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	BAP-dependent / not significant anticipated	High
Residual	Risk-based assessment following committed controls	BFDs, bird-safe electrical design and PCFM reduce collision/electrocution risk; additional conservation actions through the BAP are required before the residual conclusion is fully closed.	Collision with OHLs by breeding birds commuting between colony and foraging areas across the reservoir, including pygmy cormorant, glossy ibis and egret species present in large numbers.

Impact pathway / basis: BAP-dependent / not significant anticipated

Reconciliation note: Detailed narrative assesses magnitude as moderate to high; the current Minor / Medium / Low summary is not aligned.

TE096 – Raptors and vultures of conservation significance

ID	VER	Receptor	Baseline sensitivity
TE096	74	Raptors and vultures of conservation significance	Extreme
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Low	High
Residual	Risk-based assessment following committed controls	Alignment-wide PCFM, bird-safe electrical design and retrospective installation of BFDs at any identified high-risk areas reduce residual collision mortality to Low significance.	Collision with OHLs and electrocution risk to large raptors and vultures using the wider Project alignment.

Impact pathway / basis: Low

Reconciliation note: This appears duplicative of TE088 and should be checked during final register rationalisation.

TE098 – Other bird species of conservation significance

ID	VER	Receptor	Baseline sensitivity
TE098	75	Other bird species of conservation significance	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Low	Medium
Residual	Risk-based assessment following committed controls	Bird-safe electrical design, PCFM and retrospective BFD installation at any identified high-risk areas reduce residual collision mortality to Low significance.	Collision/electrocution risk to other bird species of conservation significance, particularly Little Bustard during low display/dispersal flights; Yellow-eyed Pigeon is considered materially less susceptible.

Impact pathway / basis: Low

Reconciliation note: Detailed narrative describes the combined Little Bustard operational effect as moderate-magnitude/significant; the collision pathway should not be presented as a generic Minor impact without that context.

TE113 – IUCN-listed mammals

ID	VER	Receptor	Baseline sensitivity
TE113	77	IUCN-listed mammals	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Mortality or injury to mammals attempting to cross the operational railway, principally through collision with moving trains; exposure is reduced where species avoid the alignment because of nearby agriculture, settlements and operational disturbance.	Medium
Residual	Risk-based assessment following committed controls	Residual collision risk after wildlife-permeable fencing, targeted underpasses/crossings, monitoring of wildlife use and maintenance of a mammal collision register.	Low

Impact pathway / basis: Mortality or injury to mammals attempting to cross the operational railway, principally through collision with moving trains; exposure is reduced where species avoid the alignment because of nearby agriculture, settlements and operational disturbance.

TE121 – IUCN-listed reptiles

ID	VER	Receptor	Baseline sensitivity
TE121	78	IUCN-listed reptiles	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Mortality or injury to slow-moving reptiles, including Central Asian tortoise and European Glass Lizard, where individuals attempt to cross the operational railway and encounter moving trains.	Medium
Residual	Risk-based assessment following committed controls	Residual collision risk following targeted wildlife-permeable fencing/crossing measures, monitoring and adaptive review during operation.	Low

Impact pathway / basis: Mortality or injury to slow-moving reptiles, including Central Asian tortoise and European Glass Lizard, where individuals attempt to cross the operational railway and encounter moving trains.

TE123 – Invasive species

ID			VER			Receptor		Baseline sensitivity		
TE123			82			Invasive species		Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	High (3)	Reversible (1)	17	Minor	Moderate	Low
Residual	Negligible (1)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	10	Negligible	Moderate	NS

Impact pathway / basis: Introduction or spread of invasive alien species during operation through rolling stock, routine maintenance, vegetation management and disturbed trackside ground. Operational hygiene, vegetation management and monitoring reduce the residual pathway to negligible.

WH007 – Operational and maintenance workforce

ID	VER	Receptor	Baseline sensitivity
WH007	84	Operational and maintenance workforce	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Serious injury or fatality during inspection and maintenance of track and railway infrastructure, including work on or adjacent to live railway operations.	High
Residual	Risk-based assessment following committed controls	Residual worker safety risk after formal possession arrangements, access control, lookout/warning systems where required, competency certification, supervision, PPE and the operational H&S management system.	Low

Impact pathway / basis: Serious injury or fatality during inspection and maintenance of track and railway infrastructure, including work on or adjacent to live railway operations.

Reconciliation note: This is an OHS likelihood–consequence assessment. Do not apply the environmental magnitude × receptor-sensitivity matrix.

