Environmental Impact Assessment

April 2019

AFG: Arghandab Integrated Water Resources Development Project

Project No. 48096-002

Part 1 of 1: Main Report

Prepared by FCG ANZDEC, Prime Nimmo Bell Partners, Finnish Consulting Group Asia, Afghan Tarin Engineering Services, and CMS Engineering Consult for the Asian Development Bank (ADB).

CURRENCY EQUIVALENTS

(as of 8 Feb 2019)

Currency unit	–	Afghanistan Afghani (AFN)
AFN1.00	=	$ 0.013361
$1.00	=	AF74.8373

ABBREVIATIONS

ADB	–	Asian Development Bank
ADF	–	Asian Development Fund
ASBA	–	Arghandab Sub-Basin Agency
AUWSSC	–	Afghanistan Urban Water Supply & Sanitation Corporation
CIA	–	Cumulative Impact Assessment
CIDA	–	Canadian International Development Agency
DABS	–	Da Afghanistan Breshna Sherkat
DAIL	–	Department of Agriculture, Irrigation, and Livestock
DFID	–	Department for International Development
EA	–	Executing agency
EARF	–	Environmental assessment and review framework
EHS	–	Environmental, Health, and Safety
EIA	–	Environmental impact assessment
ESIA	–	Environmental and Social Impact Assessment
EMP	–	Environment management plan
EMR	–	Environmental monitoring report
EU	–	European Union
GDP	–	Gross domestic product
GRM	–	Grievance redress mechanism
HACCP	–	Hazard analysis critical control points
IA	–	Implementing agency
IEE	–	Initial environmental examination
IFC	–	International Finance Cooperation
ISC	–	Implementation support consultant
JICA	–	Japan International Cooperation Agency
MASL	–	Meters above sea level
MAIL	–	Ministry of Agriculture, Irrigation, and Livestock
MEW	–	Ministry of Energy and Water
MOF	–	Ministry of Finance
MRM	–	Midterm review mission
NEPA	–	National Environmental Protection Agency
O&M	–	Operation and maintenance
PC	–	Public consultation
PCM	–	Public consultation meeting
PIU	–	Project implementing Unit
RCP	–	Representative Concentration Pathway
EMP	–	Environmental Management Plan
UNEP	–	United Nations Environment Program
UNESCO	–	United Nations Educational Scientific and Cultural Organization
UNMACA	–	United Nations Mine Action Centre for Afghanistan
USAID	–	United States Agency for International Development

USACE	–	US Army Corps of Engineers
UXO	–	Unexploded ordinance
WEAP	–	Water Evaluation and Planning
WHO	–	World Health Organization

WEIGHTS AND MEASURES

^{o}C	–	Degree Celsius
m^3	–	Cubic meter
ha	–	Hectare, 10,000 m^2
km	–	Kilometer
m	–	Meter

GLOSSARY

Dehkani	–	Share cropping
Jerib	–	2,000 m²
Karez	–	Kanat, a system of connected wells through tunnels
Mirab	–	Water Master
Shura	–	Community Development Council
Gozar	–	Street

NOTE

(i) In this report, "$" refers to US dollars.

EXECUTIVE SUMMARY

The Government of the Islamic Republic of Afghanistan (Government) requested the Asian Development Bank (ADB) for Transaction Technical Assistance (TRTA) to prepare a project to improve water resources management, irrigated agriculture, water supply for Kandahar City, and to augment electric power in Kandahar City and the surrounding area.

The contract for consulting services for TA-9273 AFG: Preparing the Arghandab Integrated Water Resources Development Investment Project was signed on 20 September 2017 between ADB and FCG ANZDEC Limited from New Zealand. The objective of this TRTA is to design a project suitable for funding. The ensuing project is envisaged to comprise four components: (i) Component 1: raising Dahla Dam and six saddle dams; (ii) Component 2: irrigation and agriculture development; (iii) Component 3: water supply for Kandahar City; and (iv) Component 4: Dahla Dam hydroelectric power development. Component 1 project activities have the most potential to cause significant adverse human and environmental impacts. ADB funding is predominantly being allocated to Component 1. Separate Environmental Impact Assessment (EIA) have been prepared for each project component.

This EIA concerns addressing the potential impacts from Component 1: Raising Dahla Dam and six saddle dams, combined with the associated re-alignment of a portion of the Route Bearer Highway. The Component 1 project is classified as ADB Category A due to anticipated irreversible, diverse, or unprecedented impacts from raising the existing dam's height by 13.6 m and related infrastructure. Buildings in several villages will be affected, as well as several hectares of irrigable land surrounding the reservoir.

This EIA presents a preliminary review of baseline environmental conditions, impacts, and risks. It should be interpreted as an interim and working document. The recommended Arghandab River Environmental Study (ARES) is essential to reinforce the assessment findings and recommended management actions which will be produced during the detailed design stage. This EIA report will be revised on several occasions prior to the construction phase in order to satisfy ADB Safeguard Policy Statement (SPS) requirements, providing an adequate basis for understanding potential project impacts and identification of appropriate mitigation measures.

The ARES is recommended for implementation before commencement and during the detailed design, from the second half of 2019. The detailed design shall, using information from the ARES, update the EIA. Identified data gaps to be filled include specifics regarding an important range of biophysical elements (e.g. flora, aquatic and ornithological environments), contemporary figures relating to the establishment of environmental flows, and site-specific baseline data related to noise, air and water quality. Additional information concerning potential community mobilization to implement revegetation establishment and protection is also a component of the ARES.

Component 1 project and impacts. The project is raising the existing dam height and related infrastructure by 13.6 m providing an additional 500 million m^3 water to Dahla reservoir. By increasing storage volume, the project aims at improving water management and water allocations throughout the year as compared to the existing situation.

Realignment of a portion of the Route Bear Highway is subsequently required. Minimal environmental impact is expected as a result of the route realignment, as the proposed road is located away from settlement and located on land which is almost unvegetated. A 600 m portion of the proposed alignment passes through an agricultural land to be acquired prior construction.

The tract of the existing Route Bearer Highway (which will be inundated) is being proposed as the 'borrow pit' for material suitable for the dam wall.

EIA methodology and report. A field visit to Kandahar was conducted during 9-13 July 2018. The main irrigation canal, upper division weir (Component 2), saddle dams, spillway, main dam including infrastructure (tower, waste collecting structure), proposed contractor's yard, and the reservoir were visited. A boat trip was carried out on the reservoir. The main stakeholders (Ministry of Energy and Water (MEW), Ministry of Agriculture, Irrigation, and Livestock (MAIL), National Environmental Protection Agency (NEPA), Arghandab Sub-Basin Agency (ASBA), Da Afghanistan Breshna Sherkat (DABS), Afghanistan Urban Water Supply and Sewerage Corporation (AUWSSC), and the Cultural Department of Kandahar City) were visited.

Data collected from various sources have been evaluated (NEPA in Kabul and Kandahar, AUWSSC, Cultural Department Kandahar, DABS, ASBA, Helmand River Basin Authority, Archaeology Institute Kabul, and KNMI climate explorer, Helmholtz Institut Geesthacht, Germany).

This EIA report includes description of the physical and the biological environment, assessment of impacts on the environment during detailed design, construction and operation, and the Environmental Management Plan (EMP). Environmental impacts have been identified and mitigation measures have been recommended accordingly. The EMP includes monitoring activities to be conducted during construction and during the operational stage.

Mitigation measures. Presentation of the impacts and recommendations for their mitigation have been categorized for detailed design, construction, and operation, using a risk-based approach that assesses impact significance and provides a rating:

(i) Mitigation of impacts identified for addressing at detailed design include protection of the water resource and biophysical environment, development of precautionary emergency response plan, addressing social issues associated with resettlement and land use, ensuring appropriate detailed design specifications for seismic condition and strategic long-term catchment management issues, as well as independent review of all documentation.

(ii) For construction phase, the critical impact mitigation measure is for the contractor to assume solid ownership of the major environmental concerns through adoption of the Site-Specific Environmental Management Plan (SSEMP) which outlines management of all biophysical and social issues including on-site safety and employment of local people wherever possible.

(iii) The operation phase foresees the need develop appropriate environmental flows and ensure that both water quality and water management issues increasingly involve farmers for successful implementation. In addition, re-establishment of potential habitat around the perimeter of the new water alignment is anticipated to offer sanctuary for avian species.

It is generally found that the raising of Dahla Dam will not have any long-term impacts upon the biological environment, and in most cases, pre-conditions can be improved. There are no protected areas in the vicinity of the dam. Protected species have been recorded during the environmental surveys in November 2018. While some species will be affected in the short term during construction of the dam raise and saddle dams, mitigation measures are in place to minimize the impact of these. Introduction of water protection zones including protective measures around the reservoir are suggested for maintaining water quality in the reservoir over the long run.

Challenges and limitations. The realities against which this document has been produced need to be clearly stated. Afghanistan is recognized as being one of the most insecure environments in which such a study can be conducted. Major parts of the catchment to this dam area are considered to be “no-go” areas, which has highly compromised the efficacy and rigorousness of the EIA data gathering and analysis process. Although there has been generous cooperation between the TRTA, partners and government agencies, the insecurity has been a major driver in determining the limitations of what could be done.

Firmly associated with both the insecurity and the lengthy period of the civil war, is the lack of contemporary data on which analysis and conclusions can be made. While government agencies are willing partners in assisting the TRTA, both their human resource capacity and lack of physical resource add to the general state of inferior data. These issues can be overcome but they require longer time than what logical planning would determine. This EIA has been a victim of such shortfalls.

To establish appropriate environmental flows is a pertinent example of the challenges faced. The time required to assess the variables involved including the deliberations by TRTA members in consulting with all the stakeholders involved and documenting the issue has been professional, well placed, but insufficient. At the same time, instituting any environmental flows will require proactive collaboration with farmers and water users along the river. To be successful, these actions will require a cautious and careful mix of technical dialogue combined with an understanding of the realities of subsistence level arid-zone farming. As a result, what is being recommended in this document is a two-stage process to establish a pilot approach, and then secondly refine the real-time data gathering process during the dam operation phase.

CONTENTS

APPENDIXES (separate document)

I. INTRODUCTION

1. The proposed Arghandab Integrated Water Resources Development Investment Project (the project) will finance improvements to the availability and use of water resources for irrigated agriculture, urban water supply, and power generation for Kandahar, the country's second largest city, and its vicinity. The project—located in the Arghandab River sub-basin, within the Helmand River system—will also make the management of these water resources more efficient. The availability of water in the sub-basin, along with the rest of the Islamic Republic of Afghanistan, is highly seasonal and erratic, with frequent and worsening droughts affecting agriculture, living standards, and the local economy. The water supply for Kandahar City as well as irrigated agriculture for over 64,000 ha of farmlands in the Kandahar vicinity is solely dependent on Dahla Dam. Built in 1952, the dam stores irregular runoffs from snowmelt in high mountains, however, the reservoir has lost 40% of its storage capacity to sedimentation over 66 years of continuous operations. Subsequently its ability to provide regulated flows during frequent droughts is seriously constrained.

2. Promoting stability and growth in Kandahar province is a high priority for the Government of the Islamic Republic of Afghanistan (Government). The potential for socio-economic development in the province is severely impeded by the lack of access to sustained and reliable water. Enough water would be available to address these issues if this resource was managed efficiently, however, the ability of the Government and provincial authorities to do this is severely constrained by the diminishing storage in Dahla Dam reservoir, lack of institutional and human capacity in water sector institutions. The proposed investment program will provide a long-term sustainable solution to these problems.

3. Given the large number of development partners and limited institutional capacity, the Government and ADB agreed that ADB's assistance would be focused on the infrastructure investments in agriculture and natural resources management, energy, and transport and communications. The Country Partnership Strategy (2017-2021) shows that the performance of ADB's Afghanistan portfolio was above the average despite vast implementation challenges, and the performance of agriculture and natural resources sector projects were generally satisfactory. The Government puts a high priority on this proposed investment program.[1]

A. Purpose of the Report

4. This Environmental Impact Assessment (EIA) report has been prepared to identify potential environmental impacts for Component 1 of the project. Component 1 is focused on raising the wall of the Dahla Dam and saddle dams, and the re-alignment of the Route Bearer Highway. The project is classified as ADB Environmental Category A due to impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. Physical works will focus on raising six saddle dam walls and construction of the re-aligned highway. Environmental impacts are expected for these construction sites and, in addition, for the area to be inundated after the dam wall raising. Category A projects require environmental assessment in the form of an EIA. EIA findings are used to prepare the Environmental Management Plan (EMP) including the environmental monitoring plan.

5. The EIA was prepared for, and in coordination and consultation with, the Ministry of Energy and Water (MEW) from May 2018 to February 2019. The international and national

[1] ADB. 2017. "Afghanistan: Country Partnership Strategy (2017-2021)". Manila. https://www.adb.org/documents/afghanistan-country-partnership-strategy-2017-2021

environmental specialists visited the project sites. Consultations with the relevant stakeholders were carried out in order to discuss the project's goals and implementation. Scope and progress of the EIA were presented to the Project Steering Committee (PSC) at MEW in Kabul on 8 July 2018.

B. Data Collection

6. Baseline data referring to the physical, biological and the socio-economic environment have been collected from previous studies and through meetings with the following authorities and agencies:

(i) Ministry of Energy and Water (MEW) Kabul;
(ii) Afghanistan Urban Water Supply and Sewerage Corporation (AUWSSC);
(iii) Arghandab Sub-Basin Agency Kandahar (ASBA);
(iv) Da Afghanistan Breshna Sherkat (DABS) Kandahar;
(v) Helmand River Basin Authority;
(vi) NEPA Kabul and NEPA Kandahar;
(vii) Archaeology Institute Kabul;
(viii) Department of Culture Kandahar.

7. The primary data was collected through site visits and observations, technical and environmental surveys, and consultations with the government and community representatives. The TRTA team conducted two sites visits to Dahla Dam in 2018 (in January–February 2018 by dam engineers and in July 2018 by environmental specialists). These site visits provided the TRTA team with valuable familiarization of physical site characteristics and condition and a first-hand opportunity to collect data. Further, following surveys were conducted: (i) bathymetric survey to assess topography of bottom of Dahla Dam reservoir and estimate reservoir volume capacity in May 2018; topographic survey to refine reservoir volume capacity from September to December 2018; geotechnical survey to conduct sample tests on main dam, saddle dam 6, and borrow areas during September and October 2018; environmental ornithological and fish surveys in the Dahla reservoir area in November 2018; and environmental surveys to assess air quality (reservoir area, current highway) and water quality (reservoir, canal downstream and Kandahar groundwater wells). Subsequent to the site-based data-gathering work, the TRTA team consulted and collaborated with relevant government agencies including implementation agencies in Kandahar and Kabul. Additionally, a Kandahar based TRTA coordinator has been providing information as required.

8. Secondary research utilized the considerable body of work which has been produced by agencies regarding previous proposals to upgrade the Dahla Dam, including the now defunct Canadian CIDA investigations and partial implementation / rehabilitation of both the Dahla Dam and irrigation network, and the DFID funded Helmand River Basin Master-Plan, a three-year study which specifically included the Arghandab river as a tributary.

C. Impact Assessment and Mitigation

9. Potential consequences and project impacts on the physical and biological environment have been assessed. Analysis is based on findings during field visits and evaluation of data received from various sources. Assessment relates to environmental impacts during construction and operation of Component 1 (Dahla Dam wall raising). A Rapid Environmental Assessment (REA) has been carried out to address the likely/potential impacts. Significant adverse environmental impacts which are irreversible, diverse, or unprecedented due to construction and operation of Component 1 have been identified. The likely and potential

impacts and mitigation measures are summarized in the EMP and mitigation measures have been developed accordingly.

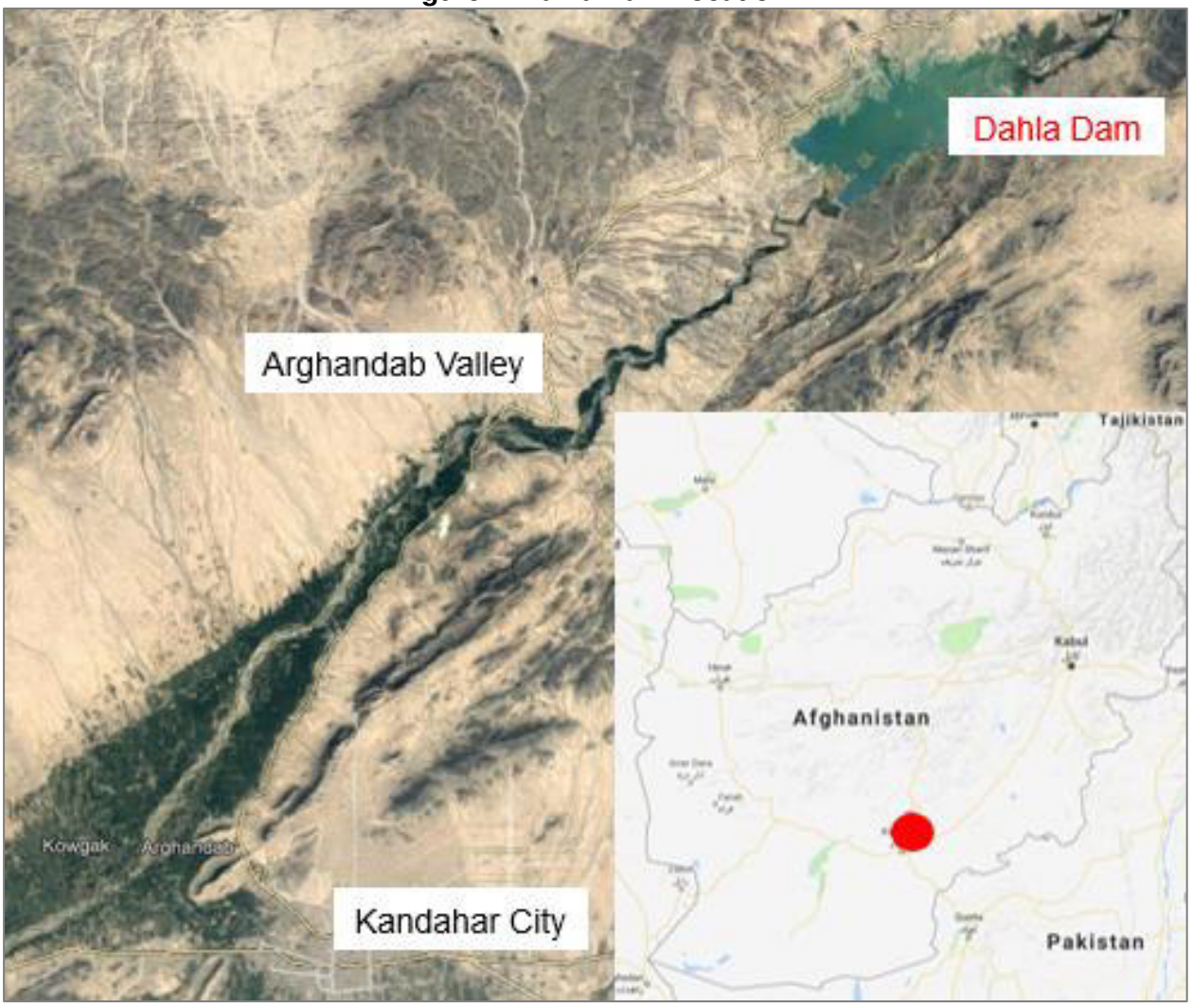
III. DESCRIPTION OF THE PROJECT

A. Existing Dam

1. Location and Purpose

10. Dahla Dam is the largest dam in Kandahar Province, and the second largest in Afghanistan. It is located approximately 35 km northeast of Kandahar City on the Arghandab River. Its location is presented in the Figure below.

Figure 1. Dahla Dam Location



Source: TRTA Consultants, 2019

11. Dahla Dam was designed by International Engineering Company, Inc. and constructed by Morrison-Knudsen, Afghanistan, Inc for the Government of Afghanistan as part of the larger Helmand and Arghandab Valley Authority (HAVA) Project. Dam construction began in 1950, and the dam has been in operation since 1952. It is operated by HAVA. Dahla Dam was constructed to store 478 million m^3 of water mainly for irrigation and flood control purposes, with the anticipated extension of the Arghandab reservoir water use for hydropower generation not being implemented.

2. Main Characteristics

12. The dam has a clay core rockfill embankment / zoned earth fill, and has a catchment area of 12,925 km^2.

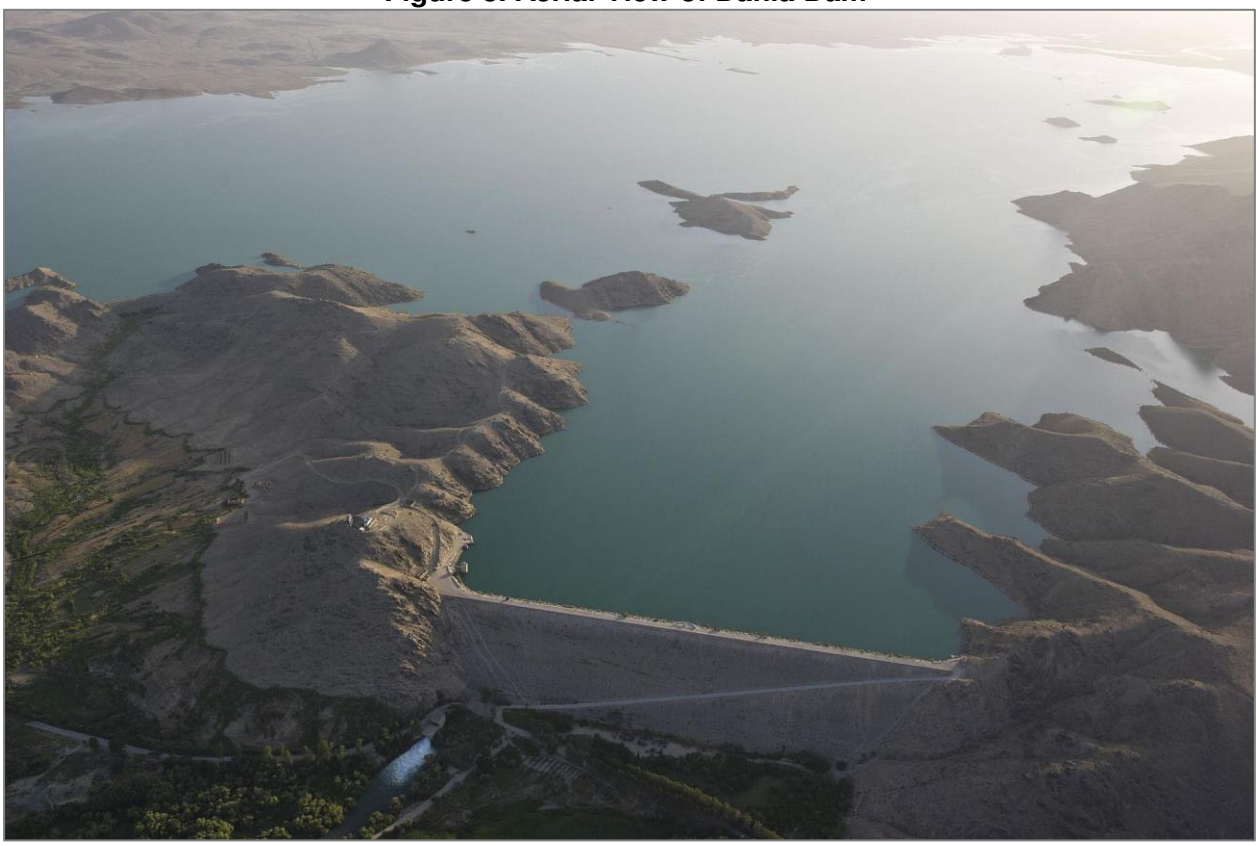
13. The main dam embankment is 60 m high from the deepest foundation, has a WGS84 crest elevation of 1140.9 m with a crest length of approximately 540 m. The reservoir's full supply level (FSL) is 1,135.4 m, with a surface area of 29.4 km^2 and a storage capacity of approximately 478 million m^3 at FSL. The project includes six saddle dams along the reservoir perimeter. Five of the saddle dams have a maximum height of 15 m and an aggregate length of 1,515 m. The sixth saddle dam has a maximum height of 20 m and a crest length of 145 m.