WH008 – Operational and maintenance workforce

ID	VER	Receptor	Baseline sensitivity
WH008	84	Operational and maintenance workforce	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Electrical shock, burns, arc flash or fatal electrocution during inspection or maintenance of the 10 kV distribution system, transformer installations and associated electrical equipment.	Medium
Residual	Risk-based assessment following committed controls	Residual electrical safety risk following isolation/lock-out-tag-out, permit-to-work arrangements, competent authorised personnel, testing for dead, earthing where required, PPE and emergency procedures.	Low

Impact pathway / basis: Electrical shock, burns, arc flash or fatal electrocution during inspection or maintenance of the 10 kV distribution system, transformer installations and associated electrical equipment.

WH009 – Operational and maintenance workforce

ID	VER	Receptor	Baseline sensitivity
WH009	84	Operational and maintenance workforce	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Serious injury or fatality to railway workers and emergency responders during derailments, collisions, fires, dangerous-goods incidents and other railway emergencies.	Medium
Residual	Risk-based assessment following committed controls	Residual emergency-response risk after implementation of the operational railway safety, emergency preparedness and incident-response controls.	Low

Impact pathway / basis: Worker and emergency-responder exposure to low-frequency but potentially severe railway emergency events. This is an OHS risk assessment; receptor sensitivity is not used to recalculate the risk rating.

GHG002 – Global and regional climate

ID	VER	Receptor	Baseline sensitivity
GHG002	85	Global and regional climate	High
Assessment	**Method**	**Impact / emissions pathway**	**Significance**
Pre-mitigation	GHG emissions assessment	Operational Scope 1 emissions from diesel traction and Scope 2 emissions from electricity use; annual tCO_2e to be updated using the final OVOS operating basis.	Medium
Residual	GHG emissions assessment after operational efficiency / management measures	Ongoing operational Scope 1 and Scope 2 emissions over the railway operating life.	Medium

Impact pathway / basis: Operational greenhouse-gas emissions are assessed using the Project's annual emissions inventory and GHG significance approach, rather than the six-factor local-impact matrix.

EMF001 – Residents near the auxiliary 10 kV OHL and associated electrical infrastructure

ID	VER	Receptor	Baseline sensitivity
EMF001	88	Residents near the auxiliary 10 kV OHL and associated electrical infrastructure	Moderate
Assessment	**Method**	**Impact / exposure pathway**	**Significance**
Pre-mitigation	Standards-based EMF exposure assessment	Community exposure to electric and magnetic fields from the 10 kV auxiliary OHLs, transformers and associated electrical installations.	Low
Residual	Standards-based EMF exposure assessment following design/operational controls	Residual community EMF exposure during normal operation of the 10 kV electrical infrastructure.	Low

Impact pathway / basis: Potential community exposure to EMF from the auxiliary electrical system. The supplied register reports Low before and after mitigation; this is better represented as a standards/exposure-compliance assessment than as Negligible × Moderate, which would produce NS under the generic matrix.

CC001 – Project infrastructure exposed to physical climate hazards

ID	VER	Receptor	Baseline sensitivity
CC001	86	Project infrastructure exposed to physical climate hazards	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Climate-risk / likelihood–consequence assessment	Long-term physical climate risk to railway infrastructure and operations from river flooding, rainfall-induced slope instability, increasing temperatures and associated track-buckling risk over the Project design life.	High
Residual	Risk-based assessment following committed controls	Residual physical climate risk after incorporation of climate-resilient design, drainage/flood protection, inspection, maintenance and adaptive operational measures.	Moderate

Impact pathway / basis: Climate hazards affect infrastructure performance, safety and service continuity over the design life. The High → Moderate conclusion is therefore retained as a climate-risk conclusion rather than reconstructed through the six-factor impact matrix.

HG002 – Other watercourses, canals, drains and ditches

ID			VER			Receptor			Baseline sensitivity	
HG002			43			Other watercourses, canals, drains and ditches			Moderate	
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Medium (5)	Local (2)	Long term (7)	Frequent (5)	Certain (5)	Reversible (3)	27	Moderate	Moderate	Medium
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate	Low

Impact pathway / basis: Operational hydraulic effects at culverts and drainage structures, including increased downstream velocity and erosion, upstream ponding and reduced hydraulic capacity where structures are obstructed, inadequately maintained or hydraulically deficient.

HC001 – Local communities within the Project Area of Influence

ID	VER	Receptor	Baseline sensitivity
HC001	23	Local communities within the Project Area of Influence	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Low-probability/high-consequence hazardous-cargo accident involving derailment, collision, fire or release, with potential consequences for nearby communities, the Syr Darya/Shardara IBA/KBA, water resources and agricultural infrastructure.	Medium
Residual	Risk-based assessment following committed controls	Residual hazardous-cargo accident risk after operational railway-safety, dangerous-goods management, emergency preparedness, spill-response and notification controls.	Medium

Impact pathway / basis: This is an accident-risk pathway rather than a routine environmental effect. A Medium residual is retained because controls reduce likelihood and consequence but cannot eliminate the possibility of a major dangerous-goods event.

WM004 – Groundwater resources and hydrogeological regime

ID			VER			Receptor		Baseline sensitivity		
WM004			28			Groundwater resources and hydrogeological regime		High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	High (3)	Reversible (1)	17	Minor	High	Medium
Residual	Low (3)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	12	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Hazardous and biosecurity-related waste generated at the Maktaaral disinfection complex, including disinfectant residues, contaminated wash-water, PPE and biological materials, with potential soil and groundwater contamination if storage, handling, transport or disposal is inadequate.

Reconciliation note: Residual scoring is a matrix-equivalent reconstruction; impact-specific susceptibility is reduced after containment and controlled waste management.

WR001 – Regional water resources and existing potable-water supply users

ID	VER	Receptor	Baseline sensitivity
WR001	96 – new	Regional water resources and existing potable-water supply users	Moderate

Assessment	Size	Extent	Duration	Frequency	Probability	Reversibility	Total	Magnitude	Sensitivity used	Significance
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	High (3)	Reversible (1)	17	Minor	Moderate	Low
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate	Low

Impact pathway / basis: Operational water demand at Maktaaral Station and the biosecurity/disinfection facilities, with potential pressure on existing potable-water users where the supply network lacks sustainable capacity or operational headroom.

Reconciliation note: The supplied Medium pre-mitigation significance is not reproduced by Minor × Moderate. In the absence of a detailed narrative supporting an exception, the matrix-consistent pre-mitigation significance is Low.

CS008 – Local communities within the Project Area of Influence

ID	VER	Receptor	Baseline sensitivity
CS008	23	Local communities within the Project Area of Influence	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Community health and safety risk from accidental chemical release, disinfectant exposure or other biosecurity-related incident at the Maktaaral disinfection complex.	Medium
Residual	Risk-based assessment following committed controls	Residual community risk after chemical-management, containment, access-control, emergency-response and biosecurity procedures are implemented.	Low

Impact pathway / basis: Potential acute community exposure arising from abnormal events at the disinfection complex; appropriately assessed as a likelihood–consequence risk.

WM005 – Groundwater resources and hydrogeological regime

ID			VER		Receptor			Baseline sensitivity		
WM005			28		Groundwater resources and hydrogeological regime			High		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	High (3)	Reversible (1)	17	Minor	High	Medium
Residual	Low (3)	Very local (1)	Short term (3)	Rare (2)	Low (2)	Reversible (1)	12	Minor	Moderate – impact-specific	Low

Impact pathway / basis: Hazardous and non-hazardous waste generated by locomotive and wagon servicing at Yerdaut, with potential contamination of soil and shallow groundwater if wastes are inadequately segregated, stored, transported or disposed.

Reconciliation note: Residual scoring is a matrix-equivalent reconstruction; the supplied source does not provide the original six-factor residual scores.

SG004 – Groundwater resources and hydrogeological regime

ID	VER	Receptor	Baseline sensitivity
SG004	28	Groundwater resources and hydrogeological regime	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Fuel-storage, unloading and locomotive-refuelling spill risk at Yerdaut, including potential contamination of soil, shallow groundwater and drainage infrastructure.	Medium
Residual	Risk-based assessment following committed controls	Residual spill risk after bunding/containment, controlled transfer and refuelling procedures, inspection, spill-response arrangements and incident management.	Low

Impact pathway / basis: Accidental fuel release is a low-frequency event with potentially material consequences and is therefore retained as a risk-based assessment.

WH011 – Operational and maintenance workforce

ID	VER	Receptor	Baseline sensitivity
WH011	84	Operational and maintenance workforce	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	OHS risks to the Yerdaut locomotive-maintenance workforce from interaction with rolling stock, lifting operations, fuel handling, work at height, confined spaces, hot work and electrical servicing.	Medium
Residual	Risk-based assessment following committed controls	Residual OHS risk after task-specific safe systems of work, competency controls, permits, isolation, supervision, PPE and emergency arrangements.	Low

Impact pathway / basis: This is a multi-hazard OHS risk assessment. The environmental magnitude × sensitivity matrix is not applicable.