14. There are two open channel spillways: Spillway 1 is about 240 m long and is located 1.5 km between Saddle Dams 6 and 5, and Spillway 2 is about 100 m long and is located 2.2 km northwest of the main embankment between Saddle Dams 3 and 4. Both spillways have an ungated concrete weir and discharge into existing channels that enter the river downstream of the dam. The Figures below show the main components of Dahla Dam and an aerial view of Dahla Dam, its main embankment and Saddle Dam 6.

Figure 2. Dahla Dam: Main Embankment, Saddle Dams and Spillways

Source: USACE, TAM Construction Management Plan Concept of Operation, 30 April 2014, Dahla Dam Improvements Project

Figure 3. Aerial View of Dahla Dam



Source: Wikipedia, accessed in 2019

3. Dam Safety

15. Technical aspects investigated and considered in this study include 'constructability' and safety of the proposed investment options through performing failure mode and slope stability analyses. Under this TRTA, 27 stability cases were run for the dam options including the 1952 level, 8 m raise, and 12 m raise for the main dam and saddle dams. Under the proposed designs, slope stability factors of safety are consistent with the initial 1952 design and the required minimum as per international dam safety practice. It was concluded that under the proposed design, all dams should be safe for the full-supply level, dam crest floods, and seismic loads, which ensures that dam raising options for both 8 m and 12 m are technically feasible and meet safety requirements. Further dam stability analysis for the selected investment option will be conducted in the final feasibility study stage, as more detailed data on the strength for the soil become available.

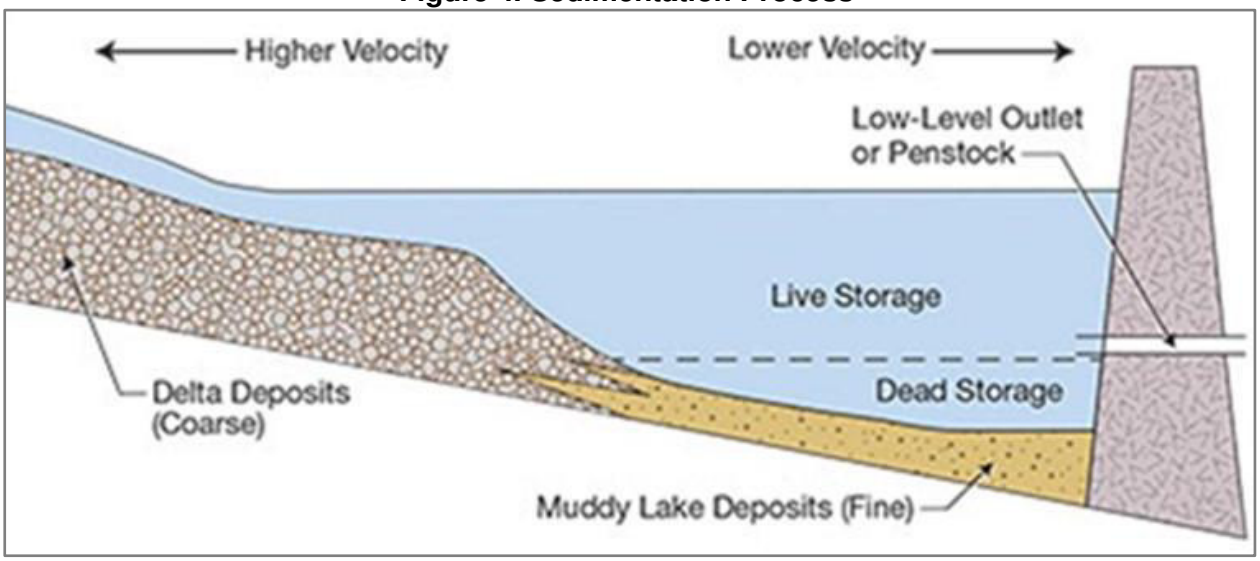
B. Rationale

16. The TRTA team completed a bathymetric survey and a topographic survey in 2018 and collected data which were used in this study combined with data from previous studies. Bathymetric survey estimated volumes were further improved with the results of the topographic survey. The estimated corrected reservoir volumes were:

(i) Present reservoir volume, as of 2018, at FSL (spillway crest level): 288 million m^3; and
(ii) Estimated reservoir volume with 13.6 m dam raise: 782 million m^3.

17. Sedimentation in the dam since 1952 has reduced the storage from 478 to 288 million m^3: 190 million m^3 over a period of 67 years. The reservoir has consequently lost 40% of water storage capacity. Sedimentation with delta deposits (coarse material) in high velocity zones and muddy lake deposits (fine material) in low velocity zones has taken place.

Figure 4. Sedimentation Process



Note: Typically, sedimentation in the reservoir behind a dam takes the form of progressively finer materials being deposited as the flows approach the dam.
Source: Adapted from Morris G.L. and J. Fan, Reservoir Sedimentation Manual, McGraw-Hill, New York, 1998.

18. Present sedimentation rate is 2.7 million m^3 per year. It is anticipated that during high inflows, sedimentation flushing should be performed through irrigation outlets. The irrigation outlets should be kept fully open. During detailed design, consideration should be given to re-assess the discharge capacity and changing the type of the outlet channel. Additional sedimentation studies should also be performed during detailed design.

19. Considering a sedimentation rate of 2.7 million m^3 per year, in a no project scenario, the dam would be filled with sediments with no water storage in about 100 years and the dam would be decommissioned. This would have a very critical impact on irrigation and agriculture of the Arghandab valley and livelihoods for those that depend on water from the reservoir. It shall be noted that over 64,000 hectares of farmlands are solely dependent on Dahla Dam.

20. The potential for socio-economic development in the province is severely impeded by a lack of access to sustained and reliable water and a chronic power shortage.

21. Extensive studies have been conducted for raising Dahla Dam since 2012, including the studies carried out by the Canadian International Development Agency (CIDA) and the United States Army Corps of Engineers (USACE).

22. Raising Dahla Dam by 13.6 m will add an additional storage of about 500 million m^3 to the existing 288 million m^3 reservoir and will be a significant opportunity to generate and add electricity to the grid. Dahla reservoir once raised should have a life of over 200 years. When raised, the Dahla Dam is envisaged to provide water for domestic and municipal water supply, irrigation, hydropower and environmental flows.

C. Proposed Project

1. Raising of Dahla Dam

23. The project involves rehabilitation and raising of the main embankment of Dahla Dam, its six saddle dams, and two new spillways.

24. The outlet works consists one 4.6 m diameter tunnel, an inlet portal and trash rack located at the main dam right abutment, an octagonal concrete intake tower located 49 m upstream of the dam axis, and an outlet control valve house, located at the right abutment at the downstream toe of the embankment. Two 122 cm diameter pipes branch from the tunnel into the valve house to supply the irrigation outlets, which are controlled by Howell Bunger valves.

25. The Table below presents the principal project data for the 1952 design existing dam and proposed dam with a 13.6 m spillway raise.

Table 1. Principal Project Data

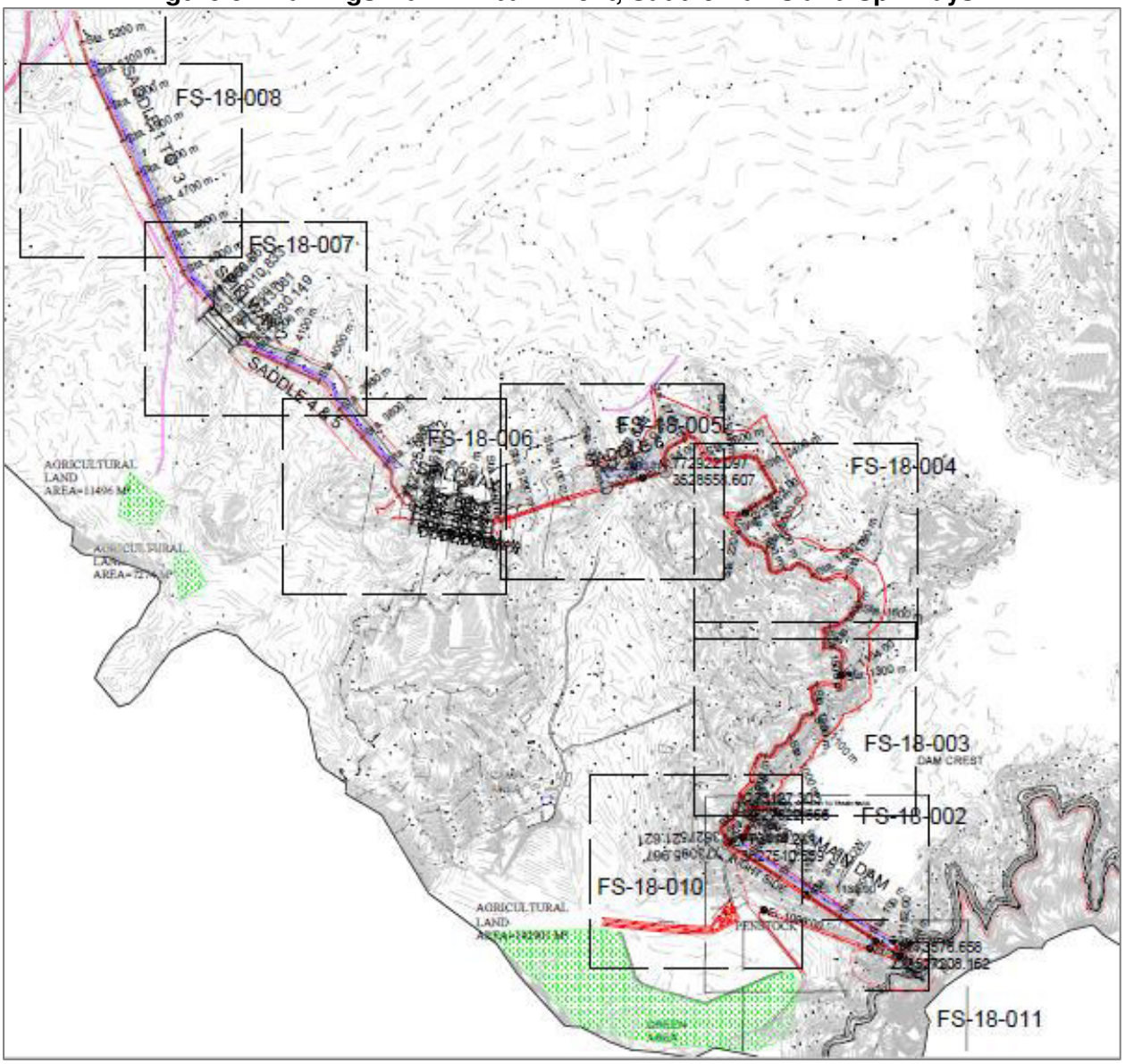
Characteristic	Current dam	Change	Proposed dam
Catchment area (km^2)	12,925	-	12,925
Bottom of conservation storage (WGS 84) (m)	1,0954.4	-	1,0954.4
Storage capacity (million m^3)	478	304	782
Current storage, 2019 (million m^3)	**288**	**494**	**782**
Reservoir area (km^2)			
At Full Supply Level (FSL)	29.54	16.27	45.81
At Probable Maximum Flood (PMF)	33.00	17.05	50.05
At Dam Crest Flood (DCF)	35.05	17.66	52.71
Dam crest elevation (WGS 84) (m)	**1,141**	**13**	**1,154**
Dam height above deepest foundation (m)			
Main dam	60	13	73
Saddle Dam 6	20	13	33
Saddle Dams 1 to 5	5-15	13	18-29
Dam crest length (m)			
Main dam	535	220	755
Saddle Dam 6 and extension	180	330	510
Saddle Dams 1 to 5 and extension	1,515	480	1,995
Dam crest width (m)			
Main dam	8.0	-	8.0
Saddle Dam 6 and extension	6.4	1.6	8.0
Saddle dam 1 to 5 and extension	6.4	1.6	8.0
Saddle Dam 5 extension with Spillway 1		12.0	12.0
Saddle Dam 3,4 extension with Spillway 2		12.0	12.0
Free board at spillway level (m)	5.0	-	5.0
Spillway crest elevation (WGS 84) m	**1,135.4**	**13.6**	**1,149**
Spillway length (m)			
Spillway 1	260		220
Spillway 2	100		120
Discharge capacity at PMF (m^3/s)			
Spillway 1	2,600	-299	2,301
Spillway 2	1,160	-95	1,255

Total discharge capacity	3,760	-394	3,556
Inlet / outlet / diversion tunnel Trash rack Intake Tower Irrigation outlet Penstock outlet for hydropower	To be reviewed in detailed design		

Source: TRTA Consultants, 2019

26. The Figure below shows the drawings of the main construction work.

Figure 5. Drawings Main Embankment, Saddle Dams and Spillways



Source: TRTA Consultants, 2019

2. Realignment of Route Bearer Highway

a. Existing Highway

27. The proposed dam raise requires realignment of a section of the existing Route Bearer Highway also known as Kandahar-Bamiyan Highway in Shah Wali Kot District of Kandahar. The Route Bear Highway passes the project area along the right abutment of saddle dam no. 1. The highway was realigned at limited reaches for an 8 m raise of the Dahla Dam in 2014.

Figure 6. Existing Route Bearer Highway

Source: Google Maps, 2019

28. Existing Route Bearer is a two-lane single carriage highway. The highway is 7.3 m wide of paved area and has 1.5 m shoulders on both sides. Existing alignment passes mainly along barren hilly areas with limited or no inhabitant adjacent to it. Shahjuy is the only village in this stretch.

Figure 7. Photo of the Existing Route Bearer Highway

Source: TRTA Consultants, 2018

29. No drains exist along the existing route and water flow naturally along the road embankment in natural topography. No embankment damage was noted due to non-availability of drains along the route. There are number of culverts and one existing causeway. Several of the existing culverts were destroyed by the improvised explosive devices (IEDs) attacks.

b. Proposed Alignment

30. The proposed realigned highway will be 9.3 km long and passes mostly through barren hilly terrain. This includes 850 m stretch of existing highway for rehabilitation / repair. The new construction will be limited to about 8.45 km.

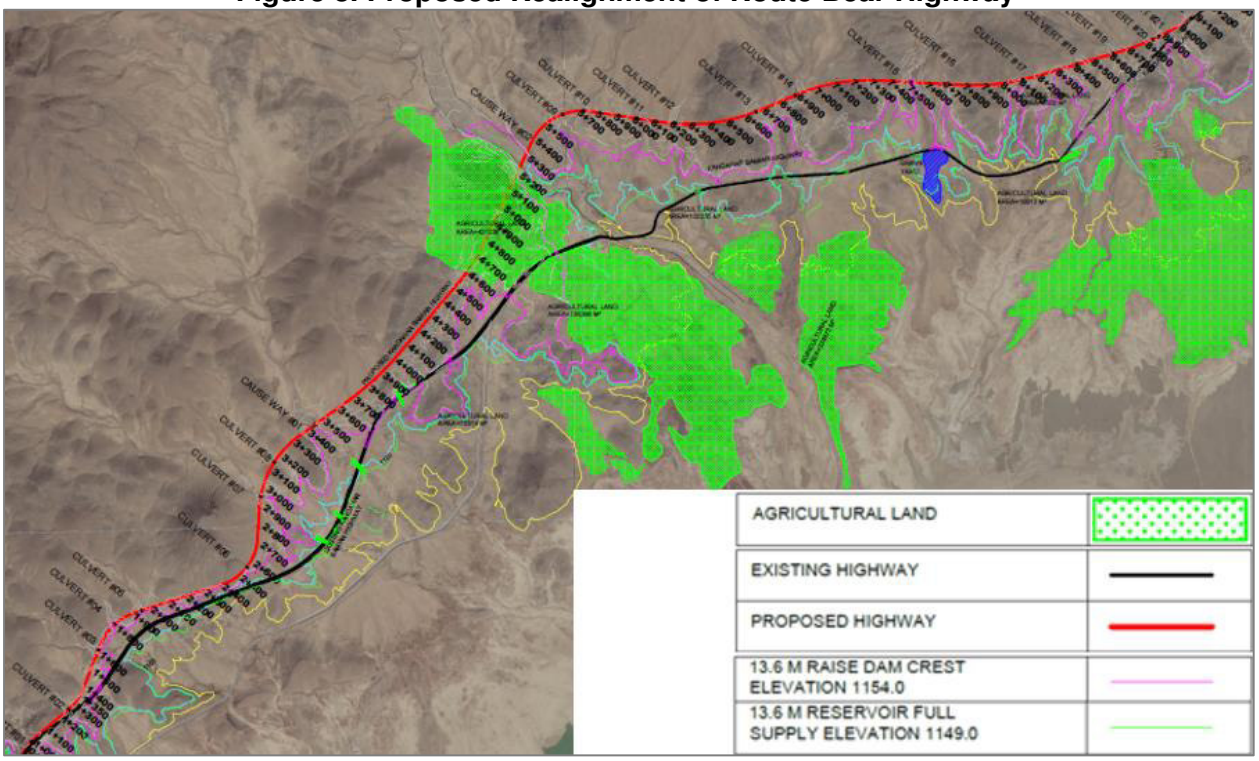
31. The proposed alignment design was considered based on number of issues like all time safe travel for road users even in case of Dam Crest Flood i.e. above 1154,0 m (WGS 84 elevation), possibility of future extension to motorway, possibility for dual carriageway, minimum cut and fill or balance cut and fill, minimal effect on commute distance and travel time for users.

32. 23 culverts and two super passages (causeways) are proposed along the route. It was noted that number of existing culverts were destroyed and due to security risks, it was preferred to defer design of bridge along the super passage.

33. The detailed design of the highway prepared by the TRTA in 2019 is according to the American Association of State Highway and Transportation Officials (AASHTO) standard.

34. The Figure below shows the proposed realigned highway and existing highway with the 13.6 m raise at dam crest flood and at full supply elevation.

Figure 8. Proposed Realignment of Route Bear Highway



Source: TRTA Consultants, 2019

D. Construction Activities

1. Raising of Dahla Dam

35. The construction activities for raising of Dahla Dam will include:

(i) **Borrow areas:** Development of the borrow area for clay core, filters, rockfill, riprap and aggregates for the dam and concrete works.

(ii) **Raise of main dam**: raising of the main dam from 1140.9 to 1154 m with an increase in length of the dam from 535 to 755 m. The design assumes up to 5 m excavation of the existing core to eliminate any tension cracks and mitigate risk of high seepage zones. Then the core and other zones will be extended to 1,152 m (WGS84) elevation at existing slope. A 2 m high retaining wall provides additional free board in case of PMF. Although it has been found that core and sandy gravels are in filter relationship, the core shall also be protected with a geotextile bidim A64 or similar to mitigating risk of escape of fines from the dam body in to sandy gravel zones. A 2 m thick sandy gravel zone filter shall be placed along the existing embankment slope to provide additional filter capacity to check seepage. A crest width of 8 m is proposed for the dam. Downstream slope remains the same as on 1952 design: 1V: 2.5H. The Figure below shows a typical cross section of the embankment.

(iii) **Raise of Saddle Dam 6**: raising of Saddle Dam 6 from 1140.9 to 1154 m with an increase in length of from 180 to 510 m and widening of the crest width from 6.4 to 8 m; Saddle Dam 6 extension increase in crest width with Spillway 1 from 8 to 12 m. Grouting or Bentonite cut-off wall construction works for the reaches of the saddle dams. The design assumes 5 m excavation of the existing core under

gravel crest to eliminate any tension cracks and mitigate risk of high seepage zones. Although it has been found that core and sandy gravels are in filter relationship the core shall also be protected with geotextile bidim A64 or similar to mitigate risk of escape of fines from the dam body in to sandy gravel zones. A 2 m thick sandy gravel zone filter shall be placed along the existing embankment slope to provide additional filter capacity to check seepage. Downstream slope remains the same as on 1952 design: 1V: 2.5H. The Figure below shows the cross section of the saddle dam.

(iv) **Raise of Saddle Dams 1 to 5**: raising of Saddle Dams 1 to 5 from 1140.9 to 1154 m with an increase in total length from 1,515 to 1,995 m and widening of the crest width from 6.4 to 8 m; Saddle Dam 5 extension increase in crest width with Spillway 1 from 8 to 12 m; Saddle Dam 3 and 4 extension increase in crest width with Spillway 2 from 8 to 12 m. Grouting or Bentonite cut-off wall construction works for the reaches of the saddle dams. The design for Saddle Dams 1-5 has been performed considering both an upstream core in additional to the original 1952 design and the remaining parts, such as saddle Dam 6. For a 13.6 m raise, a 6 m wide core along the upstream at a slope of 1:2.25 has been proposed. The design assumes 5 m excavation of the existing core to eliminate any tension cracks and mitigate risk of high seepage zones. Although it has been found that core and sandy gravels are in filter relationship, the core shall also be protected with geotextile bidim A64 or similar to mitigate risk of escape of fines from the dam body in to sandy gravel zones. A 2 m thick sandy gravel zone filter shall be placed along the existing embankment slope to provide additional filter capacity to check seepage. The downstream slope remains the same as on 1952 design: 1V: 2.5H. The Figure below shows the cross section of the saddle dams.