WR002 – Regional water resources and existing potable-water supply users

ID			VER		Receptor			Baseline sensitivity		
WR002			96 – new		Regional water resources and existing potable-water supply users			Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	High (3)	Reversible (1)	17	Minor	Moderate	Low
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate	Low

Impact pathway / basis: Operational water demand at Yerdaut Station and servicing facilities, with potential pressure on existing water users where network capacity or sustainable supply headroom is inadequate.

Reconciliation note: The supplied Medium pre-mitigation significance conflicts with Minor × Moderate. No detailed narrative was located to justify the exception, so Low is retained as the matrix-consistent significance.

AF008 – Irrigation and drainage infrastructure

ID			VER			Receptor		Baseline sensitivity		
AF008			4			Irrigation and drainage infrastructure		Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	High (3)	Reversible (1)	17	Minor	Moderate	Low
Residual	Low (3)	Local (2)	Medium term (5)	Infrequent (3)	Low (2)	Reversible (1)	16	Minor	Moderate	Low

Impact pathway / basis: Operational degradation of irrigation or drainage performance at railway crossings through blockage, sedimentation, erosion, altered flow or inadequate hydraulic capacity, potentially affecting downstream agricultural users.

Reconciliation note: The supplied Medium pre-mitigation significance conflicts with Minor × Moderate; without a source-supported exception, the matrix-consistent significance is Low.

WH012 – Operational and maintenance workforce

ID	VER	Receptor	Baseline sensitivity
WH012	84	Operational and maintenance workforce	High
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Health, safety and welfare risks associated with Project-provided operational worker accommodation, locomotive crew-rest facilities and related welfare infrastructure.	Medium
Residual	Risk-based assessment following committed controls	Residual worker health, safety and welfare risk after accommodation standards, hygiene, fire/life-safety, welfare management, inspection and worker grievance arrangements.	Low

Impact pathway / basis: Accommodation and welfare risk to operational personnel; assessed through the OHS/labour-management risk framework rather than the environmental receptor-sensitivity matrix.

SG005 – Other watercourses, canals, drains and ditches

ID	VER	Receptor	Baseline sensitivity
SG005	43	Other watercourses, canals, drains and ditches	Moderate
Assessment	**Method**	**Impact / risk pathway**	**Significance**
Pre-mitigation	Risk-based likelihood–consequence assessment	Operational diffuse water and soil pollution from minor spills, leaks and discharges associated with routine railway operation outside the Shardara IBA/KBA.	Medium
Residual	Risk-based assessment following committed controls	Residual pollution risk after routine spill prevention, drainage management, inspection, maintenance and incident-response controls.	Low

Impact pathway / basis: The supplied assessment treats this as an operational pollution risk. Retaining a risk-based approach avoids forcing a spill-event pathway through the routine magnitude × sensitivity matrix.

LV001 – Landscape character and public views

ID		VER		Receptor			Baseline sensitivity			
LV001		14		Landscape character and public views			Moderate			
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	High (8)	Regional (3)	Permanent (10)	Continuous (7)	Certain (5)	Irreversible (5)	38	Major	Moderate	High
Residual	Medium (5)	Local (2)	Long term (7)	Frequent (5)	High (3)	Irreversible (5)	27	Moderate	Moderate	Medium

Impact pathway / basis: Permanent presence of the railway, embankment, bridges, stations, sidings and associated infrastructure causing long-term change in landscape character.

Reconciliation note: Major × Moderate gives High under the project matrix. The supplied Medium pre-mitigation rating is therefore corrected to High; no source-supported exception was located.

LV002 – Landscape character and public views

ID			VER			Receptor		Baseline sensitivity		
LV002			14			Landscape character and public views		Moderate		
Assessment	**Size**	**Extent**	**Duration**	**Frequency**	**Probability**	**Reversibility**	**Total**	**Magnitude**	**Sensitivity used**	**Significance**
Pre-mitigation	Medium (5)	Local (2)	Long term (7)	Frequent (5)	Certain (5)	Reversible (3)	27	Moderate	Moderate	Medium
Residual	Medium (5)	Local (2)	Long term (7)	Frequent (5)	High (3)	Irreversible (5)	27	Moderate	Moderate	Medium

Impact pathway / basis: Long-term change in views experienced by residents, land users, travellers and recreational users as a result of the permanent railway, stations, structures, lighting and train operations.

Vista
Environment