(v) **Raise of intake tower, tunnel lining and trash rack:** raising of the existing 5.2 m diameter intake tower from elevation 1136.4 to 1158 m elevation with an existing 0.4 m wall thickness; raising of the existing 2.6 m x 12.37 m wide two trash racks from 1136.5 m to 1150.5 m elevation; and concrete lining of the remaining 184 m length of the inlet / outlet diversion tunnel.

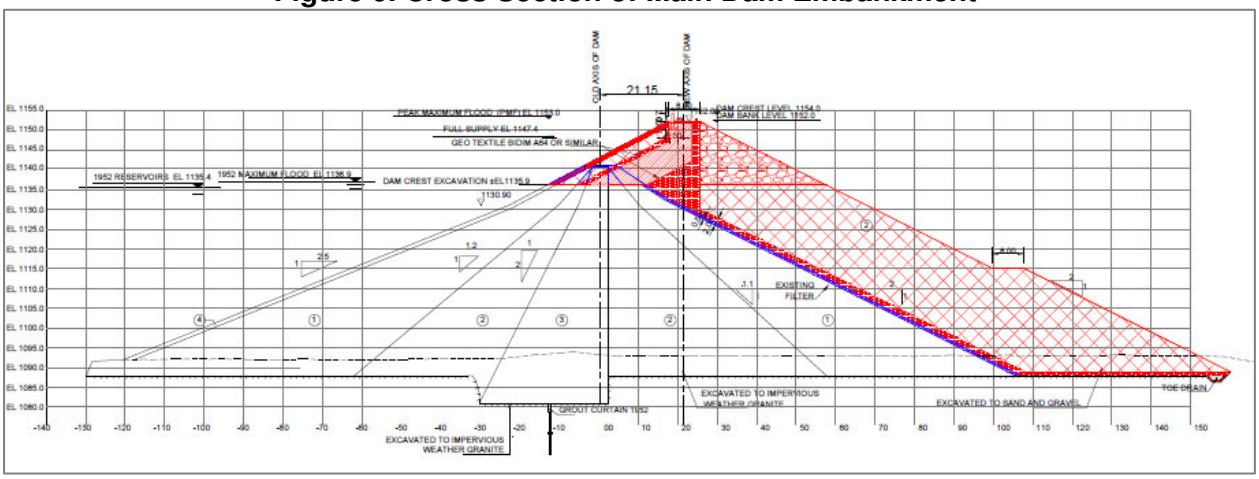
(vi) **Extension of Saddle Dam 1**: Saddle Dam 1 extension from station 5+150 to 5+600 with dam crest elevation at 1153.0 m to act as fuse plug embankment. The crest will be protected with concrete 0.15 m thick from elevation 1149 and downstream will be rock armored.

(vii) **Preparatory work for Spillway 1 and 2**: Construction of coffer dam / diversion works for the construction of Spillway 1 and 2; Removal / dismantling of the existing spillways; Foundation grouting works of the Spillway 1 and 2;

(viii) **Construction of Spillway 1 and 2**: constructing a new concrete spillway adjacent to old Spillway 1 from 1135 m to 1149 m with a 220 m long overflow weir abutting against rock.

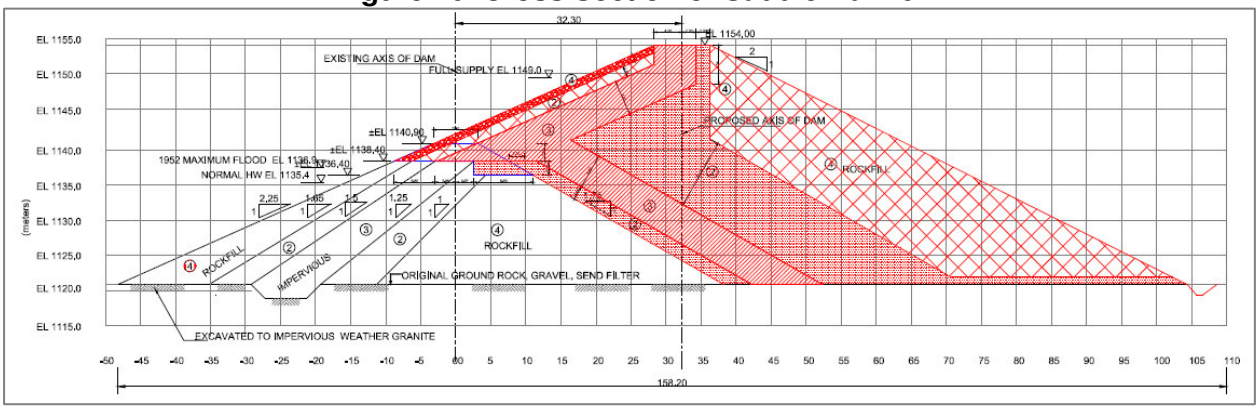
(ix) **Construction of Spillway 2**: constructing a new concrete spillway adjacent to old Spillway 2 from 1135 m to 1149 m with a 120 m long overflow weir abutting against embankments.

Figure 9. Cross Section of Main Dam Embankment



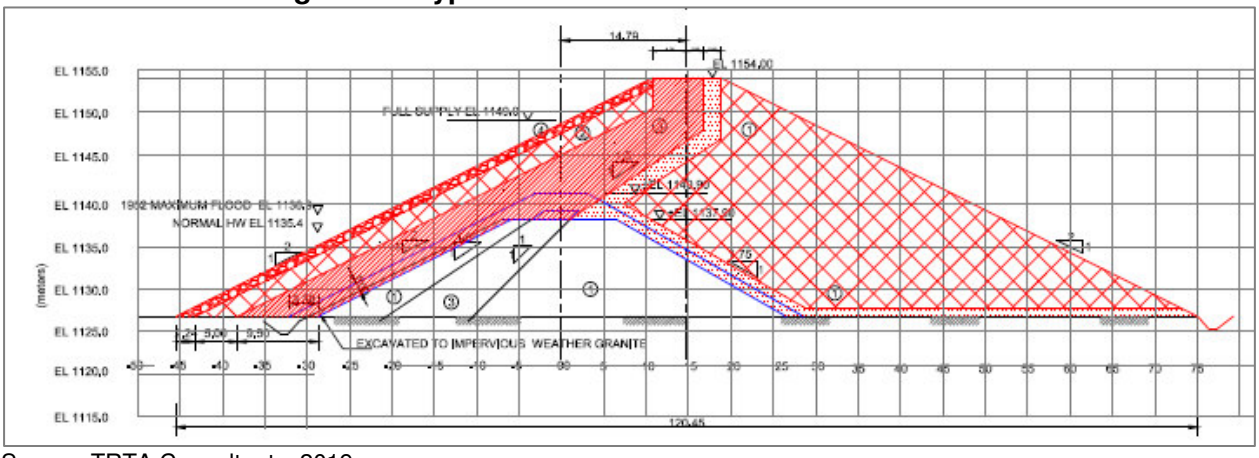
Source: TRTA Consultants, 2019

Figure 10. Cross Section of Saddle Dam 6



Source: TRTA Consultants, 2019

Figure 11. Typical Cross Section of Saddle Dam 1-5



Source: TRTA Consultants, 2019

36. Other activities will include:

(i) Site security fence;
(iii) Electrification along dam;

(iv) Staff colony and security camp; this will require town planning input to plan a small colony adjacent to dam site for the operation and security staff working on the dam. Possibly the camp will be in the same area where Turkish Contractor 77 built his camp for the construction of the new outlet structure.
(v) Geotechnical instrumentation; Installation of the geotechnical, seismic and hydraulic instrumentations;
(vi) Dam safety staff training;
(vii) Resettlement; resettlement will be initiated for the villages living along the reservoir prior construction.

2. Realignment of Route Bearer Highway

37. The construction activities for the Component 1 – realignment of Route Bear Highway will include:

(i) Construction of 9.3 km highway including 0.85 km rehabilitation of existing road, width maximum 11 m in hilly terrain;
(ii) Construction of carriage way (7 m), 1 m shoulder on each side, side drain;
(iii) Cut and fill will almost balance, no surplus soil for disposal is expected;
(iv) construction of a number of 18 to 22 small to medium culverts (610 mm circular pipe) and two causeways along with the pavement works;[2]
(v) Security fencing of culverts to mitigate risk of IED explosion;
(vi) Construction works will include excavation, limited drilling and blasting to remove rockfill and pavement works;
(vii) Stockpiling and processing of construction material downstream of saddle dam 6; (area used by previous contractors);
(viii) Asphalt to be imported from Pakistan (Quetta);
(ix) Stone, rock gravel and sand from existing quarries inside the dam and in the vicinity of the dam;
(x) Installation of asphalt plant, crushing plant at contractor's camp;
(xi) Pavement works will be performed after the road surface has been prepared;
(xii) The proposed alignment from Chainage 4+600 to 5+200 i.e. (length: 600m), will pass through Shah Joi village agriculture land - removal and stockpiling of topsoil in fertile stretches for subsequent use or landscaping is required;
(xiii) Removal of fruit trees from agricultural land by owners or by contractor;
(xiv) Pothole repairing at existing highway (0.85 km) with double bituminous surface treatment (DBST);
(xv) Traffic management along the existing road. A temporary road will be required to divert traffic during rehabilitation of existing road;
(xvi) Provision of security including clearance of mines and explosives along the ROW;
(xvii) Works in existing streams shall consider suitable measures to manage water flow and drainage;
(xviii) traffic signs and road markings along the rea-aligned highway will be installed.

E. Construction Schedule

38. **Raising of Dahla Dam**. Typically, low reservoir volume periods are from July to November. Most construction could be planned in such days with minimal risk of spillway flows.

[2] Locations of all culverts will be finalized as per site conditions and approved by the engineer.

Contractor has to design his own coffer dams to protect under construction spillways and structures. Similarly, various material for construction should be procured early so that most construction could be completed during low reservoir levels.

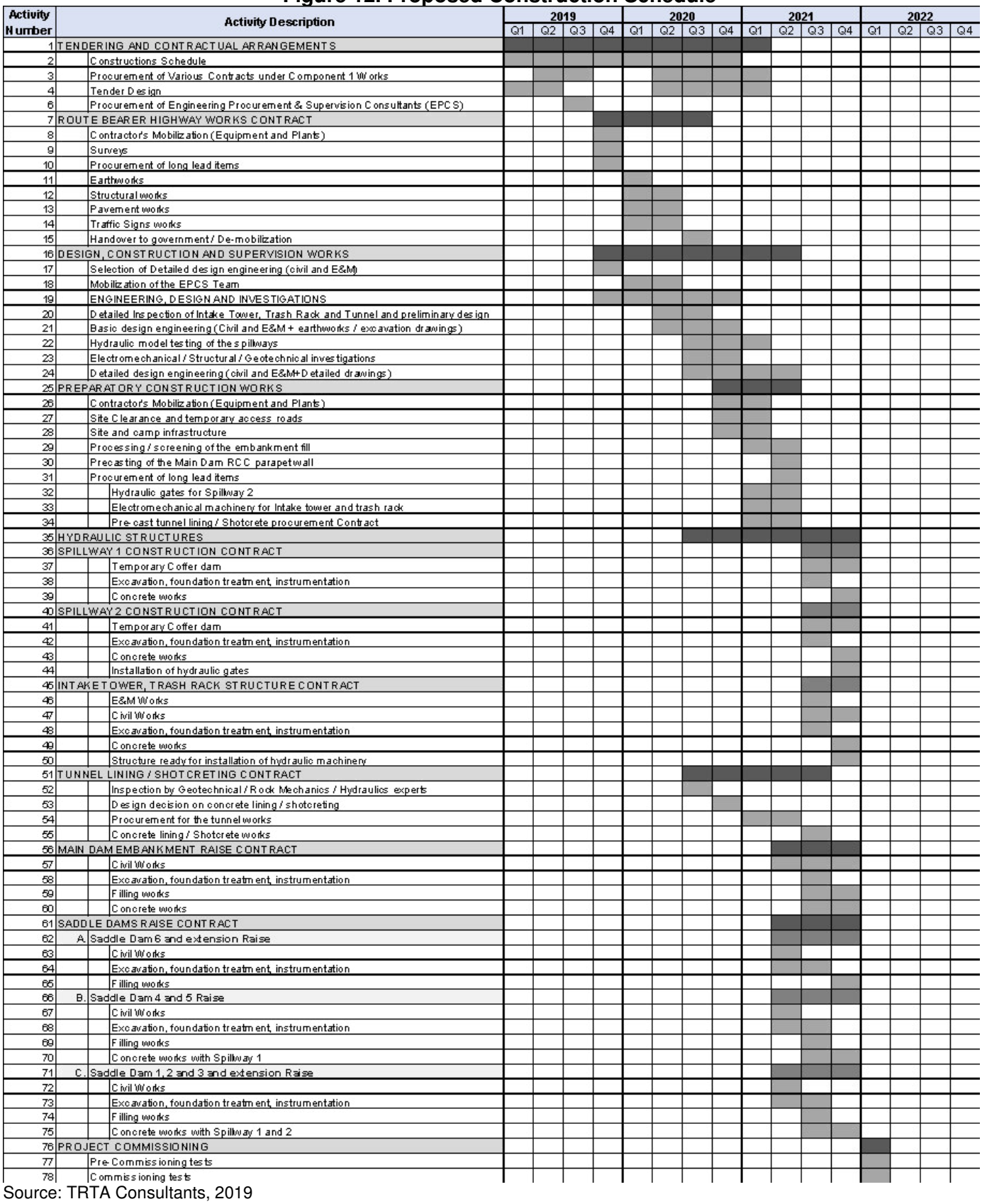
39. Recent geotechnical investigations have confirmed availability of significant quantities of the construction material along clay core, sand gravel mix, rockfill from the extended reservoir area. Rockfill should also be available from spillway area excavation. Drilling and blasting need careful planning. As this area is clear of the reservoir, contractor can easily start processing and stockpiling of the material for use during low reservoir time. This is a critical activity and must be managed carefully well in advance to ensure availability of enough material for construction. The contractor must perform his own investigations to validate the availability of the construction material from various sources and develop strength parameters before start of construction. Like cement and gravels can be obtained from various local quarries and are easily available in Kandahar. The proposed wall along main dam crest should be pre-casted well in advance to place on dam crest during dry months. All filters and other materials must be stockpiled before the start of the dry season to complete the construction with in dry months.

40. A planning for long lead items will be required. Long lead items have to be identified at the earliest and procurement of these items must be started soon to avoid delay in the construction to avoid unnecessary claims.

41. **Route Bearer Highway**. Works for the realignment of the route bearer highway can start at any time of the year. It is anticipated that the procurement for the work will be completed during second and third quarter of 2019. The construction works should be completed within six to nine months and is expected to start on first quarter of 2020.

42. The construction schedule is presented in the Figure below.

Figure 12. Proposed Construction Schedule



Activity Number	Activity Description	2019				2020				2021				2022			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	TENDERING AND CONTRACTUAL ARRANGEMENTS																
2	Constructions Schedule																
3	Procurement of Various Contracts under Component 1 Works																
4	Tender Design																
6	Procurement of Engineering Procurement & Supervision Consultants (EPCS)																
7	ROUTE BEARER HIGHWAY WORKS CONTRACT																
8	Contractor's Mobilization (Equipment and Plants)																
9	Surveys																
10	Procurement of long lead items																
11	Earthworks																
12	Structural works																
13	Pavement works																
14	Traffic Signs works																
15	Handover to government / De-mobilization																
16	DESIGN, CONSTRUCTION AND SUPERVISION WORKS																
17	Selection of Detailed design engineering (civil and E&M)																
18	Mobilization of the EPCS Team																
19	ENGINEERING, DESIGN AND INVESTIGATIONS																
20	Detailed Inspection of Intake Tower, Trash Rack and Tunnel and preliminary design																
21	Basic design engineering (Civil and E&M + earthworks / excavation drawings)																
22	Hydraulic model testing of the spillways																
23	Electromechanical / Structural / Geotechnical investigations																
24	Detailed design engineering (civil and E&M+Detailed drawings)																
25	PREPARATORY CONSTRUCTION WORKS																
26	Contractor's Mobilization (Equipment and Plants)																
27	Site Clearance and temporary access roads																
28	Site and camp infrastructure																
29	Processing / screening of the embankment fill																
30	Precasting of the Main Dam RCC parapetwall																
31	Procurement of long lead items																
32	Hydraulic gates for Spillway 2																
33	Electromechanical machinery for Intake tower and trash rack																
34	Pre-cast tunnel lining / Shotcrete procurement Contract																
35	HYDRAULIC STRUCTURES																
36	SPILLWAY 1 CONSTRUCTION CONTRACT																
37	Temporary Coffer dam																
38	Excavation, foundation treatment, instrumentation																
39	Concrete works																
40	SPILLWAY 2 CONSTRUCTION CONTRACT																
41	Temporary Coffer dam																
42	Excavation, foundation treatment, instrumentation																
43	Concrete works																
44	Installation of hydraulic gates																
45	INTAKE TOWER, TRASH RACK STRUCTURE CONTRACT																
46	E&M Works																
47	Civil Works																
48	Excavation, foundation treatment, instrumentation																
49	Concrete works																
50	Structure ready for installation of hydraulic machinery																
51	TUNNEL LINING / SHOTCRETING CONTRACT																
52	Inspection by Geotechnical / Rock Mechanics / Hydraulics experts																
53	Design decision on concrete lining / shotcreting																
54	Procurement for the tunnel works																
55	Concrete lining / Shotcrete works																
56	MAIN DAM EMBANKMENT RAISE CONTRACT																
57	Civil Works																
58	Excavation, foundation treatment, instrumentation																
59	Filling works																
60	Concrete works																
61	SADDLE DAMS RAISE CONTRACT																
62	A. Saddle Dam 6 and extension Raise																
63	Civil Works																
64	Excavation, foundation treatment, instrumentation																
65	Filling works																
66	B. Saddle Dam 4 and 5 Raise																
67	Civil Works																
68	Excavation, foundation treatment, instrumentation																
69	Filling works																
70	Concrete works with Spillway 1																
71	C. Saddle Dam 1, 2 and 3 and extension Raise																
72	Civil Works																
73	Excavation, foundation treatment, instrumentation																
74	Filling works																
75	Concrete works with Spillway 1 and 2																
76	PROJECT COMMISSIONING																
77	Pre-Commissioning tests																
78	Commissioning tests																

Source: TRTA Consultants, 2019

F. Operation and Maintenance, Emergency Response

43. This activity will include the following works:

(i) A study, design and installation of a Seasonal Forecasting Tool for Kandahar basin. This shall be done by a hydrologist / meteorologist and will require close coordination with MEW, ASBA, NEPA, Weather Bureau and Kandahar government. This will involve procurement of the equipment, installation in Kandahar in an approved building and hiring and training national staff;
(ii) Management of the operation and maintenance of the dam;
(iii) Capacity development of ASBA by hiring relevant engineering and operational staff. Numbers and positions need to be discussed and agreed with ASBA and MEW: engineers (civil, hydrologists, hydraulics, geotechnical, electrical, mechanical, GIS) and staff for operation of the dam safety emergency response vehicles;
(iv) Preparation of the operation and maintenance manuals for the dam in close coordination with MEW / ASBA and other relevant agencies for: the dam operational safety and, the dam safety emergency response;
(v) Training to the dam safety staff for emergency response: ASBA staff and other relevant emergency response organizations;
(vi) Procurement of emergency response equipment and vehicles for ASBA and MEW:

a. 2 Land Cruiser Prado Vehicles for the management;
b. 4 Toyota Hilux double cabin SRS 4 x 4 or equivalent vehicles for the staff working on dam safety;
c. 4 Toyota Hilux single cabin 4 x 4 or equivalent vehicles for the staff working on dam safety;
d. 2 long reach boom excavators Komatsu or equivalent;
e. 2 wheel loaders WA470-7 Komatsu or equivalent;
f. 2 dump trucks HM-400-5 Komatsu or equivalent;
g. 2 smooth wheel double drum 12 tons rollers Komatsu or equivalent;
h. 2 dozers D39EXi/PXi-23 Komatsu or equivalent;
i. 1 sheep foot roller 12 tons Komatsu or equivalent;
j. 1 9HP walk behind Double drum roller;

(vii) Provision of the inhouse mechanical and electrical workshop for the maintenance of these vehicles;
(viii) Provision for the petrol, oil and lubricants and maintenance of these vehicle for the project duration;

44. Costs for these dam safety activities are expected to be spread over five years and need careful management. It is assumed that subsequently Afghan government / MEW will be able to manage the O&M costs.

G. Human Resources and Equipment

45. The project will be subdivided into number of sub-components to encourage use of local contractors. The typical machineries involved the project will include cranes, long reach boom excavators, loaders, dumpers, graders, dozers, smooth wheel drum rollers, sheet foot rollers, walk drum rollers, water tanks, and sprinklers, etc.

46. Approximate number and categories of job opportunities likely to be created as a result of the proposed construction are presented in the Tables below.

Table 2. Raising of Dahla Dam: Human Resources Requirements

Type/Profession	Construction	O&M
Resident Site Engineers (Civil, Geotechnical, Mechanical, Electrical, Hydraulics) with B.Sc Engineering Degree and 10-15 years' experience	5	2
Assistants Resident Site Engineer, Geotechnical, with B.Sc Engineering Degree and 5 years experience	3	1
Assistants Resident Site Engineer, Hydraulics, with B.Sc Engineering Degree and 5 years experience	3	1
Assistants Resident Site Engineer, Mechanical, with B.Sc Engineering Degree and 5 years experience	2	1
Assistants Resident Site Engineer, Electrical, with B.Sc Engineering Degree and 5 years experience	2	1
Assistant Engineer, Civil, with B.Sc Engineering Degree and 3 years experience or Diploma holder with 8 years experience	5	2
Assistant Engineer, Geotechnical, with B.Sc Engineering Degree and 3 years experience or Diploma holder with 8 years experience	3	2
Assistant Engineer, Mechanical, with B.Sc Engineering Degree and 3 years experience or Diploma holder with 8 years experience	5	2
Assistant Engineer, Electrical, with B.Sc Engineering Degree and 3 years experience or Diploma holder with 8 years experience	5	2
Assistant Engineer ,Hydraulics, with B.Sc Engineering Degree and 3 years experience or Diploma holder with 8 years experience	1	2
Assistant Engineer, Civil / Civil 3D/ AutoCAD, with B.Sc Engineering Degree and 3 years experience or Diploma holder with 8 years experience	3	1
Work supervisor, diploma holder with 3 years' experience	20	0
Administrator	5	2
Administration staff	10	2
Clerical staff	20	4
Skilled labour	200	5
Unskilled labour/helpers	500	0
Total	**791**	**32**

Source: TRTA Consultants, 2019

Table 3. Realignment of Route Bearer Highway: Human Resources Requirements

Type/Profession	Construction
Resident Site Engineers (Civil, Geotechnical) with B.Sc. Engineering Degree and 10-15 years' experience	2
Assistants Resident Site Engineer, Geotechnical, with B.Sc. Engineering Degree and 5 years' experience	1
Assistants Resident Site Engineer, Hydraulics, with B.Sc. Engineering Degree and 5 years' experience	1
Assistant Engineer, Civil, with B.Sc. Engineering Degree and 3 years' experience or Diploma holder with 8 years' experience	2
Assistant Engineer, Geotechnical, with B.Sc. Engineering Degree and 3 years' experience or Diploma holder with 8 years' experience	2
Assistant Engineer, Civil / Civil 3D/ AutoCAD, with B.Sc. Engineering Degree and 3 years' experience or Diploma holder with 8 years' experience	2
Work supervisor, diploma holder with 3 years' experience	5
Administrator	2
Administration staff	3
Clerical staff	2
Skilled labor	100
Unskilled labor / helpers	200
Total	**322**

Source: TRTA Consultants, 2019

47. Following are the list of equipment, which would be required during the implementation stage of the subprojects. The contractor will provide the equipment and machinery required for execution of this subproject.

Table 4. Raising of Dahla Dam: Equipment Requirements

Equipment	Quantity	Capacity
Long boom excavators	5	
Front end loaders	10	
Dump trucks	30	
Grader	5	
Steel smooth wheel drum roller	5	
Vibratory roller	5	
Water tanks	20	
Crane	2	70 ton
Mobile crane	2	50 ton
Concrete mixer	10	
Asphalt plant	1	
Crusher plant	1	
Processing plant	1	
Drilling / grouting plant	3	

Source: TRTA Consultants, 2019

Table 5. Realignment of Route Bearer Highway: Equipment Requirements

Equipment	Quantity	Capacity
Long boom excavators	3	0.45 - 0.8 m^3
Front end loaders / bulldozer	10	15 ton
Dump trucks	15	
Grader	3	
Steel smooth wheel drum roller	4	
Vibratory roller	4	8 - 20 ton
Tire roller	4	8 - 20 ton
Water tanks	5	
Concrete mixer	5	> 0.6 m^3
Asphalt Plant	1	60 ton / hr
Crusher plant	1	
Processing plant	1	
Asphalt finisher	1	2.4 - 6 m
Vibrating roller	2	3 - 4 ton and 0.5 - 0.6 ton
Vibrating compactor	1	50 - 60 kg
Line marker	1	Thermoplastic type
Truck crane	2	16 ton and 4.9 ton
Rough terrain crane	1	20 ton
Dump truck	1	10 ton
Truck	3	2 ton; 3-3.5 ton; 4-4.5 ton

Source: TRTA Consultants, 2019

H. Identified Sites

1. Borrow Areas

48. Summary of the estimated quantity of soils for the earthworks is presented in the Table below. About 7.3 million m^3 overall volume is required from borrow areas: (i) clay core 1.2 million m^3, (ii) sandy gravels 4,8 million m^3, (iii) riprap / filters: 1.3 million m^3.

Table 6. Quantities of Soil for Raising of Dahla Dam (m^3)

Description	Main Dam	Reservoir Protection	Saddle Dam 6	Saddle Dam 4-5	Saddle Dam 1-3	Spillways
Excavation	388,675	229,190	20,760	76,000	123,500	445,400
Filling	4,797,745	-	1,043,520	531,880	908,180	71,740
Expansion Joint	-	-	-	-	-	1,014
Geo Textile	71,220	-	-	-	-	-
Concrete	2,643	-	-	-	-	112,240
PCC Blinding	-	-	-	-	-	16,480
Road Surfacing	6,795	-	4,590	6,840	11,115	-

Source: TRTA Consultants

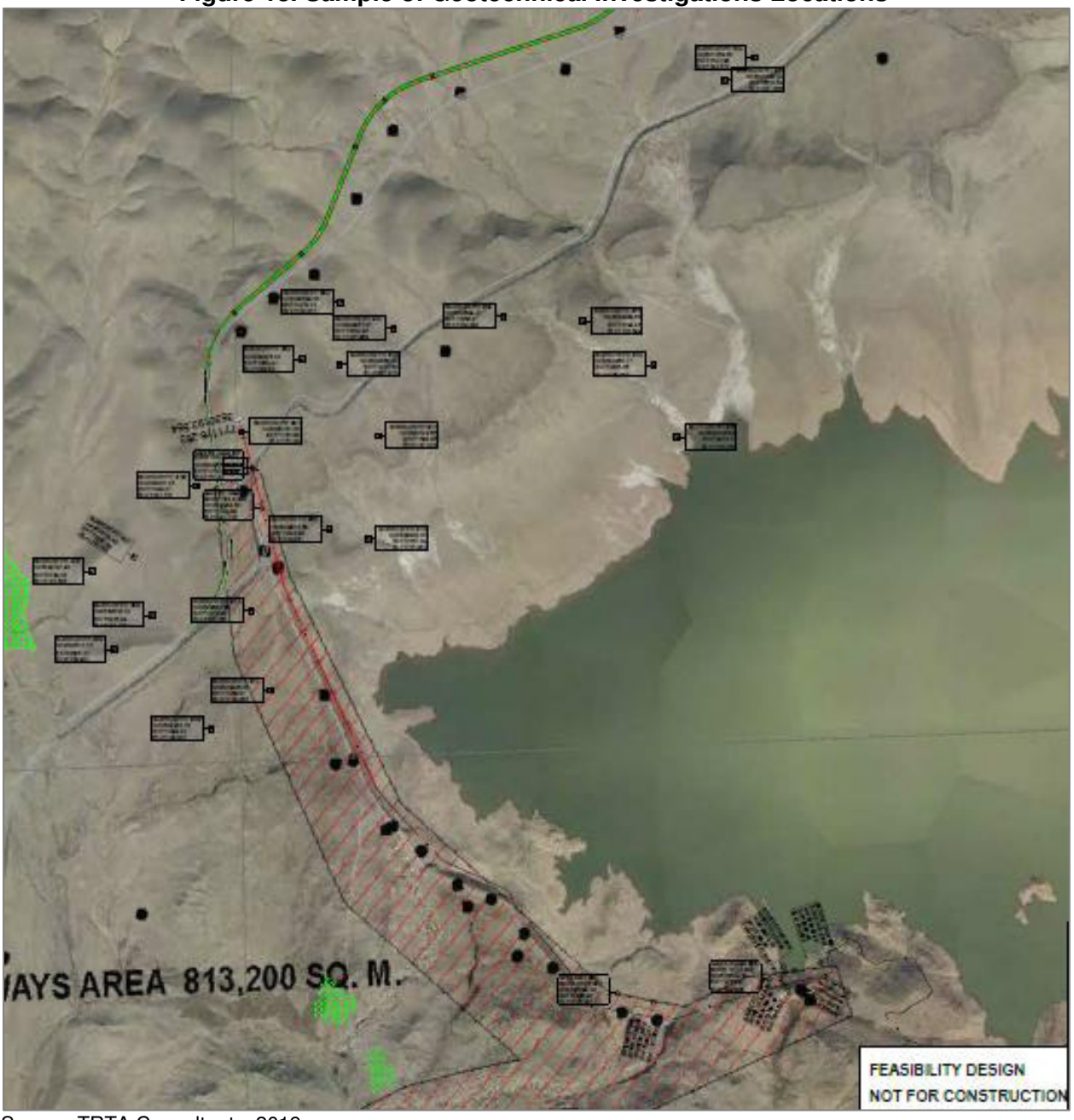
49. Preliminary field investigations showed that materials suitable for construction of an earth fill dam, and in suitable quantities, were available near the main dam site. The available materials were generally of two types which were suitable together for a zoned embankment: an impervious silty clay and pervious sand and gravel.

50. Quarries for raising the dam and construction of Route Bear highway are located in the vicinity of the dam. Some of them are to be found in the area to be flooded after the dam rise. Most of the areas adjacent to the existing raised Route Bearer Highway should have sufficient material for the earthwork. However, processing of this material will be required.

51. Rockfill from spillway 1 area will also be available after removal. Gravels and cement will be obtained from Kandahar.

52. Only existing and licensed borrow areas will be used and NEPA shall approve their use. Below Figure is an extract of boreholes in Saddle Dams 1-6, spillways, and borrow areas testing performed along the existing structures and along the existing route bearer highway.

Figure 13. Sample of Geotechnical Investigations Locations



Source: TRTA Consultants, 2019

2. Landfill

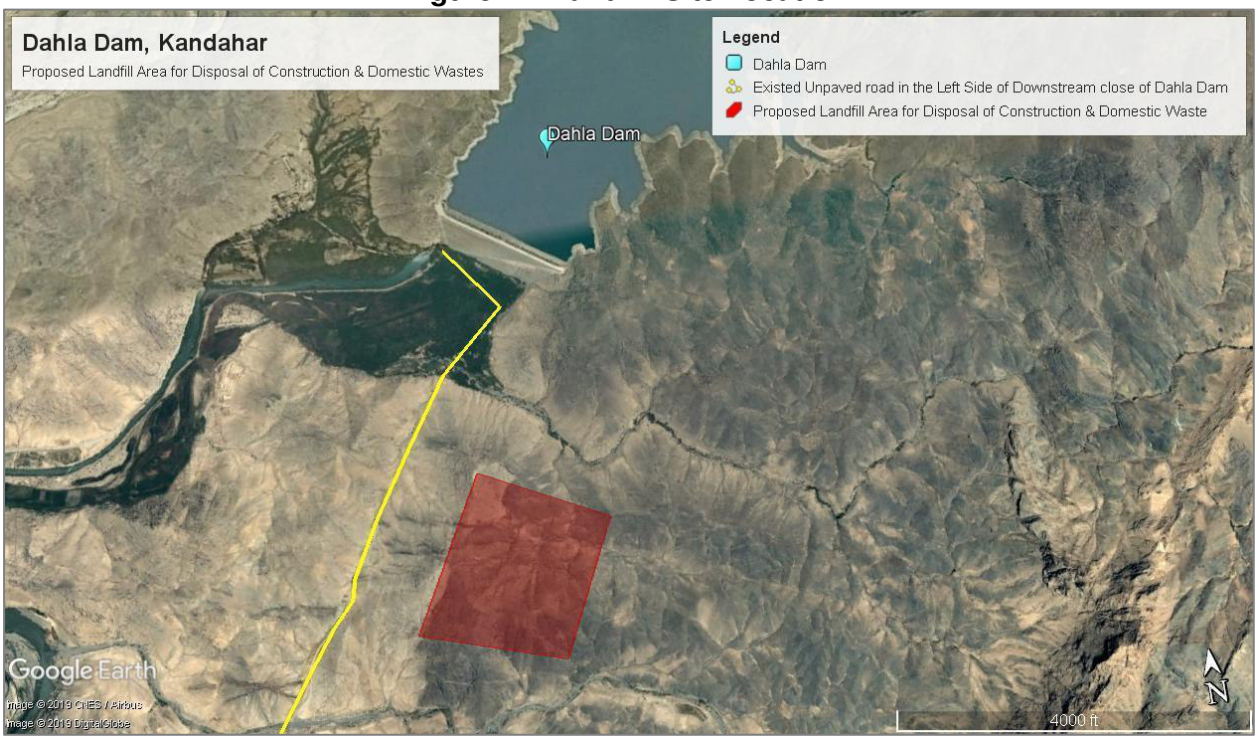
53. The design has been performed in general to nearly balance out the cut and fill. This should minimize wastage and disposal issues. The unsuitable material will be disposed in landfills approved by the National Environment Protection Agency (NEPA) downstream of Main Dahla dam to ensure that the excavated does not interfere with existing streams or water ways.

54. There will be need for stockpiling and processing / screening of the excavated and borrow material. Borrow fill would be available from existing reservoir area. This may be

performed at location downstream of the Saddle Dam 6 where previous contractors made their site offices.

55. A site located 1.7 km in the left downstream side of Dahla Dam outlet, is considered has best location for disposal of construction waste. The site is in barren state land and is not located nearby any residential, water body, orchard, or agriculture land. This was confirmed by ASBA in March 2019. The location of the site is presented in the Figure below.

Figure 14. Landfill Site Location



Source: TRTA Consultants, 2019

3. Construction Camp

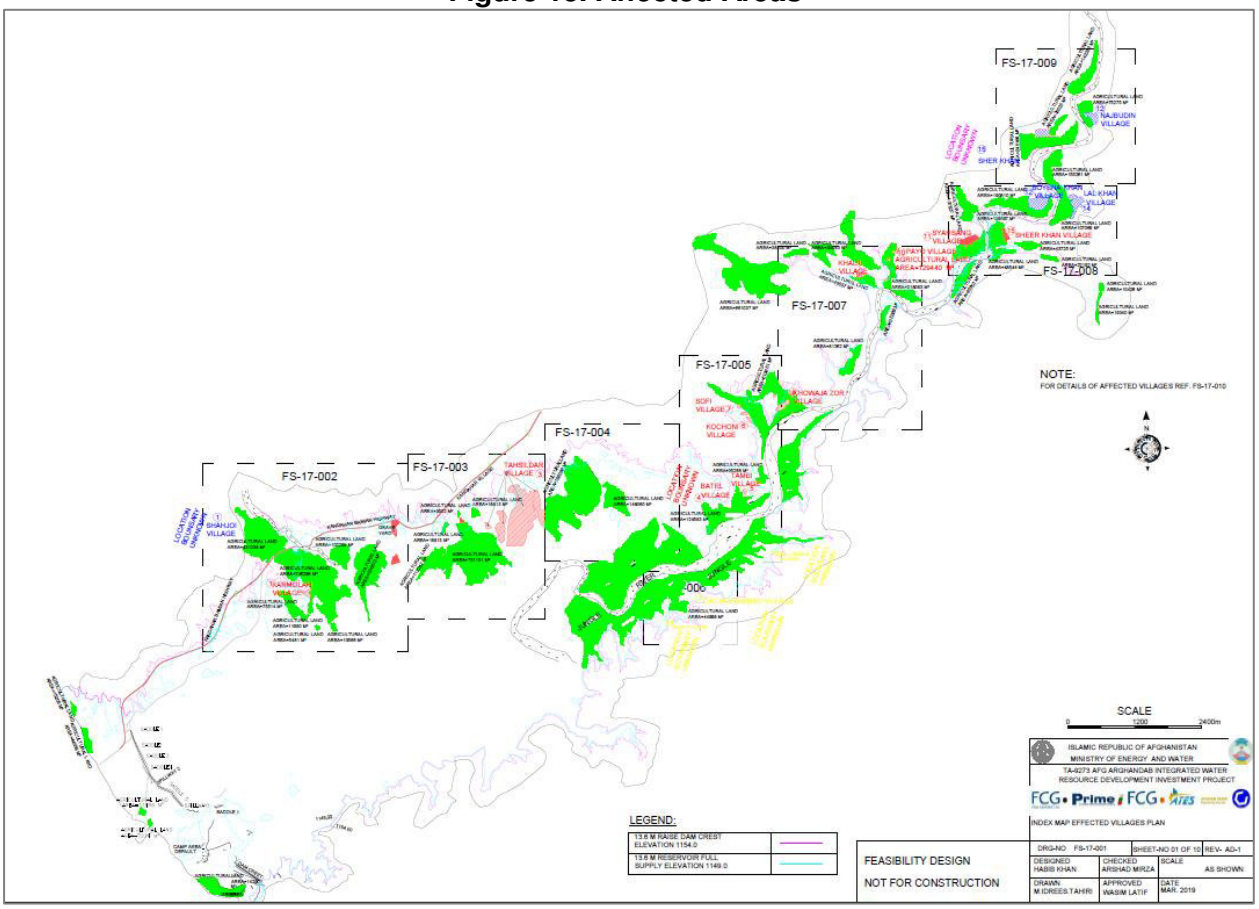
56. A construction site-camp exists near saddle dam 6. It is an open area, with paved ground surface. The site is close to both Saddle Dam 6 and main dam. This place was used as construction camp for the dam construction in 1952, as well as by 77-Turkish company more recently. There is enough space for construction site offices, construction machinery, and other site camp activities.

I. Project Impacted Areas

1. Raising of Dahla Dam

57. Agricultural land and settled areas will be inundated after the dam raise. An estimated 22 villages with a population of approximately 6,500 will be affected. The inundation will cause a loss of about 800 hectares of arable land, 300 hectares of pasture land, 643 orchards with 92,241 fruit trees and 16,000 wood trees. A preliminary map of affected areas is presented in the Figure below.

Figure 15. Affected Areas



Note: The green areas represent the agriculture lands affected and the red areas the villages affected.
Source: TRTA Consultants, 2019

58. Areas of the project that will be impacted due to the raising of the dam are:

(i) Area to be inundated upstream the dam (up to 22 villages, and agricultural land and Route Bear Highway);
(ii) The whole construction area of the main dam, the six saddle dams and the two spillways;
(iii) Access roads;
(iv) Canals below the spillways;
(v) Floodplain of the Arghandab River;
(vi) Borrow areas;
(vii) Area and close vicinity of contractor's camp.

2. Route Bearer Highway

59. The proposed alignment from Chainage 4+600 to 5+200 i.e. 600 m long, will pass through Shahjuy village agriculture land. The right-of-way (ROW) has been considered as 50 m from centerline. Considering the proposed ROW, a land of 30,000 m^2 will need to be obtained for this highway. In order to start realignment works, the concerned land has to be acquired. Land acquisition will be a critical activity before the start of construction of the highway. The Resettlement surveys are currently underway, and the Land Acquisition and Resettlement Plan will be prepared in April 2019.

60. It shall be noted that the existing route bearer highway already passes through this agricultural land.

61. Impacted areas of this highway for a 13.6 m reservoir level increase are as follows:

(i) Agricultural land of Shah Joi village (Chainage 4+600 to 5+200 i.e. (length: 600m);
(viii) Road corridor needed for the realignment: 9.3 km in hilly terrain including 0.85 km of existing highway;
(ix) Structures sites and effects on temporary streams;
(x) Topsoil stockpiles;
(xi) Waste disposal areas;
(xii) Access roads;
(xiii) Borrow areas inside Dahla Dam and in the vicinity of the dam;
(xiv) Contractor's camp including asphalt plant, crushing plant;
(xv) Existing temporary streams.

3. Construction Camp

62. The establishment of a contractor's work camp may cause adverse impacts on the environment if aspects such as liquid and solid waste management, equipment maintenance, materials' storage, and provision of safe drinking water are not addressed properly. The site for the work yard will be selected by the contractor. It is suggested to use the existing facilities below the dam which have been used by previous contractors. A large already sealed area can be used for the installation of equipment and storage sites. The existing area provides enough space to set up the concrete batching plant.

63. In order to ensure that potential impacts resulting from the construction works are kept at a minimum, the contractor will be obliged to prepare the following plans or method statements:

(i) Layout plan of the work camp including a description of all precautionary measures proposed to avoid potential adverse impacts on the receiving environment (surface and groundwater, soils, ambient air, human settlement);
(ii) Sewage management plan for the provision of sanitary latrines and proper sewage collection and disposal system to prevent pollution of soil, watercourses or groundwater;
(iii) Waste management plan covering the provision of garbage bins, regular collection and disposal in a hygienic manner, as well as proposed disposal sites for various types of wastes (e.g., domestic waste, used tires, etc.) consistent with applicable national regulations;
(iv) Description and layout of equipment maintenance areas and lubricant and fuel storage facilities, including distance from water courses. Storage facilities for fuels and chemicals will be located far from open watercourses. Such facilities will be bounded and provided with impermeable lining to contain spillage and prevent soil and water contamination;
(v) These plans will be approved by the supervising engineer prior to beginning of construction activities.

64. Prior to the establishment of the work camp(s) the contractor shall conduct consultations with local authorities to identify sources of potable water for the workforce that will not compete with the needs of the local population. Potable water for the workforce shall comply with WHO quality standards.

IV. ANALYSIS OF ALTERNATIVES

A. Raising of Dahla Dam

65. The project feasibility involves raising or rehabilitating existing structures. Only the alternatives discussed in the engineering design are therefore mentioned in this section.

66. During concept design and dam optimization phase, possible dam raise options of 9.1 m and 13.6 m were explored. The resettlement effects for 9.1 m and 13.6 m were evaluated, and it was noted that there was no significant difference between them. Following detailed assessment of various dam raise options, the Government has accepted the TRTA recommendation for a dam raise of 13.6 m.

67. The main dam, saddle dams and the two spillways are located in geologically favorable areas with strong to very strong granite and granodiorite foundation rocks. Preliminary field investigations, prior to dam construction, showed that materials suitable for construction of an earth fill dam, and in suitable quantities, were available near the main dam site. The investigations have confirmed availability of significant quantities of the construction material clay core, sand gravel mix, rockfill from the extended reservoir area along already raised Route Bearer Highway adjacent to Shahjuy village. Rockfill should also be available from spillway and Route Bearer Highway realignment area excavation. Drilling and blasting will be needed along Spillway 1 and along Route Bearer Highway. This work will be performed during low water in the reservoir.

68. Justification of the major options considered are detailed in the table below.

Table 1. Alternative options considered

Subject	Options considered	Option chosen and justification
Dam Site	Construct Hasanzay dam 50 km upstream Raise existing dam	There is only limited information on Hasanzay. The proposed site is not accessible due to security concerns. The estimated cost for Hasanzay was $330 million in previous studies with a capacity of 500 MCM. Dahla is easily accessible and people have willingness to support government for the raise of the existing dam site. The site has limited risks as compared to Hasanzay. The dam has performed well since 1952 and there should be less dam safety concerns. The cost for the Dahla raise for a storage of 500 MCM is only $231 million. The raise with existing storage will also give 29 MW hydropower potential which will be a great benefit for people of the region. Hasanzay Dam may be be constructed in the medium run, to reduce sedimentation to Dahla Dam. Additional sedimentation studies should also be performed during detailed design.
Intervention type	Raise of the dam, or dredging	Sluicing / flushing or dredging were considered by CIDA (2013) and concluded that sediment removal by sluicing and flushing would likely be technically infeasible and that sediment removal by dredging would be relatively costly on the basis of cost per cubic meter of recovered storage. The report also estimated that dredging would be a very time-consuming method of increasing storage capacity, with continuous dredging operations over a number of years required in order to recover significant capacity. The report concluded that preferred alternative for increasing storage

		capacity is to raise the dam.
Dam Type	Raising the dam by Roller Compacted Concrete Dam; Concrete Faced Rockfill Dam or by Earthfill similar to existing dam body	Existing Dahla Dam is a mixed homogenous earth and rockfilled dam. A roller compacted concrete dam on top of such a dam may have several concerns including differential settlements under normal and seismic events. A concrete faced dam option was possible for the Saddle Dam 6 and 1 to 5. However, this could be considered if limited construction material was available at dam site. For Dahla dam body material is readily available from extended reservoir area excavation. These materials have to be in filter relation as per existing dam body material. The material used will be Zone 1 - Selected Compacted Sand & Gravel Fill; Zone 2 - Random Roll Fill; Zone 3; Impervious Rolled Fill (Clay Core) and Zone 4 : Dumped Rock Fill. Zone 1,2 and 3 will be available from Reservoir side borrow areas. Zone 4 will be available from Spillway 1 excavation and from approved borrow areas. The details on borrow areas and likely availability of various material is discussed in Feasibility Drawing FS-60-004. Processing of these materials will be required to satisfy filter criteria.
Storage Levels	9.1 and 13.6 m raise in Full Supply Levels	13.6 m increase in storage was selected due to increased long term benefits.
Spillway Options	Roller Compacted Concrete weir or Conventional Reinforced Cement Concrete Spillways to pass flood and lower water in case of an emergency	Conventional Reinforced Cement Concrete Spillways were selected to facilitate and simplify operation. Additional Model studies will be performed during detailed design to see if a gated spillway, fuse plug or a Low Level Outlet facility would be required.

Source: TRTA Consultants

B. Realignment of Route Bearer Highway

69. The TRTA selected a possible alignment which is economical in the long run and offers flexibility and ease to road users. The proposed alignment was considered based on the following factors:

(i) Safe travel for road users even in case of Dam Crest Flood (i.e. above 1154.0 m);
(ii) Development of regional economic activities;
(iii) Improvement of the living environment of citizens;
(iv) Possibility for dual carriageway;
(v) Possibility of future extension to motorway;
(vi) Minimum cut and fill or balance cut and fill; and
(vii) Minimal effect on commute distance and travel time for users.
(viii) Optimized design for super passages will ensure safe access to commuters most of the year around.

70. The design has been performed to optimize cut and fill. This should minimize wastage and disposal issues. The unusable material will be disposed in approved landfills of NEPA along downstream of the main dam to ensure that the excavation does not interfere with existing streams or waterways.

71. The terrain along the realigned Route Bearer is mainly hilly with some mountains and dissected by numerous gullies and at least two river valleys. The realigned road crosses Shah

Joi Village near 4+600 m chainage. Then the road passes through agriculture land of the village. The typical elevations of the mountains are in the range of 1100−1170 MASL. The road only crosses Shahjuy agriculture land with no requirement to remove houses or buildings. Re-settlement requires government to acquire that land. Various options were initially explored to avoid the village but would require road to cross high mountains resulting in high cost, more distance and gradients along road. This would have resulted in high fuel cost and poor economy for the realigned part.

72. Generally, the hills and mountains are barren with limited vegetation. However, Shah Joi village has good agricultural land along the route. The fertile top soil from the area may be removed and stockpiled for construction of a recreational facility like a ground / park downstream of the dam site.

C. No Project Scenario

73. A 13.6 m dam wall raise at Dahla Dam will add an additional storage of 500 million m^3 to the existing 288 million m^3 reservoir. Considering a sedimentation rate of 2.7 million m^3/year, Dahla reservoir once raised should have a life extended by more than 200 years.

74. The additional benefits are reduction of emissions through generation of electrical power using hydropower replacing diesel generation and the reduction of the need for continual and ongoing extraction of groundwater from boreholes by improved water storage of natural annual rainfall and snow melt water.

75. Another positive impact will be the reduction of water loss from spillways with consequent ability to enable minimal environmental flows to be maintained in the main river networks of the river delta and its linked canals. With its enlarged capacity, the dam will have potential for improved flood control and should be able to reduce flood damage even in the wettest years, and eliminate it in average and above average years. Improved flood control is considered a major benefit of raising Dahla Dam.

76. In the no project scenario, the dam will be filled with sediments with no water storage in 106 years. The dam will have to decommissioned. This will have a negative effect on irrigation, agriculture, and livelihoods for those that depend on water from the reservoir.

77. Afghanistan is considered highly vulnerable to the adverse effects of climate change. Current models indicate significant warming across all regions of Afghanistan, and a decrease in precipitation, particularly spring rainfall. Climate change predictions indicate increasing drought frequency, more extreme weather events and a raising of the ambient Afghanistan climatic temperature by 4°C to 6°C over the next 50 years. The lack of buffering effect of the Arghandab reservoir means that flows cannot be managed between upstream inflow and downstream demands.

78. Environmental supply to the river environment and downstream wetlands is also a high priority, for the river channel, adjacent communities, river-based ecosystems and downstream wetlands.

79. The following environmental, social and economic impacts are expected if this project is not implemented:

(i) Ongoing sedimentation of the dam will reduce its storage capacity;
(ii) Ongoing shortage of water in the agricultural sector (irrigation);
(iii) Increasing harvest and economic losses;

(iv) Ongoing decrease of the ground water level linked to an ongoing overexploitation of groundwater resources;
(v) Limited water supply will not satisfy the needs of a rapidly-growing city;
(vi) Climate change, severe droughts and/or increased sediment inflows reduces the storage of the reservoir; and
(vii) Significant effect on the ecosystem of the region along river.

V. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

80. The project is classified 'Category A' under ADB's SPS, requiring preparation of a project EIA. Under Afghanistan regulations, the project is classified as Category 1 implying potentially 'significant impacts'.

A. Afghanistan

1. Constitution

81. The following laws of the Government of Islamic Republic of Afghanistan govern the way in which the environmental management of the project must be implemented, in order to proceed. Constitutional articles pertaining to environmental management include:

82. **Article 40:** Private Property

(i) Property is immune from invasion;
(xvi) No person shall be forbidden from acquiring and making use of a property except within the limits of law;
(xvii) Nobody's property shall be confiscated without the provisions of law and the order of an authorized court;
(xviii) Acquisition of a person's property, in return for a prior and just compensation within the bounds of law, is permitted only for securing public interests in accordance with the provisions of law;
(xix) Inspection and disclosure of a private property are carried out only in accordance with the provisions of law.

83. **Article 51:** Compensation

(i) Any person suffering undue harm by government action is entitled to compensation, which he can claim by appealing to the court;
(ii) With the exception of situations stated in the law, the state cannot claim its right without the order of an authorized court.

84. **Article 15:** Environment

(i) With the exception of situations stated in the law, the state cannot claim its right without the order of an authorized court;
(ii) The state is obliged to adopt necessary measures for safeguarding forests and the environment.

2. National Legislation, Policies, and Regulations

85. **Environment Act (2007).** The Government of Islamic Republic of Afghanistan adopted its first environmental framework, the Environment Act of 2005, with the goal of ensuring that environmental issues were addressed as an integral part of the development process. The Environment Act was approved by the Cabinet in December 2005 and was developed by NEPA over a period of two years with the assistance of international experts, including extensive stakeholder consultation with concerned ministries, quasi-government agencies, civil society and other interested parties.

86. The Environment Act sets forth national administrative roles and coordination with provincial authorities; establishes management frameworks for natural resource conservation,

biodiversity, drinking water, pollution control, environmental education, and defines enforcement tools.[3]

87. The Act has been promulgated to give effect to Article 15 of the Constitution of Afghanistan and provide for the management of issues relating to rehabilitation of the environment and the conservation and sustainable use of natural resources, living organisms and non-living organisms.

88. Legislators continued this new theme, leading to the drafting of an enhanced Environmental Law in 2006. Subsequently, the Environmental Law became part of the Islamic Republic of Afghanistan Official Gazette No. 912, dated 25 January 2007.

89. **Environmental Law (Official Gazette No. 912, 25 January 2007).** The Environmental Law is the fundamental law on environmental consideration in Afghanistan; it stipulates basic policies and procedures of activities for environmental consideration such as environmental impact assessment, pollution control, conservation and management of water resources, protected area, biodiversity, environmental information and education. The law also defines National Environmental Protection Agency (NEPA) as the responsible agency on the activities for environment. NEPA has overall responsibility to address policy and legal issues as well as environmental management in coordination with other related departments.

90. The Environmental Law contains a specifically designed legal framework needed to sustainably manage Afghanistan's natural resources and rehabilitate its damaged environment. The law also clarifies institutional responsibilities and contains the compliance and enforcement provisions required to allow the Government to enforce the legislation. The law is a fundamental prerequisite to enable NEPA to fulfill its mandate. The primary objectives of the law are to:

(i) Improve living conditions and protect the health of humans, fauna, and flora;
(ii) Maintain ecological functions and evolutionary processes;
(iii) Secure the needs and interests of present and future generations;
(iv) Conserve natural and cultural heritages; and,
(v) Facilitate the reconstruction and sustainable development of the national economy.

91. The Environmental Law (2007), Article 19, provides a legal framework for public consultation during environmental assessment.

92. Article 19, public participation: Affected persons may express their opinion on a proposed project, plan, policy or activity, preliminary assessment, environmental impact statement, final record of opinion and comprehensive mitigation plan, before the approval of the project, plan, policy or activity, and the proponent must demonstrate to the NEPA that affected persons have had meaningful opportunities, through independent consultation and participation in public hearings, to express their opinions on these matters on a timely basis.

93. NEPA shall not reach a decision on any application for a permit until such time that the proponent has demonstrated to the satisfaction of NEPA that copies of the document has been distributed to affected persons, informed the public that the document is being made available for public review by advertising the document and displaying a copy of it for inspection, and convened and recorded the proceedings of a public hearing.

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[3] Taylor, D. A. 2006. "Policy: new environment law for Afghanistan". *Environmental Health Perspectives*, 114(3). Accessed at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1392251/

94. After NEPA has reviewed the application for a permit, they shall reach a decision, inform the public of that decision and make available any relevant documentation or information for public review.

3. Regulations and guidelines for EIA

95. National EIA Policy is an integrated approach to EIA in Afghanistan. The definition of EIA as described in the Environmental Law is: 'EIA refers to the procedures used for evaluating the likely environmental and consequent social impacts, both beneficial and adverse, of proposed projects, plans, policies or activities where there is a possibility of significant adverse effects arising as a result, in order to improve the quality and development impact of such projects by identifying ways of improving project selection, siting, planning, design and implementation'.

96. NEPA created this policy to provide guidance to project proponents while undertaking development projects that may have potential impacts on the environment. They also provide guidance on how the public should be consulted and define the roles and responsibilities of various stakeholders in that process.

97. The three documents below are the main regulations and guidelines for EIA in Afghanistan.

(i) **National Environmental Impact Assessment Policy (2007)** follows on from the Environment Law and sets forth a policy vision, principles, strategy, and process for environmental assessment in Afghanistan. The emphasis is on ensuring that projects with potentially significant impacts are identified to the national environmental regulator, NEPA, and follow adequate due diligence procedures. The document provides a range of additional useful information on NEPA and environmental assessment in the Afghanistan context.

(ii) **Environmental Impact Assessment Regulations.** Official Gazette No. 939 (March 2008). Schedule I lists project types likely to have significant impacts (Category 1) or potentially adverse impacts (Category 2); and the industries likely to give rise to pollution. Schedule II provides the clearance certificate application form.

(iii) **Administrative Guidelines for the Preparation of Environmental Impact Assessments** (June 2008). These guidelines were prepared as a companion to the 2008 Regulations, to guide proponents on interacting with NEPA, on public consultation, and roles and responsibilities of stakeholders.

98. Under Article 20 of the Environment Law, NEPA shall appoint an EIA Board of Experts to review, assess and consider applications and documents submitted by proponents for obtaining permits and make technical recommendations in regard to whether to issue permits, as well as the conditions that should be attached to any permit that is granted.

99. In more detail, the legal procedure of EIA starts with submitting application to NEPA by the project proponent. The purpose of the application is to screen the projects which require EIA. A screening report needs to be attached to the report to explain brief description of the project activities, site conditions, potential impacts and mitigations in IEE level. It is also required to describe results of public consultation with affected people. The systematic process to identify, predict and evaluate the environmental effects of proposed projects, plans or policies given in the National EIA policy is described in the figure below. The policy also describes the timeline for approval of different stages of EIA process.

100. National EIA policy provides a project screening list which categorizes different projects. Category 1 and category 2 are defined for each type of activities based on the likelihood of the significance of the impacts stemming from particular projects. Category 1 is for activities likely to have significant adverse impacts while category 2 is for those with less adverse than category 1. According to NEPA, both of categories 1 and 2 require EIA. NEPA reviews the submitted screening report and finalize the requirement of EIA considering the results of the public disclosure after submission of the screening report. Public disclosure is conducted by the proponent under the responsibility of NEPA.

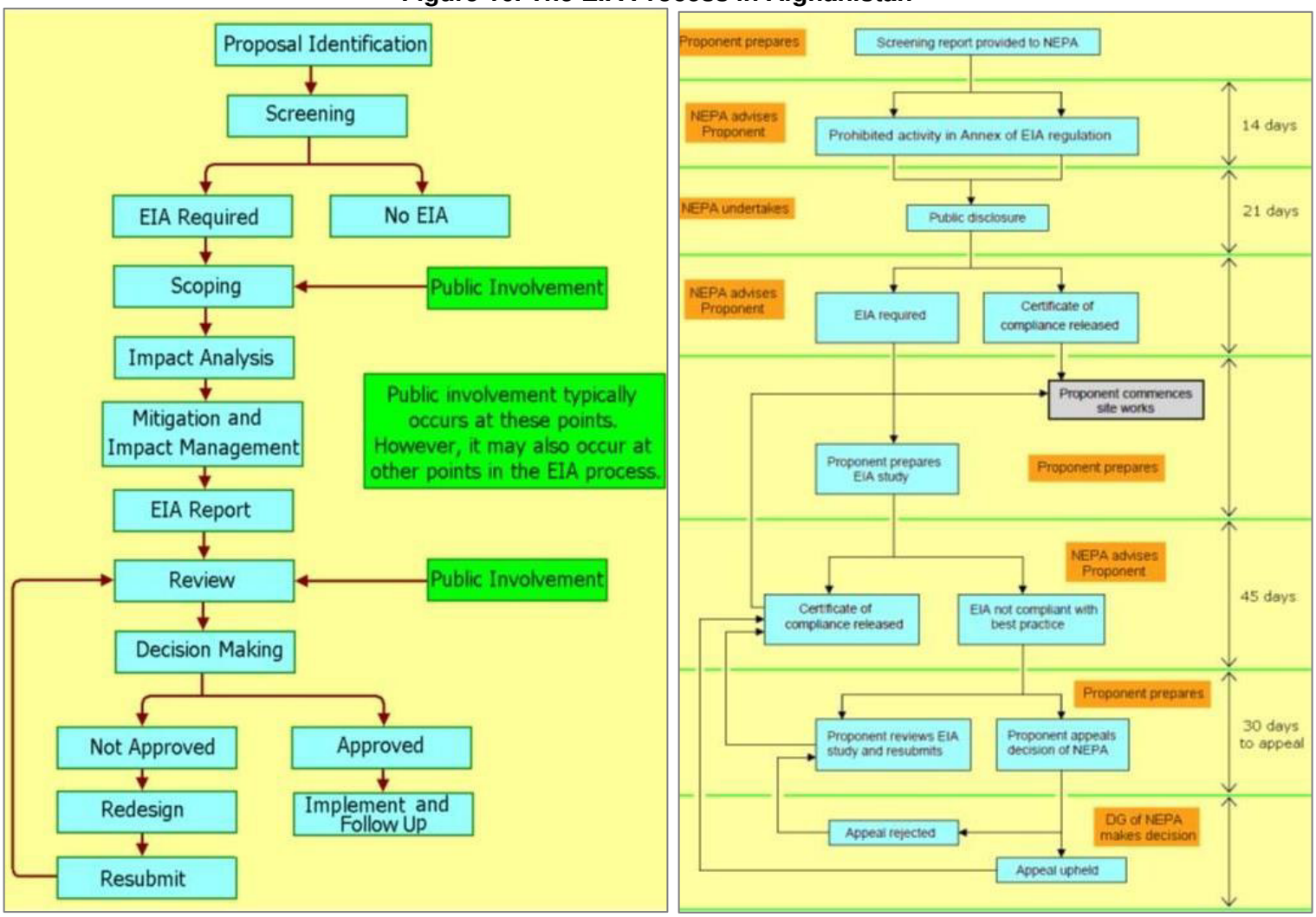
101. The regulations state that a proponent intending to undertake multiple projects in a particular area should prepare a single screening report and assign the environment category appropriate to the projects' collective potential environmental impacts. Separate screenings are unacceptable.

102. In the case that NEPA decided that the activity does not require EIA, certificate for compliance is issued without EIA to approve the activity. In the case that EIA is decided to be required, the project proponent has to complete EIA and submit EIA report to NEPA. Within 45 days after the submission, NEPA reviews the report and approve the activity if it is sufficient. According to NEPA, board of experts has been established which comprises of 12 experts from Kabul University and ministries for reviewing EIA.

103. In addition, EIA Regulations Schedule 1 lists project types that are automatically assigned to these two categories. Category 1 and 2 projects must obtain a Certificate of Compliance from NEPA prior to starting construction. Certificate applications consist of a screening report and the application form in EIA Regulations Schedule 2.

104. The raising of the Dahla Dam in Component 1 is categorized as Category 1 according to Afghan EIA policy. Physical works will focus on the raise of the dam, six saddle dams and realignment of a section of the route bearer highway. Environmental impacts are expected for these construction sites and, in addition, for the area to be inundated after dam raising.

Figure 16. The EIA Process in Afghanistan



Source: National Environmental Impact Assessment Policy (2007)

4. Other relevant laws and regulations

105. **Water Law (2009**). The Water Law states that water is owned by the public and that the Government is responsible for water protection and management. It assigns responsibilities to government institutions for management and protection of water resources, water ownership, and regulates water ownership fees, rights, permits, and usage.[4]

106. Afghanistan's Water Law is one component of the country's strategy to integrate its water systems and institutions. The water law recognizes the key role of local water user associations in the protection and management of water resources. The MEW has responsibility for setting up water user associations (Article 10), and the Ministry of Agriculture, Irrigation and Livestock (MAIL) has the task of setting up irrigation associations (Article 11). Throughout years of conflict, Non-Governmental Organizations (NGOs) developed and maintained strong links with rural communities in all provinces. The Afghanistan Urban Water Supply and Sewerage Corporation (AUWSSC) proposes broadening their role to coach Water Users Associations and

[4] Ahmad, T. 2013. *Legislation on use of water in agriculture: Afghanistan*. http://www.loc.gov/law/help/water-law/afghanistan.php

members of Community Development Councils in conservation techniques and water management systems. In particular, AUWSSC advocates end-user participation in decision making relating to water resource management, operation and maintenance of water supply systems and agreeing on water use allocations.

107. **Law on the Protection of Historical and Cultural Properties**, Issue No. 828 (2004). After defining the material falling within its scope, the law sets forth the State's interest and rights in such materials, specifies prohibited and regulated activities involving such materials, and establishes enforcement measures such as penalties and fees.

108. **The Law on Land Expropriation** sets out the provisions governing the expropriation or acquisition of land for public interest purposes, such as the establishment/construction of public infrastructure or for acquisition of land with cultural or scientific values, land of higher agricultural productivity and large gardens.

109. Accordingly, the Law declares that:

(i) Acquisition of a plot or portion of a plot of land for public use is decided by the Council of Ministers and is compensated at fair value based on current market rates (Article 2);
(ii) The right of the owner or land user will be terminated three months prior to the start of civil works on the project and after the proper reimbursement to the owner or person using the land has been made. (Article 6); and
(iii) The value of land, value of houses and buildings on the land, and value of trees and other assets on the land will be considered for compensation (Article 8;) and compensation is determined by the Council of Ministers.

110. **Pesticide Regulations** (1989). Afghanistan has had pesticide regulations since 1989, but they have never been enforced due to lack of resources. A draft Pesticide Law dating from 2009 has yet to be enacted.

B. International Agreements

1. International Environmental Agreements

111. The Constitution binds the state to abide by the United Nations (UN) charter, international treaties, international conventions that Afghanistan has signed, and the Universal Declaration of Human Rights (Article 7).

112. International agreements relevant to environmental management of water resources development to which Afghanistan is a party are (listed in order by the year in which each came into force):

(i) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 1975) – international cooperation to control trade in species threatened with extinction or in danger of becoming so; in species whose trade interferes with regulation of trade in extinction-threatened species; and in species identified by a party under national-level trade control to prevent/restrict exploitation, for which international cooperation is needed;
(ii) Convention on the Conservation of Migratory Species of Wild Animals (also called Convention on Migratory Species, CMS, and the Bonn Convention, 1983) – conserve terrestrial, marine and avian migratory species throughout their ranges;

(iii) UN Convention on Biological Diversity (1993) – objectives are to conserve biological diversity; promote sustainable use of biological diversity; and (iii) seek more fair and equitable sharing of the benefits of genetic resource utilization;
(iv) UN Framework Convention on Climate Change (1994) – aims to stabilize greenhouse gases in the atmosphere at levels that will not change climate systems in dangerous ways;
(v) UN Convention to Combat Desertification (1996) – aims to combat desertification and mitigate drought effects in countries experiencing serious drought or desertification;
(vi) Kyoto Protocol (2005) – extends the Convention on Climate Change;
(vii) Paris Agreement on Climate change (2015);
(viii) Afghan – Iranian Helmand River Water Treaty (1973) Afghanistan is committed to sharing the water from Helmand River with Iran and supply it with 26 m^3 of water per second or 850 million m^3 per annum.[5]

113. In addition, Afghanistan has signed but not ratified:

(i) The United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (1970) – aims to protect cultural property against theft and promotes restitution of stolen items;
(ii) Ramsar Convention on Wetlands (1975) – promotes conservation and sustainable use of wetlands;
(iii) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992*)* – aims to reduce movement of hazardous waste between nations, prevent transfer of such waste from developed to less developed countries (LDCs); minimize waste amounts and toxicity; promote environmentally sound management at or near generation sites; assist LDCs in environmentally sound management of their wastes; does not address radioactive waste;
(iv) Memorandum of Understanding Concerning Conservation Measures for the Siberian Crane (1993) – aims to protect the species (*Leucogeranus leucogeranus)* through concerted, coordinated actions to prevent disappearance of remaining populations;
(v) The United Nations International Institute for the Unification of Private Law (UNIDROIT) Convention on Stolen or Illegally Exported Cultural Objects (1995) – attempts to fill gaps in the UNESCO convention by making the final owner of a stolen cultural item who cannot show due diligence responsible for restitution;
(vi) UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2006) – safeguard, ensure respect for, and raise awareness at local, national, international levels, and provide international cooperation and assistance.

2. International Commission on Large Dam

114. The International Commission on Large Dams (ICOLD) was founded in 1928 to provide a forum for discussion and for the exchange of knowledge and experience in dam engineering for engineers and others concerned with the development of water resources. Its objectives are to encourage improvements in dam engineering in all its aspects, and in all phases of the planning, design, construction and operation of dams and associated works.

[5] The 1973 Helmand River Treaty is the only agreement that Afghanistan has that specifically addresses water allocations

115. At Congresses and Symposia as well as in specially appointed Technical Committees, the Commission gathers relevant information, and addresses questions concerning technical, environmental, social, economic and financial aspects of dam development, with particular emphasis on overall safety and compatibility with the environment, and then disseminates the results to its members.

116. IOCLD has about 90 member countries including Afghanistan.

117. Although ICOLD was initially mostly concerned with security, it became pretty early concerned with the subject of environment. Environment was first discussed during the 1973 Congress, one year after the first UN Environment summit of Stockholm. The first Technical Committee devoted to the subject was created in 1977 and the first Technical Bulletin appeared in 1981. In 1997, ICOLD published a document that presents guidance for environmental consideration, assessment and mitigation: "Position Paper on Dams and the Environment". It states: "Increased awareness of the natural environment and its endangered situation is one of the most important developments of the late 20th century."

118. Large dams are defined by the International Commission on Large Dams[6] as those with a crest height of 15 m or more from the foundation and also those between 5-15 m high with a reservoir volume over 3 million m^3. With a crest height of 60 m above foundation prior to the raise (73 m after) and a reservoir volume of 288 million m^3 prior to the raise (882 million m^3 after), Dahla Dam is categorized as a large dam.

C. Asian Development Bank

1. Policies

119. **Safeguard Policy Statement (2009)** is ADB's safeguards policy document. It describes the common objectives and policy principles of ADB's safeguards and outlines the delivery process for ADB's safeguard policy. SPS 2009 promotes sustainability through protection of people and the environment from the adverse impacts of projects, and by supporting the strengthening of country safeguard systems. It presents a consistent, consolidated framework for environment, resettlement, and indigenous peoples safeguards.

120. **Public Communications Policy (2018)** guides ADB's efforts to be transparent and accountable to the people it serves, which it recognizes are essential to development effectiveness. The policy recognizes the right of people to seek, access, and impart information about ADB's operations, and it aims to enhance stakeholders' trust in and ability to engage with ADB, through proactive disclosure, presumption in favor of disclosure, recognition of the right to access and impart information and ideas, country ownership, limited exceptions, and the right to appeal.

121. **Information Disclosure.** In line with ADB's Public Communications Policy, ADB is committed to working with the borrower/client to ensure that relevant information (whether positive or negative) about social and environmental safeguard issues is made available in a timely manner, in an accessible place, and in a form and language(s) understandable to meaningful inputs into project design and implementation. For environment category A projects, ADB will post draft EIAs at least 120 days before Board consideration on the ADB website. Final EIAs along with EMP will be uploaded upon receipt.

[6] International Comission on Large Dams (ICOLD)

122. **Due Diligence and Review.** For projects proposed for financing, ADB will conduct safeguard reviews, including reviews of the borrower's/client's safeguard documents, as part of its overall due diligence. ADB's safeguard due diligence and review emphasizes environmental and social impact assessments and the planning process, in addition to safeguard documentation. Due diligence and review involves field visits as well as desk reviews. Through such due diligence and review, ADB will confirm:

(i) that all key potential social and environmental impacts and risks of a project are identified;
(ii) that effective measures to avoid, minimize, mitigate, or compensate for the adverse impacts are incorporated into the safeguard plans and project design;
(iii) that the borrower/client understands ADB's safeguard policy principles and requirements and has the necessary commitment and capacity to manage social and environmental impacts and/or risks adequately;
(iv) that the role of third parties is appropriately defined in the safeguard plans; and
(v) that consultations with affected people are conducted in accordance with ADB's requirements.

123. In cases where the assessment and planning process, or the safeguard documents, do not meet ADB's safeguard requirements, the borrower/client will be required to undertake additional assessment and/or improve the safeguard plans. When the borrower/client has inadequate capacity to carry out safeguard plans for a proposed project, the project will include component(s) to strengthen that capacity. For projects that are deemed by ADB to be highly complex and sensitive, ADB will require the borrower/client to engage an independent advisory panel during project preparation and implementation.

2. Guidance

124. **Environmental Assessment Guidelines (2003)**. These guidelines describe how to fulfill the requirements outlined in ADB's Environment Policy and the Operations Manual on Environmental Considerations in ADB Operations. These guidelines also guide consultants in preparation of an initial environmental examination (IEE) or an EIA report for a project under consideration.

125. **Environmentally Responsible Procurement (2007)**. This document provides guidance to ADB staff, consultants, and executing agencies on environmentally responsible procurement, defined as "a systematic approach to the purchase of goods and services that are thought to be less damaging to the environment than other goods and services that serve the same purpose," specifically, products that "reduce waste, improve energy efficiency, limit toxic by-products, contain recycled content or are reusable, and are produced with the least environmental impact, and services that help improve the environment, are rendered with minimum environmental and social impacts, and use resources and energy efficiently."

126. **Complaint Handling in Development Projects - Grievance Mechanisms: A Critical Component of Project Management (2010)**. This document presents definitions, concepts, rationale, and history relevant to the ADB project grievance redress mechanism.

127. **Complaint Handling in Development Projects - Building Capacity for Grievance Redress Mechanisms (2010)**. This document presents a framework and practical suggestions for building the capacity of an organization to manage an effective grievance redress mechanism.

128. **Selected References for Good Practice in Environmental Safeguards Implementation (2014)**. This internal Central and West Asia Department document presents internet hyperlinks to exemplary environmental safeguards documents (IEEs, EIAs, EARFs, etc.) prepared for projects in these countries.

3. Categorization

129. ADB water resources projects and subprojects are screened using a rapid environmental assessment checklist filled out for the components. This checklist captures the type; location, sensitivity, scale, nature, and magnitude of potential environmental impacts, and availability of cost-effective mitigation measures. Based on the checklist findings, the project or component is assigned to one of the following ADB environmental categories.

130. **Category A** – likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An EIA, including an environmental management plan (EMP), is required.

131. **Category B** – Potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required.

132. **Category C** – A proposed project is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.

133. The project Component 1 has been categorized as Category A due to anticipated irreversible, diverse, or unprecedented impacts from raising the existing dam's height by 13.6 m and related infrastructure. An EIA report has been prepared accordingly.

D. Assessment Standards and Guidelines

134. Implementation of Afghanistan laws and regulations is supported by technical national and international standards and guidelines. Afghanistan has recently established national environmental standards or guidelines for air quality, noise, or water quality. Baseline measurements have been compared to Afghanistan standards and guidelines when available and to International institutions such as the International Finance Cooperation (IFC)[7], and the World Health Organization. The Ministry of Mining of Afghanistan, for example, uses the IFC Environmental, Health and Safety Guidelines in its environment, health, and safety regime, and WHO standards are routinely used for drinking water quality.

135. The relevant standards applicable to the project are listed below:

(i) WHO Water Quality Standards (4th edition 2017)
(ii) WHO Air Quality Standards (Global update 2005)
(iii) International Finance Cooperation (IFC) Environmental, Health, and Safety Guidelines (2018)
(iv) Afghanistan National Air Quality Standards (Standard Organization, 2009);
(v) Regulation on Decrease and Prevention of Air Pollution (NEPA, 2010)

[7] International Finance Cooperation. 2018. Environmental, Health, and Safety Guidelines. Approaches for Annual Crop Production. www.ifc.org/ehsguidelines

(vi) Afghanistan National Water Quality Standards (Standard Organization, 2011);
(vii) Regulation on Water Quality Control and Maintenance (NEPA, 2015);
(viii) Afghanistan National Noise Quality Standards (Standard Organization, 2013)
(ix) Regulation on reduction and prevention of noise pollution (NEPA, 2016).

1. Water Quality

136. Drinking water: The project will provide water from the dam reservoir to water treatment plants (Component 3) for subsequent drinking water supply to Kandahar communities. Water to be supplied to residents must comply with Afghanistan Drinking Water Quality Standard.

137. Irrigation water: The project will provide water from the dam reservoir to the Arghandab canals for irrigation purposes (Component 2). Irrigation modernization is expected to increase the current river basin irrigated area from 54,088 ha to between 65,000 and 90,000 ha.

138. Biodiversity: Fishing is occurring at the dam reservoir but also upstream and downstream. Water quality and water flows must be monitored in order to preserve biodiversity.

139. **WHO Drinking Water Quality Guidelines (4th edition 2017).** The guidelines have formed an authoritative basis for the setting of national regulations and standards for water safety in support of public health.

140. **Afghanistan National Water Quality Standards** have been prepared subsequently of WHO guidelines.

Table 7. Afghanistan and WHO Drinking Water Quality Guidelines

Parameters	Afghanistan National Water Quality Standard	WHO (4th edition 2017)
Micro-biological (e.g. E coli)	0 CFU/100 mL	<1 CFU/100 mL
Turbidity	5 NTU	5 NTU
pH	6.5-8.5	6.5-9.5
TDS	1000 to 2000 mg/L	-
Total Hardness	500 mg/L	-
Nitrate (as NO_3^-)	50 mg/L	50 mg/L
Nitrite (as NO_2^-)	3 mg/L	3 mg/L
Barium	0.7 mg/L	1.3 mg/L
Boron	2.4 mg/L	2.4 mg/L
Arsenic	0.05 mg/L	0.01 mg/L
Fluoride	1.5 mg/L	1.5 mg/L
Lead	0.01 mg/L	0.01 mg/L
Cyanide	0.05 mg/L	previously 0.07 mg/L
Nickel	0.07 mg/L	0.07 mg/L
Nitrate as Nitrogen	11 mg/L	11 mg/L
Zinc	3 mg/L	-
Selenium	3 mg/L	0.04 mg/L
Chloride	250 mg/L	-
Sulphate	250 mg/L	-

Source: Afghanistan National Water Quality Standards and WHO Drinking Quality Standards 2017

2. Air Quality

141. **WHO Air Quality Guidelines (Global update 2005).** The WHO guidelines offer guidance on thresholds and limits for key air pollutants that pose health risks.

142. **Afghanistan National Water Quality Standards** have been prepared subsequently of WHO guidelines.

Table 8. Afghanistan and WHO Air Quality Standards

	Averaging Period	WHO Guideline value in µg/^{m3}	Afghanistan maximum allowable concentration value in µg/^{m3}
TSP	24 hours	-	300
Carbon monoxide (CO)	8 hours	-	10
	1 hour		30
	30 minutes		60
Lead (Pb)	1 year	-	0.5
Sulfur Dioxide SO_2	24 hours	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)	50
	10 minutes	5000 (guideline)	-
Nitrogen dioxide NO_2	1 year	49 (guideline)	40
	1 hour	200 (guideline)	80
Particulate Matter PM_{10}	1 year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)	70
	24 hours	150 (Interim target-1) 100 (Interim target-2) 74 (Interim target-3) 50 (guideline)	150
Particulate Matter $PM_{2,5}$	1 year	35 (Interim target-1) 23 (Interim target-2) 15 (Interim target-3) 10 (guideline)	35
	24 hours	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)	75
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)	100

Source: Afghanistan National Air Quality Standards and WHO Air Quality Standards 2005

3. Noise Levels

143. **IFC EHS Guidelines on Environmental Noise Management** (2018). The EHS guidelines are technical references and measures that are generally considered to be achievable in new facilities with reasonable costs. IFC has set limits which noise impacts shall not exceed. When national standards differ from the EHS guidelines measures, the projects are required to follow the more stringent option.

Table 9. Afghanistan and IFC EHS Noise Management Standards

	Afghanistan		IFC EHS	
Receptor	**Day-time 7:00 – 22:00**	**Night-time 22:00 – 7:00**	**Day-time 7:00 – 22:00**	**Night-time 22:00 – 7:00**

Residential, institutional, educational	55*	45*	55	45
Industrial, commercial	70*	70*	70	70

Note: * Interim figures for Afghanistan only - to be confirmed.
Source: International Finance Cooperation. 2018. Environmental, Health, and Safety Guidelines.

VI. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

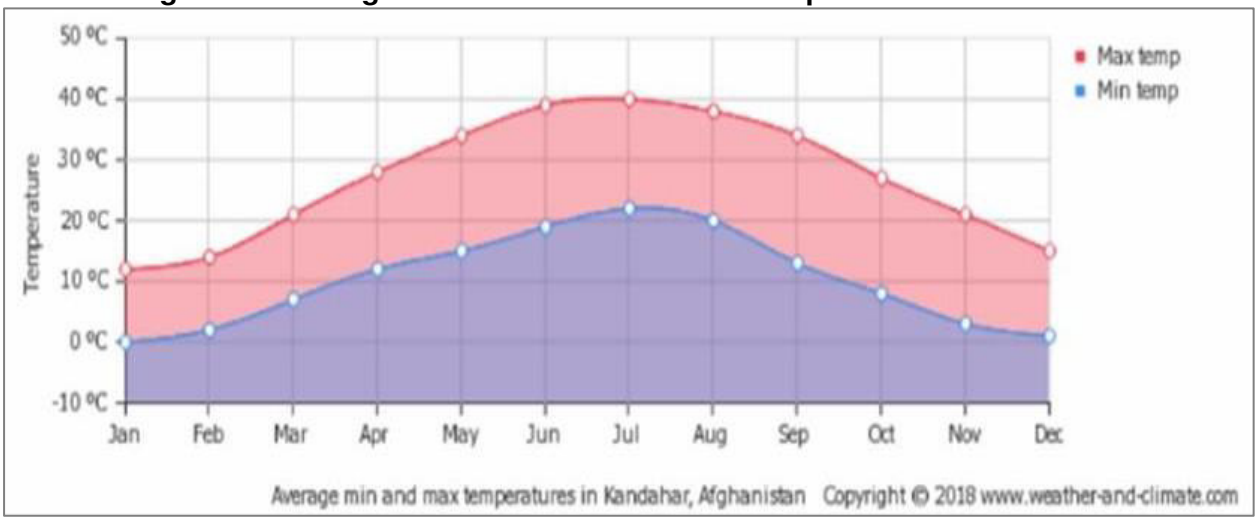
1. Climate

144. Afghanistan's climate is typical for an arid or semi-arid steppe, with cold winters and dry summers. The climate varies substantially between the different regions of the country. The plains in the western and southern regions are characterized by hot semiarid (BSh) and hot desert climates (BWh). During the summer northerly, dry and hot and steady winds prevail. The central mountains are characterized by cold semiarid and cold desert climates (BWk and BSk) with cold and dry winters. In January the temperature may drop to under -15°C at the highest altitudes, while in July the temperatures vary between 0°C and 26°C depending on the elevation. In the mountainous regions bordering Pakistan a divergent fringe effect of the monsoon brings tropical, warm and humid air masses, which sometimes advance up to the central regions between July and September. Precipitation generally fluctuates greatly during the course of the year in all parts of the country. Apart from the eastern regions, which are influenced by the monsoon, major precipitation levels occur from December to April. The annual precipitation totals vary between 50 mm in the desert and 1,100 mm on the north side of the Hindukush.

145. Kandahar is a desert climate, and precipitation is low. While annual rainfall has an average 176 mm, the evaporation figure is just over 10 times that.[8] Classification is BWh according to Köppen and Geiger. The annual average temperature in Kandahar is 18.8 °C. Annual average rainfall is 176 mm. The hottest month is July with average temperatures of 31.8 °C. January shows the lowest temperature with an average of 5.7 °C.

146. In the figure below, the mean daily maximum (solid red line) shows the maximum temperature of an average day for every month for Kandahar while the mean daily minimum (solid blue line) shows the average minimum temperature.

Figure 17. Average Minimum and Maximum Temperatures in Kandahar

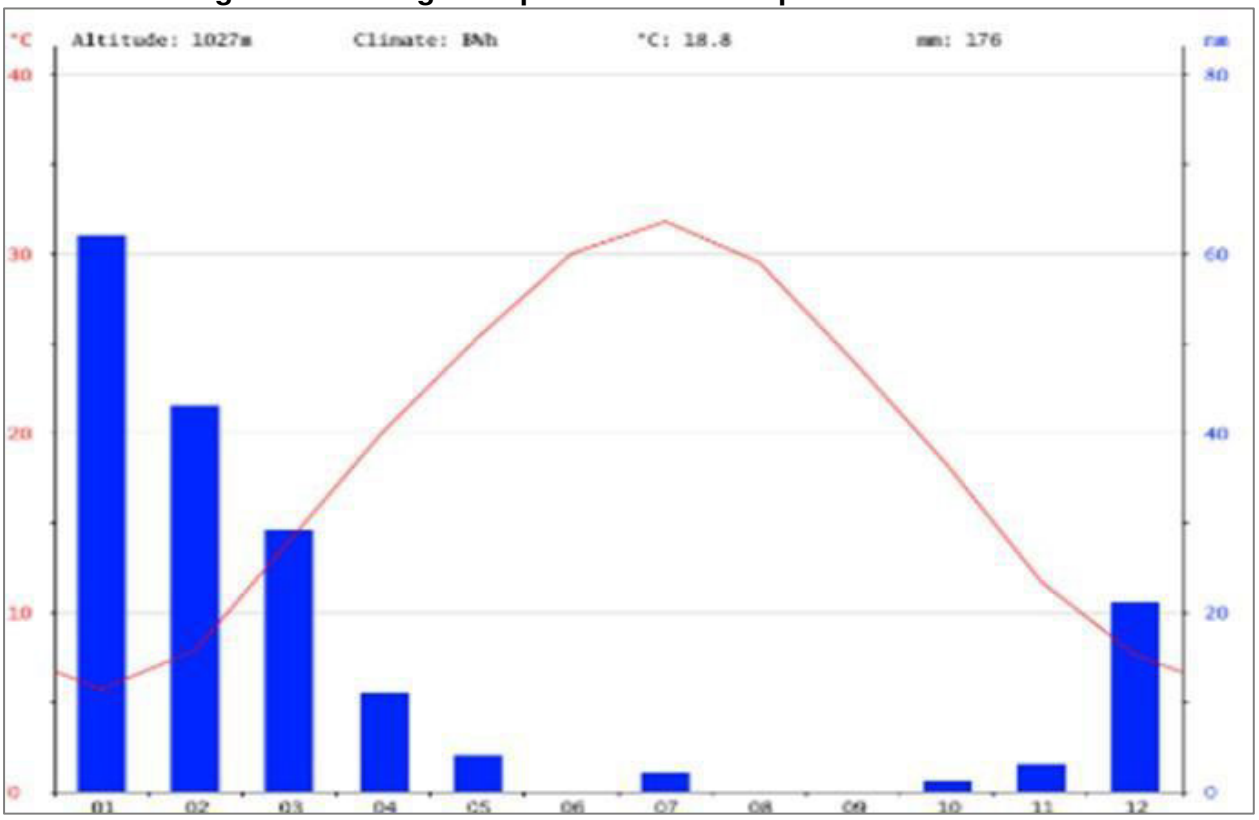


Source: World Weather and Climate Information 2010-2019

[8] Michel. 1957. The Kabul, Kunduz, and Helmand Valleys and the National Economy of Afghanistan: A Study of Regional Resources and the Comparative Advantages of Development. *National Academy of Sciences, USA.*

147. All over Kandahar Province, the summer heat is intense, and the simoom (hot dust storms) and fiery winds which frequently occur throughout this part of the country during the hot season make life difficult. At the same time, the bare rocky ridges that traverse the country, absorbing heat by day and radiating it by night, render the summer nights almost as hot.

Figure 18. Average Temperature and Precipitation in Kandahar



Source: Climate-Data.org. 2018 https://de.climate-data.org/location/1255/

2. Geographical and River Basin Location

148. The Kandahar Province is in the southeastern part of Afghanistan, which is bound on the northeast by the Zabul Province, on the north by the Uruzgan Province, on the west by the Helmand Province, and on the east and the south by Pakistan. The province's area is 53,500 km^2 and lies between 32°-30' N and 29°-30' N latitude and between 64°-30' E and 67°-50' E longitude.

149. The overall Helmand River system, including the Arghandab River as a major tributary, together drain 43% of Afghanistan including most of the southern part of the country. It has an average discharge of approximately 140 m^3/s but is highly variable both annually and seasonally as the waters are primarily snow melt from the ridge of mountains running through the center of the country. These include the Sia Koh Mountains and the Parwan Mountains northwest of Kabul.

3. Topography

150. Mountains, with an elevation of about 1,200 to 2,800 meters above sea level (MASL), dominate the northern and the eastern parts of the province. On the other hand, the southern

and the western parts of the province are dominated by desert with an elevation of about 1,000 MASL.

151. The topography of the project site includes bare mountains without vegetation and the flood plain of Arghandab River. Elevations of the mountains are up to 1,300 MASL. Highlands below the dam have very scarce vegetation (elevation: 1,120 – 1,140 MASL). The Arghandab River valley begins at 1,200 m at Dahla Dam. The elevation below Kandahar is below 1,000 MASL.

4. Geology

152. Afghanistan has some of the most complex and varied geology in the world. The oldest rocks are Archean and they are succeeded by rocks from the Proterozoic and every Phanerozoic system up to the present day. The country also has a long and complicated tectonic history, partly related to its position at the western end of the Himalaya mountain range.

153. The Kandahar province is characterized by numerous ranges of bedrock. This bedrock is elongated from northeast to southwest. Bedrock is eroded and modeled by weather (wind, rain, freeze). Sediment terraces exist in the valleys and along Arghandab River. The following bedrock occurs in the project area:[9]

(i) Limestone and sandstone (Early Cretaceous (Aptian and Barremian)—Limestone, marl, sandstone more abundant than conglomerate;
(ii) Ultramafic intrusions (Early Cretaceous)—Dunite, peridotite, serpentinite;
(iii) Lava (Oligocene and Eocene)—Basaltic andesite, basalt, trachyte, dacite, rhyolite, ignimbrite, tuff; conglomerate and sandstone, siltstone, limestone.

154. Surficial deposits in the area consist of flood plain alluvial origin. These flood plain deposits are of quarterly age, forming a body of succession of alluvium that is overlain by the surficial deposits of Holocene age. Lithologically, they can be classified as flood plain deposits.

155. According to the changing locations of the Arghandab River and its tributaries, the lithological composition or variation of the alluvial fill is varying not only in vertical but also in horizontal direction. It is evident that the alluvium consists of alternating beds of gravel, sand, silt and clay (fan alluvium and colluvium, shingly and detrital sediments, determined to be from the Holocene and late Pleistocene).

156. Loess is also very common in the project area. Loess is more abundant than sand and clay. Loess is an aeolian sediment formed by the accumulation of windblown dust and silt.

5. Soils

157. Characteristics of soils upstream of all dams in arid and semi-arid lands (ASAL) are of particular relevance due to the relatively high incidence of sedimentation in the water impoundments each year. This TRTA study relied for information on soils from the recently completed Helmund River Basin Master Plan (HRBMP).[10] The HRBMP study combined generalized findings to establish a schematic soil classification based upon the United States Department of Agriculture (USDA) classification of the Helmand Basin, combined with the USDA Natural Resources Conservation Service (NRCS) Geographic Information System study

[9] USAID. 2005. Geological map of Afghanistan.
[10] Mott McDonald, 2013

of the soils of Afghanistan. Within this collective body of work there is specific reference to the Arghandab River and the catchment north of Kandahar.

158. Soils characteristics vary in correlation to topography and adjacent the river small settlements signify the presence of favorable soils for subsistence farming systems. Above the impoundment of the Dahla Dam there are four distinct soil types, all of which are correlated with topography. They are abbreviated from the HRBMP and presented as follows:

(i) **Soils on upper river terraces and plains**: vary in depth, are moderately fine textured and moderately well drained, with slow permeability. Frequently the soils are very gravelly. There is an occurrence of both gypsum and thick lime layers with variation in hardness depending on location. Conglomerates are common at depth and washes extremely gravelly or cobbly. Soils are classified as Camborthids, Calciothids, Gypsiorthids, and Torripsamments.

(ii) **Soils on alluvial fans**: mostly more than 0.5 m in depth, moderately coarse to moderately fine textured, and range from well drained to moderately well drained, with moderate to very slow permeability. Slopes can generally range from 1 to 45%, and closer to the base of mountains more poorly drained soils occur in seepage zones. Usually, the soils are gravelly, cobbly or stony and frequently underlain by conglomerates or gravel cemented by silica. Washes are extremely gravelly or cobbly. soils are classified as Torriorthents.

(iii) **Soils on mountains**: these soils are mostly less than 0.5 m deep, coarsely structured, very gravelly and stony, and well drained. These soils generally have rapid permeability. Slopes range from 35 % to nearly vertical. The soils occur in cracks, crevices and drainage ways of otherwise continuous rock outcrops. They are classified mostly as Cryorthents at the upper elevations and Torriorthents at the lower elevations.

(iv) (iv) **Rocky outcrop**: this is mostly exposed limestone bedrock. Extrusive and intrusive rocks also outcrop on mountains in the basin. These rock outcrops are not considered to be a soil, but represent a significant proportion of the land area in the basin.

159. Water and to a lesser extent wind are the principal drivers of soil erosion. However, susceptibility to erosion and the subsequent high sediment loads it generates in river flows is endemic to vulnerable soils combined with the impact of infrequent but intense rainfall events and limited or degrading levels of biomass/vegetation.

160. Climate change scenarios include a greater incidence of uncharacteristic weather events which could exacerbate further the function of erosion. The HRBMP community consultation process confirmed the loss of important riparian vegetation systems which provided significant habitat, helped to mitigate or arrest impact of flash flooding. The civil war has not contributed in a positive way to resource stewardship, particularly protection of the vegetation communities which have defended landscape elements, most particularly soil.

161. When interpreting this information, it is important to note that the soil maps available at present for the basin are only at a reconnaissance level and as such can only highlight the broad categories of soils regions), and hence do not show specific locations of soils to any degree of accuracy (Ibid).

162. The main dam, saddle dams and the two spillways are located in geologically favorable areas with strong to very strong granite and granodiorite foundation rocks. No shear zone or fault was witnessed during the TRTA study, geotechnical investigations and field observations.

Limited grouting, however, will be required in some areas to check seepage due to embedded sand gravels and permeable zones.

163. During the TRTA, geotechnical investigations were undertaken. A total of nine Consolidated Undrained Tests were requested. Two tests were requested on Main Dam and one on Saddle dam 6. Six tests were requested on the borrow areas samples. The investigations are reported as below:

164. **Main Dam:** The core typically starts at 2 m below the dam crest and reported to have about 40 % silts and clays with 40 % sand and 20 % gravels in first borehole. As per USCS the core is stated to be SC to SM-SC. The core has only 3 to 4% low moisture with a specific gravity of 2.7. Liquid limit, Plastic Limit and Plasticity Index are reported as 22, 16 and 6 %. However, in borehole 2 it is reported as Non-Plastic from 3 to 4 m depth. Consolidated Undrained Triaxial (CU) test report an effective cohesion (c') of 22 kPa and effective angle of internal friction (ø') as 33 degrees. The reported permeability is 5 x 10^{-10} m/sec. The material above 2 m is non-plastic and comprises 10 to 15% clays and 34 to 43 % sands and remaining as gravels. The reported permeability is 1.5 x 10^{-9} m/sec. Test pit remolded samples report Maximum Dry Density (MDD) as 2.05 g/cc and an Optimum Moisture Content (OMC) as 9.6% for the material above core. Two additional Consolidated Undrained Triaxial (CU) test report an effective cohesion (c') of 18 and 12 kPa and effective angle of internal friction (ø') as 36 and 39 degrees.

165. **Saddle Dam 6:** As per USCS the core is stated to be CL, SC, CL-ML to SM-SC. The core typically starts at 2 m below the dam crest, is inclined as per 1952 design and reported to have about 40 to 60 % silts and clays with 30 to 40% sand and remaining gravels in borehole number 2. The core has 3 to 9% moisture with a specific gravity of 2.7. Liquid limit, Plastic Limit and Plasticity Index are reported from 17 to 40, 12 to 15 and 5 to 26 %. Consolidated Undrained Triaxial (CU) test report an effective cohesion (c') from 14 to 30 kPa and effective angle of internal friction (ø') from 25 to 28 degrees. Insitu density has been reported as 2.1 gm/cc. Test pit remolded samples report Maximum Dry Density (MDD) as 1.86 g/cc and an Optimum Moisture Content (OMC) as 15%. This appears to require further reduction in moisture content to 10% or so. For the Main Dam MDD was reported higher like 2.05 gm/cc at 10% moisture. Therefore, it appears that under 10% moisture content, MDD should be higher. The material above 2 m is non-plastic and comprises 10 to 15% clays and 34 to 43 % sands and remaining as gravels. The reported permeability is 2 x 10^{-9} m/sec for the material above core.

166. **Test Pit Investigations:** Based on the reported data, stiff to hard clay / claystone has been reported in Test Pits 4, 5, 6, 7, 12, 16, 17 and 23. The clays were highly over-consolidated and have Insitu strength. These clays should be available in significant quantity at the reported sites. These clays typically have high thixotropic strength gain after compaction like the existing clay core for the existing dam. The reported Maximum Dry Density (MDD) ranges from 1.7 to 1.85 gm/cc at moisture range typically around 20%. This appears to require further reduction in moisture content to 10% or so. For the Main Dam MDD was reported higher like 2.05 gm/cc at 10% moisture. Therefore, it appears that under 10% moisture content, MDD should be higher. This should be further validated during detailed design. Typically, same consolidated triaxial strength parameters could be used for these soils as stated above for Main and Saddle dams. However, it is proposed that Contractor must perform additional geotechnical investigations on proposed borrow areas including CU Triaxial tests before construction and validate remolded strength and thixotropic strength. Thixotropic strength gain may be estimated on samples compacted to 98% SMDD and left for 28 and 90 days testing in a closed moist container.

6. Seismic Hazard

167. The history of destructive earthquakes in Afghanistan spans more than 4,000 years. Earthquakes have killed more than 7,000 Afghans in the last 10 years, including the Nahrin earthquake in May 1998 that killed an estimated 4,000 people. Future large earthquakes, driven by ongoing active geologic processes in the region, will occur close to population centres and lifelines, with a consequent risk for greater casualties and damage. The seismic hazard must be considered in the siting, construction, and restoration of communities and facilities in Afghanistan

168. Several sources of seismicity are present in Afghanistan and contribute to appreciable seismic hazard for several major cities including Kabul, Mazar-e Sharif, and Herat.

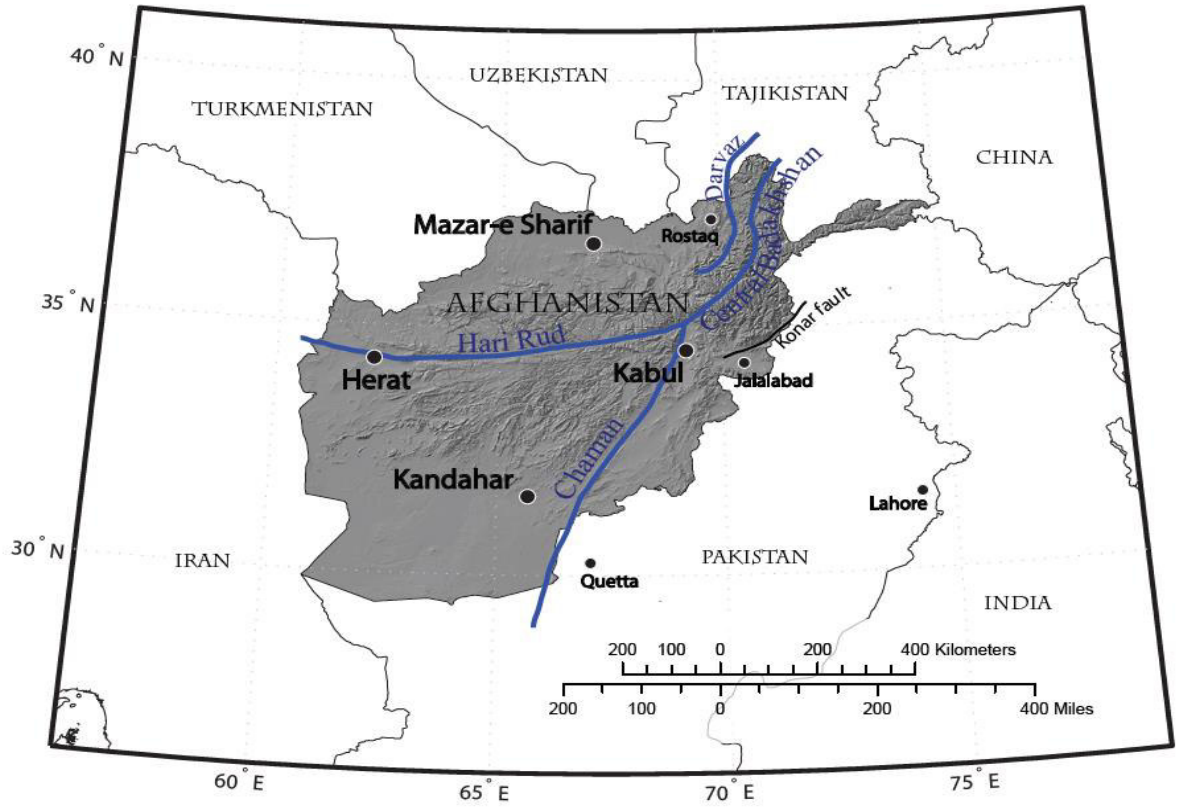
169. Kabul, Mazar-e Sharif, Herat, and Kandahar have 2% chance in 50 years of exceeding a peak ground acceleration of 50, 35, 28, and 13% gravity respectively, and 10% chance in 50 years of exceeding a peak ground acceleration of 27, 17, 7, and 7% gravity, respectively. These values are similar to values found for the intermountain West of the United States. However, the hazard values for Afghanistan are relatively uncertain owing to a lack of information characterizing the sources of seismic hazard, particularly the many faults that might be active.

170. In 2007, the US Geological Survey completed the most extensive study to date of potential seismic sources in Afghanistan and developed probabilistic ground motion maps to help quantify the expected frequency and strength of ground shaking in the country.[11] An Operational Basis Earthquake (OBE) event normally corresponds to a 144-year return period. However, to date there is no published probabilistic Peak Ground Acceleration (PGA) developed for a 144-year event in Afghanistan. Therefore, the 475-year event was selected as the OBE event (which is conservative).

171. The figure below presents the map of Afghanistan showing the locations of modeled fault sources (heavy blue lines).

[11] USGS, Dahla Seismic Write-up, 2011

Figure 19. Preliminary Earthquake Hazard Map of Afghanistan



Source: USAID, by Oliver S. Boyd, Charles S. Mueller, and Kenneth S. Rukstales, U.S. Department of the Interior, U.S. Geological Survey, 2007

172. For Dahla Dam embankment, OBE was assigned a return period of 500 years with a PGA of 0.075 gravity while the Maximum Design Earthquake (MDE) was assigned a return period of 10,000 years with a PGA of 0.18 gravity.

173. In 1952, the dam structures were designed to resist inertia forces produced by a ground wave-acceleration equivalent to 0.05 gravity. As this ground acceleration is too low in today's practice for high dams with high hazard consequences, USACE initiated geotechnical investigations in 2014 for determining the shear strength parameters. The deterministic seismic hazard analysis performed by USACE in 2014 yielded a peak ground acceleration of 0.32 gravity at the foundation rock level for a magnitude 6 earthquake. The damage class for Dahla Dam is thus class 1 on a scale of 0 to 4 and the corresponding probability of transverse cracking at the crest is 0.05 which is very low. The maximum crack width in the event of a magnitude 6 earthquake could be 50 mm.

174. In December 2017, the TRTA engineers inspected the dam crest; no longitudinal cracks were observed on the dam crest and the parapet wall alignment indicates that the crest has settled by less than 1% of the embankment height over the last 60 years of dam operation. This is in line with the assessment reported above.

175. In 2017, the TRTA reviewed the USACE dam safety assessment studies, and completed additional geotechnical tests on the main embankment, saddle dam 6 (which was not tested by USACE due to its difficult access), and potential borrow pits.

176. From the TRTA studies, it was concluded that, despite the absence of a properly designed no-erosion filter, the main embankment of Dahla Dam is safe against internal erosion or piping failure. A total of 27 stability cases were run for the dam models. These included the 1952 design, 8 m raise, and 12 m raise for the main dam, saddle dams 1-6. The analysis concluded that under proposed design, all of the dams are safe for the water full supply level, dam crest floods and seismic loads.

177. The dam design will be reviewed by an independent panel of experts during detailed design stage.

7. Flooding and Climate Change

178. Typically, low reservoir volume periods in the project area are from July to November. However, the frequency of high and lows for the inflow to Dahla reservoir is likely to increase over time due to climate change. The impacts of climate change on reservoir performance are likely to result in reduced inflow and partly increased maximum flows during extreme events. This results in respective differences in downstream water availability. Especially with regards to extreme runoff events, it needs to be understood that the capacity of the reservoir and respectively the buffering capacity is limited (storage capacity is about 11% of the annual inflow under average conditions).

179. The general climate trend of reducing inflows is of less impact than the increase in extreme conditions and respective water availability fluctuations where the low inflow during dry years or the high inflow during wet years is difficult to be buffered. These differences between wet and dry years are causing the largest challenges for the downstream irrigation schemes as with a reservoir and dam built for average conditions significant spill occurs and over-year buffering is not possible.

180. Reservoir behavior was simulated as part of the TRTA hydrology study based on predefined scenarios considering baseline (2005-2014), and future 2050 conditions under average, wet and dry conditions for a defined set of downstream current and future environmental as well as urban demands. Irrigation water demand has been iteratively tuned to understand maximum irrigation water availability while maintaining a reservoir reserve of 50 million m^3. The irrigation water demand was set considering the differing monthly demands, with the condition that demands must be met in all months during the irrigation period in order to avoid crop damage. Results show that climate change, i.e. a potential drier future, will have a significant effect on water availability that cannot be fully compensated by the reservoir buffer, even with increased reservoir capacity.

181. Overall, the project is categorized as low risk for climate change impact and in practice will reduce emissions through use of generation of electrical power using hydropower replacing diesel generation. The project will also remove the need for continual and on-going extraction of ground water from boreholes by improved water storage of natural annual rainfall and snow melt water. Another positive impact will be the reduction of water loss from spillways with consequent ability to enable environmentally minimal flows to be maintained in the main river networks of the river delta and its linked canals. Climate risks were considered based on the sample subprojects.

8. Hydrology

182. An aquifer, or water bearing formation, is a term used to designate a formation that contains and can transmit a considerable amount of water. Aquifers are defined as a water-bearing bed or structure of earth, gravel or porous stone.[12]

183. The most important hydrogeological properties of an aquifer where ground water is flowing include: (i) Transmissibility = permeability x thickness of the aquifer; and (ii) Specific yield or the storage capacities of the water bearing formation.

184. Kandahar groundwater aquifers have been assessed in previous studies through several groundwater surveys. The results are presented in the table below.

Table 10. Characteristics of Kandahar Groundwater Aquifers

Kandahar City Groundwater Model	Afghanistan Geological Survey (Abdullah and Chmyroiv, 2008)	DACAAR Nationwide Monitoring Report (Saffi, 2007)	Kandahar Groundwater Resource Assessment (CDM, 2003)	Description	Notes
Unconfined/Semi-Confined	Recent, Aeolian+, Talus, Upper & Middle Quaternary	Unconfined	Unconfined	Gravels, sands, talus, sand loam	Loess cover present in north and much of Kandahar area
Upper Confined	Neogene	Neogene Multi Aquifer System	Upper Confined	Sands and gravels	May not be correlative with northern part of the model domain
City Aquifer	Neogene		City Aquifer	Sands and gravels with scattered layers of conglomerate and caliche	Not correlative with northern part of the model domain *Hard layers at percussion drilling limit (100-120m) will give a false bedrock depth
Deep Aquifer	Paleogene-Helmand-Arghandab Uplift	Not Defined	Not Defined	Variably cemented, red to pale red fine grain sediments with sandstone and conglomerate	Not correlative with northern part of the model domain *May be source of artesian flow
Mixed Age Carbonate Bedrock Aquifer System	Cretaceous Bedrock Aquifer System *Paleozoie Aquifer System	Fracture Karst Water	Not Defined	Carbonate units known and suspected to have karst potential	Relatively High Hydraulic Conductivity, enhanced neat faults and major fracture zones
Mixed Age Coarse Clastic Bedrock Aquifer System	Not Defined	Not Defined	Not Defined	Cambrian-Cretaceous and younger sandstones and conglomerates, and some mixed carbonate units	Relatively medium hydraulic conductivity excluding fracture sets and faults
Mixed Age Low Porosity	Paleogene Katawaz Artesian	Not Defined	Bedrock	Igneous metamorphic,	Relatively low hydraulic

[12] Nespak, I. 1980. Analysis and Evaluation of Pumping Test Data Second Edition (Completely Revised), *Delft.*

Bedrock Aquifer System	Basin *Mixed Age Intrusives Aquifer System *Pre-Cambrian Aquifer System		and fine-grained sedimentary rocks	conductivity excluding fracture sets and faults

185. Groundwaters have been widely used in the irrigated areas of the Arghandab basin to support surface water irrigation. While in principle, tubewells need to be approved and registered, this appears not to have happened in the Arghandab river basin, or in fact in much of Afghanistan. This is leading to rapid decline of the water table in many areas, and if not controlled will ultimately lead to the loss of aquifers and the inability of groundwater to support irrigation. Increasing the availability and planning of surface water release under the project should have a major goal of limiting the need for groundwater usage, and thus reversing or at least stabilizing the falling water tables. This must be supported through adequate links with the community.

186. Dahla Dam, which is fed by precipitation and snow melt in its upper catchments, currently only supplies irrigation water. The Loy Walla irrigation canal which is supplied with water from the dam, is one of the few surface water sources flowing through the city. This canal water is also unofficially used for domestic water consumption by residents without piped water connections, and is often used untreated. Even though the leakage water from this canal infiltrates into the shallow unconfined aquifer, groundwater levels are still dropping.

9. Water Quality

c. Water Sources

187. Kandahar has an estimated population of between 630,000 and 830,000, estimates vary depending on the source, and is currently predominantly relying on groundwater as water source. All existing water wells are operated and managed by the Afghanistan Urban Water Supply and Sewerage Corporation (AUWSSC) and are drawing water from the deep aquifer 60-200 m below Kandahar.

188. Previous studies indicate that the sustainable groundwater yield of the aquifers near the city is around 33,000 m^3/d and is insufficient to meet the total water demand for Kandahar City, which is estimated at 53,000 m^3/d based on the current population (2018) and a water consumption of 50 LPCD.

189. In addition, the water of the aquifers in many locations near Kandahar City appears to have high total dissolved solids (TDS) concentrations which exceed the Afghanistan National Water Quality Standards 2013.[13]

190. As part of Component 3 Feasibility Study, it is recommended that surface water from Dahla Dam is developed as a new source for urban water supply for Kandahar City. The water has a relatively good water quality, a low TDS and, can be supplied by gravity to 70% of the city from the dam due to its high elevation.

[13] USACE. 2015. *Kandahar City Water Supply Master Plan Kandahar Province, Afghanistan Commander's Emergency Response Program*. United States Army Corps of Engineers, 30 Sept 2015.

d. Survey Results

191. Water at 12 wells in Kandahar city were tested in November 2017 and at 2 surface water sources: Dahla dam and downstream of the reservoir in Arghandab river, in February 2018. Additional water quality analysis was conducted in January 2019 on 10 wells in Kandahar City and on 2 surface water sources. The locations of the sampling are presented in the figure below.

Figure 20. Locations of Water Quality Sampling, January 2019

Source: TRTA Consultants. 2019

192. Results are presented in details in Appendix 5. The main characteristics of all tests performed in 2017, 2018 and 2019 exceeding either WHO, or Afghanistan standard for physical, chemical or bacteriological characteristic are summarized in the table below.

Table 11. Water Quality Survey Results (2017-2019)

Sample Location	Sampling date	Physical *turbidity: 5* *EC: 1500 (WHO) - 3000 (ANSA)*	Chemical *Chloride: 250* *Sulphate: 250* *Fluoride: 1.5* *Hardness: 300* *Sodium: 200*	Bacteriological *Total coliforms: 0 col/100ml (WHO)* *Faecal coliforms: 0 col/100ml (WHO)*
SURFACE WATER				
Close to Intake Tower, Dahla Dam Reservoir, Shah Wali Kot district, Kandahar Province	26/02/2018	Turbidity: 13 NTU	-	?
	1/01/2019	Turbidity: 60 NTU	-	Total Coliform and Faecal coliform: > 250
Downstream, Dahla Dam, Shah Wali Kot district, Kandahar Province	26/02/2018	-	-	?
	1/01/2019	-	-	Total Coliform and Faecal coliform: > 250
GROUNDWATER WELL				
AUWSSC 1st operational water well in Kandahar city. Maikhanik High School, District 2, Kandahar Province	1/11/2017	-	-	?
	9/01/2019	-	Total Hardness: 360 mg/l	-
AUWSSC 3rd operational water well in Kandahar city. AUWSSC Office, District 2, Kandahar City	25/10/2017	-	-	?
	9/01/2019	-	Total Hardness: 390 mg/l	Total Coliform: 20 Faecal Coliform: 10
AUWSSC 4th operational water	31/10/2017	-	-	?

well in Kandahar city. Fazal Kandahari High School, District 8, Kandahar City	9/01/2019	-	-	Total Coliform and Faecal coliform: > 250
AUWSSC 5th operational water well in Kandahar city. Dand Chowk (Square), District 8, Kandahar City	12/11/2017	-	-	?
	9/01/2019	-	-	-
AUWSSC 8th operational water well in Kandahar city. Sra Miasht Clinic, District 14, Kandahar City	30/10/2017	-	-	?
	9/01/2019	-	Sodium: 259 mg/l	Total Coliform: 37 Faecal Coliform: 17
AUWSSC 10th operational water well in Kandahar city. Mirwais Nika High School, District 14, Kandahar City	20/11/2017	-	-	?
	9/01/2019	-	-	-
AUWSSC 11th operational water well in Kandahar city. Ahmad Shah Baba High School, District 2, Kandahar City	23/10/2017	-	-	?
	9/01/2019	-	-	-
AUWSSC 12th operational water well in Kandahar city. Kandahar Mahbas (Prison), District 8, Kandahar City	29/11/2017	-	-	?
	9/01/2019	-	-	-
AUWSSC 15th operational water well in Kandahar city. School Aino number 2, Kandahar City	18/11/2017	-	-	?
AUWSSC 16th operational water well in Kandahar city. In front of Aino Mina, District 5, Kandahar City	7/11/2017	EC: 2020 µS/cm TDS: 1010 mg/l	-	?
	9/01/2019	EC: 2460 µS/cm TDS: 1692 mg/l Turbidity: 43.55 NTU	Chloride: 510 mg/l Sulphate: 380 mg/l Fluoride: 2.5 mg/l Total Hardness: 560 mg/l Sodium: 453 mg/l	-
AUWSSC 17th operational water well in Kandahar city. AUWSSC Office, District 2, Kandahar City	25/10/2017	-	-	?
	9/01/2019	-	Total Hardness: 390 mg/l	Total and Faecal Coliform: 11
MPW Well	5/11/2017	TDS: 1088 mg/l	-	?

Note: (i) WHO and ANSA standards are indicated below the first row for the characteristics exceeded. (ii) 2017 results indicate negative bacteriological results for all tests. This may be incorrect and this test has been classified as invalid.
Source: TRTA Consultants, 2019

e. Groundwater

193. In 2017, analysis of the water samples from the 12 wells were provided to the TRTA consultants by AUWSSC. Sterilized polyethylene sampling containers were used to collect water samples. Water sampling begun at around 10 am, and water samples were stored in an ice box during collection and transportation. Laboratory tests were conducted at around 11 am the same day. The water samples were tested in AUWSSC laboratory by the Laboratory Manager. Water quality parameters were analyzed and compared with WHO and Afghanistan

National Water Quality Standards. The summary of water quality test results is presented in the Table above. The water of all samples had no noticeable odor and unobjectionable taste.

194. Water sample analysis of the 12 wells shows low level of TDS apart at MPW well and the Ansari Mena well, where TDS exceeds 1,000 mg/l, however it is still below the drinking water standards of 2000 mg/l.

195. **In January 2019, bacteriological contamination has been detected in four of the ten wells tested.** Disinfection of the water is recommended before human consumption for these wells. While the previous 2017 and 2018 displayed negative bacteriological contamination, it is expected that these results may be incorrect. Indeed, bacterial contamination is very common in the Kandahar City aquifers and wells. Water borne diseases are expected for Kandahar City due to absence of or incomplete disinfection of drinking water.

f. Arghandab River and Canals

196. Water quality data from a water sample taken at the main canal in February 2018 shows low TDS concentrations (259 mg/l < 1,000 mg/l Afghan National Standard). Electrical conductivity was low accordingly (538 µS/cm). Turbidity was also low (1,7 NTU < 5 NTU Afghan National Standard). It appears from conversations with local AUWSSC staff that during the snow melt in the spring turbidity levels increase in the Arghandab River and Dahla Reservoir.

197. Bacteriological analysis on total coliform and fecal coliform bacteria showed negative results, however it is expected that this result may be invalid. Indeed, the water quality of the canal is highly affected by domestic sewage. There is evidence of organic pollution from the following sources:

(i) Discharge of sewage from adjacent settlements into the river;
(ii) Car washing in the river;
(iii) Detergents from laundry in the river, which includes phosphates.

198. There is no public waste collection system. Waste from markets, households, and construction sites affect the river and the canals. There is also no appropriate landfill and waste disposal mechanisms in place. Most waste generated in Kandahar City is dumped into the ditches and canals, and the city is suffering from adverse effects of unmanaged waste.

199. **In January 2019, bacteriological contamination has been detected in Arghandab river.** Disinfection treatment of the water is required before human consumption.

g. Dahla Dam Reservoir

200. In February 2018, water quality analysis from the dam showed low TDS (383 mg/l < 1,000 mg/l WHO Standard) and low conductivity (384 mg/l). The dam is located in a remote area; there are some villages (Karmollah and Karamullah) and some small settlements in the vicinity of the dam. Sewage coming from these settlements may pollute the water body of the dam. The water quality of the dam itself appeared not to be affected by human activities. There is no industry, mining activities, large settlements or large agricultural fields nearby.

201. Turbidity observed was 13 NTU and exceeded the WHO drinking water standard which is between 1 and 5 NTU depending on the size of the water supply. Turbidity depends on weather patterns and inflow into the dam. For human consumption the dam water has to be treated for turbidity.

202. In January 2019, high turbidity was measured (60 NTU) and **bacteriological contamination was been detected in Dahla Dam reservoir.** Disinfection treatment of the water is recommended before human consumption and further testing is required at different times of the year.

Figure 21. Green Algae at Dahla Dam Indicating Organic Matter

Source: TRTA Consultants. 2018

203. Green algae were found at the dam during the site visit carried out by the TRTA team on 10 July 2018. The algae were found in the close vicinity of the dam itself and indicated organic matter. They have been accumulated by northern winds.

10. Noise Levels

204. The noise level, in the absence of any construction work, is typical of a busy village area and city area dominated by the cumulative effect of many unidentifiable sounds, mostly related to road traffic. Noise will increase in the project area during construction due to the noise of heavy machinery and transportation of construction materials.

205. The noise generated by the construction and operation of the raising of Dahla Dam will not affect any settlement as no communities are living closer to 500 m of the different site. As such, noise monitoring is not required. The following measurements of the closest settlement to the different project sites have been recorded by the TRTA in March 2019:

(i) Closest settlement to main dam embankment: downstream: 2,100m, upstream 4,950m;
(ii) Closest settlement to saddle dam 1: downstream: 890m, upstream: 3,980m;
(iii) Closest settlement to saddle dam 2: downstream: 1,145m, upstream: 4,113m.
(iv) Closest settlement to saddle dam 3: downstream: 1,475m, upstream: 4,222m;
(v) Closest settlement to saddle dam 4: downstream: 1,970m, upstream: 4,275m;
(vi) Closest settlement to saddle dam 5: downstream: 2,200m, upstream: 4,320m;
(vii) Closest settlement to saddle dam 6: downstream: 2,460m, upstream: 4,080m;
(viii) Closest settlement to spillway 1: downstream: 2,160m, upstream: 4,350m;
(ix) Closest settlement to spillway 2: downstream: 1,730m, upstream: 4,300m.

206. It t is anticipated that settlements located close to the proposed route bearer realignment will be affected by noise during the construction phase, and during the operation phase. The closest settlement to the proposed realigned route is Shah Joy village which is located approximately 150m away.

207. Baseline noise monitoring will be measured before commencement of construction activities at Shah Joy village. During the detailed design, documentation will detail that the contractor will be responsible for scheduling meetings with respective communities to establish agreement as to the commencement and completion of daily work times. It will also be the

responsibility of the contractor to monitor noise levels of all machinery involved in the construction.

11. Air Quality

208. Existing air quality is considered not to be a critical issue and, although not measured, appeared normal during site visits. Quality can deteriorate rapidly during dust storms generated across barren land and deserts during windy seasons. Actual pollutants in Kandahar City consist of windblown and re-entrant dusts, emission from brick kilns, residential heating and cooking, portable domestic generators, as well as mechanical shop generators. Dust storms are the main source of particulate matters.

209. Air quality measurements have been carried out at the following locations in January 2019:

(i) Right Abutment Dahla Dam, Shah Wali Kot district;
(ii) Downstream, Dahla Dam, Shah Wali Kot district;
(iii) Water supply station compound (C-3), Kotal-e-Murcha, Arghandab district;
(iv) Highway, Shah re Naw, District # 6, Kandahar City;
(v) Sub Road (1), Shah re Naw, District # 6, Kandahar City;
(vi) Sub Road (2), Shah re Naw, District # 6, Kandahar City.

Figure 22. Locations of Air Quality Monitoring, January 2019

Source: TRTA Consultants, 2019

210. The measurements have been carried out on PM 2.5 using Kaiterra Laser Egg 2 air monitoring device. A total of 60 measurements were conducted from 4 January 2019 to 8

January 2019 in the six locations. Measurements have been conducted mostly during daytime due to security reasons and therefore 24 hours measurements were not possible. The detailed results of these measurements are listed in Appendix 6.

211. The air quality measured were in most cases below the WHO Interim target-1 (75 µg/m^3) and Afghanistan maximum allowable concentration (75 µg/m^3) over 24 hours. As per the table below, in two cases for roads in Kandahar city, the concentration was higher, however, it was only recorded over 13 hours (day-time). One of the measurement was done for the road during night-time. Averaging both results for the 24 hours period, the results is estimated to be close to the standard.

Table 12. Air Quality Results Summary

Location	Date	Time	Number of samples / hours	Mean PM2.5 (µg/m^3)
Right Abutment Dahla Dam	4/01/2019	9:37 - 14:54	6	19.5
Downstream, Dahla Dam	5/01/2019	9:00 - 15:15	7	9.6
Water Supply Station Compound (C-3)	6/01/2019	8:10 - 16:47	10	42.8
Highway, Shah re Naw, District 6	7/01/2019	7:10 - 19:04	13	**115.7**
Sub Road (1), Shah re Naw, District 6	7/01/2019	7:18 - 19:10	13	**132.2**
Sub Road (2), Shah re Naw, District 6	7/01/2019	20:00 - 06:04	11	46.4

Source: TRTA Consultants, 2019

212. Additional comprehensive measurements on air quality including ozone, PM10, NO2, SO2 are suggested for the detailed design phase before commencement of construction activities.

B. Biological Environment

1. Vegetation and Land Use

213. The study area is located in a semi-desert ecosystem characterized by low annual rainfall (~70mm), high diurnal temperature range include intense heat during summer and low temperatures during the winter months. As a result, plant communities in such a situation are highly evolved to a very difficult climatic regime including both highly responsive annual and perennial material. Plant communities consist predominantly of low ground-covering shrubs exhibiting small leaf and biomass density and large root systems. In undisturbed areas plant diversity can be considerable, with 80% of the diversity being less than 1.0m in height. The diverse ecological conditions within the Arghandab catchment, ranging from barren deserts to areas affected by the Indian monsoons in the high country have fostered the establishment of a complex and varied endemic and indigenous flora. Arid zone plant communities are highly opportunistic, and can demonstrate variance in response to soils, aspect and micro-climate, precipitation and altitude. These conditioning factors result in considerable diversity in flora, and that variance can occur in the predominantly south facing land form above Dahla Dam. Where scree conditions prevail, plant material can be highly vulnerable to disturbance, so although considered tough, plant communities subjected to regular disturbance will struggle to survive. Closer to the riparian conditions, individual plants which favor more moist conditions prevail. The dominant plant families are Compositae, *Asteraceae (Artemisia spp, Cousinia spp),* as well as a large number of xerophytes and halophytes in lower sandy desert areas.

214. Of particular importance to the project is the need to select a palate of plant material which can be used for planned revegetation. It is important that the preconditions favorable for plant propagation and growth be developed as a component of the ARES.

215. As a result of the ongoing impacts of free-range grazing as well as extensive collection of biomass for use as fuel-wood across the catchment, there is limited vegetation cover out of the river basin and, as a result, top-soil degradation is common as are the signs of surface erosion. The land cover can be described as a semi-desert environment.[14]

216. The area surrounding the dam is largely altered by local residential mud house developments, but there are still pockets of natural vegetative areas with conservation value. Despite the low proliferation of alien plant species in the dam and surrounding area, a number of indigenous aquatic plant species still occupy the area. The establishment of many of these species has been promoted by the artificially wet conditions created by the dam. Remnant riparian tree flora also exists along the banks of the canal and major tributaries entering the dam, and in some cases the extent and condition of these zones has been enhanced by the dam's effects.

217. Shore vegetation may also help limit sedimentation of the dam by trapping sediment washed into the dam from the adjacent agricultural lands and small streams which flow into the dam. They may also help to improve water quality, but the extent of this is unclear and has not yet been quantified. However, considering both the sources and volumes of water and sediment supplied to the dam, it is unlikely that this is a major beneficial function of these shore habitats.

218. The immediate watersheds surrounding the dam and its reservoir are mostly denuded and the upper catchments are completely degraded. There is a dire need for a strategic and integrated watershed management program in the upper catchments to reduce soil erosion. The challenge of instituting such a program is a challenge while the major proportion of the catchment is not under the direct control of government agencies. In addition, rangelands grazing by Kuchi, fuel-wood collection and greater awareness and ultimately protection of important vegetation for habitat are all issues which will require considerable attention and resource commitment.

219. No national, provincial nor regional flora and fauna species of significance or their habitat were found within the area potentially affected by the project. While no large wetlands are located within the project area, in part, the perimeter of the existing water body provides important habitat for avian species. It is proposed that such "wetland" species be replicated to areas at what will be the new high water mark. to achieve this may require generous dressings of fine silt/soils in shallow areas. The ARES will specifically detail observations on conditions required and the speciation to be incorporated.

220. Small reed areas are found below the dam and these likewise play an important role in riparian ecology. Riparian forests along the river bank have frequently been cut with no replanting program. As a result, canopy species are now non-existent, a situation which impacts the local and micro climatic conditions as well as leaving river banks vulnerable to erosion. Long term strategies for the improved management of these riparian plant communities will include replanting programs linked with use of bioengineering devices as required.

221. Plant communities within the catchment of both the Dahla Dam and the broader Arghandab river fall into a number of categories based upon topography, soil types and aspect. (i) Riparian / water tolerant species favoring shoreline conditions and commonly supporting habitat and nursery conditions for aquatic and bird species; (ii) Immediate land beyond high water mark broadly referred to as having a fan-shape characteristics and subject to sheet erosion and seasonal flooding; (iii) higher sloping terrain. It is recommended that a

[14] UNEP 2003. *Annual Evaluation Report*. Evaluation and Oversight Unit. September 2004.

comprehensive plant list for these areas, along with propagation details, will be assembled as a component of the detailed ARES.

2. Fauna and Wildlife

a. Arghandab River

222. Both upstream and downstream of Dahla Dam, the Arghandab river banks demonstrate a range of degradation. As a result of the seasonal fluctuation of water flow levels combined with the constancy of human impact (agriculture, sewage, deforestation), the environment is in part highly compromised with a low ecological importance.

223. However, at various locations river morphology shows only minor human impact and appears undisturbed.[15] The greater the distance from permanent settlement, particularly where the river meanders and islands are very common, there are areas of natural habitat which will be of ecological importance for aquatic and terrestrial species. These areas offer potential habitat for ground nesting birds (gravel bank, reed) etc. In addition, there is evidence of deep pools where trout have been recorded to exist. The ARES will substantiate the status of a representative number of these non-degraded riparian areas to both identify nodal points where real-time monitoring could be established, and complete detailed fish / aquatic specie surveys to inform the EF database and assist the detailed engineering design stage.

224. Due to topography the river has no major drops nor large waterfalls. Subsequently, the river flows in level reaches broken up by many rapids and riffles. Deep pools can be found close to rapid areas. Depending upon outfall source and relative temperature differentials, it is anticipated that the increased flow throughout the year combined with environmental flows (after the raising of the Dahla Dam) can improve potential habitats below the dam compared to the existing situation. As hunting of birdlife is recognized as a local activity, the success of these habitats will depend upon ongoing stewardship and protection by local community groups.

225. Extensive data on wildlife numbers and habitat is not available however the ARES will be responsible for assembling greater information on relevant species, habitat and opportunities for the project to enhance and protect wildlife. There is evidence that avian species which rely on the water are present, such as: (i) Fish eagle *(Pandion haliaetus*); and (ii) Black kite *(Milvus migrans*). The November 2018 survey identified 14 waterfowl species and 17 individual birds from other species within the Dahla Dam. This is a preliminary indicator that the dam water is an important area and plays a significant role for waterfowl and other wildlife species in the south west of Afghanistan. Water birds use this area as an aquatic habitat for shelter, foraging, roosting and breeding. In addition to the water birds, the survey also identified two mammals, Jungle cat (*Felis chaus*) and Golden Jackal (Canis aureus), both of which are on the Afghanistan “Red List”.[16]

226. So, while the 2018 survey found that these species use the river as their feeding habitat, the occurrence of these species is impacted by water scarcity and human impacts, such as sewage and hunting.

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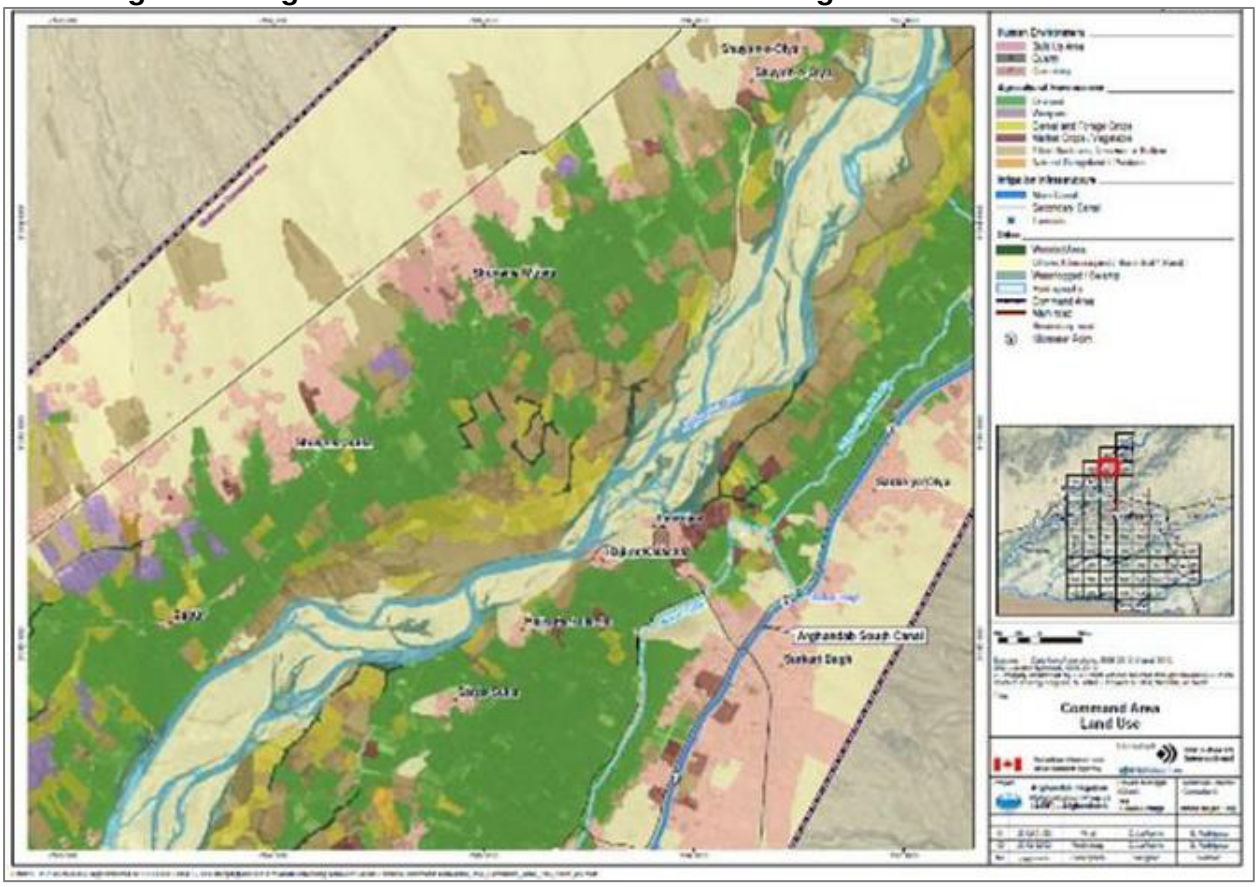
[15] Embankments consisting of natural substrate (rocks, gravel, sand), exist only in settlements and at bridges to protect against floods and erosion.

[16] **IUCN** The **IUCN Red List** of Threatened Species™ is the world's most comprehensive inventory of the **global conservation** status of plant and animal species. It uses a set of quantitative criteria to evaluate the extinction risk of thousands of species.

227. Beyond the dam, and in the surrounding catchment / desert areas, striped hyena (*Hyaena hyaena*) are very common.

Figure 23. Arghandab River Below the Dam Showing Meanders and Islands



Source: CIDA. Cartographic Atlas command area and land use, 2012

Figure 24. Upstream of First Division Weir - Reeds and Potential Habitat for Nesting Birds

Source: TRTA Consultants, 2018

b. Dahla Dam

228. Dahla Dam is an artificial, man-made habitat and is well recognized as a recreational destination for families from Kandahar. The dual purpose of the dam area means that ongoing maintenance and management of the area is critical if standards are to be maintained. The cost to support this could be covered by admittance fees.

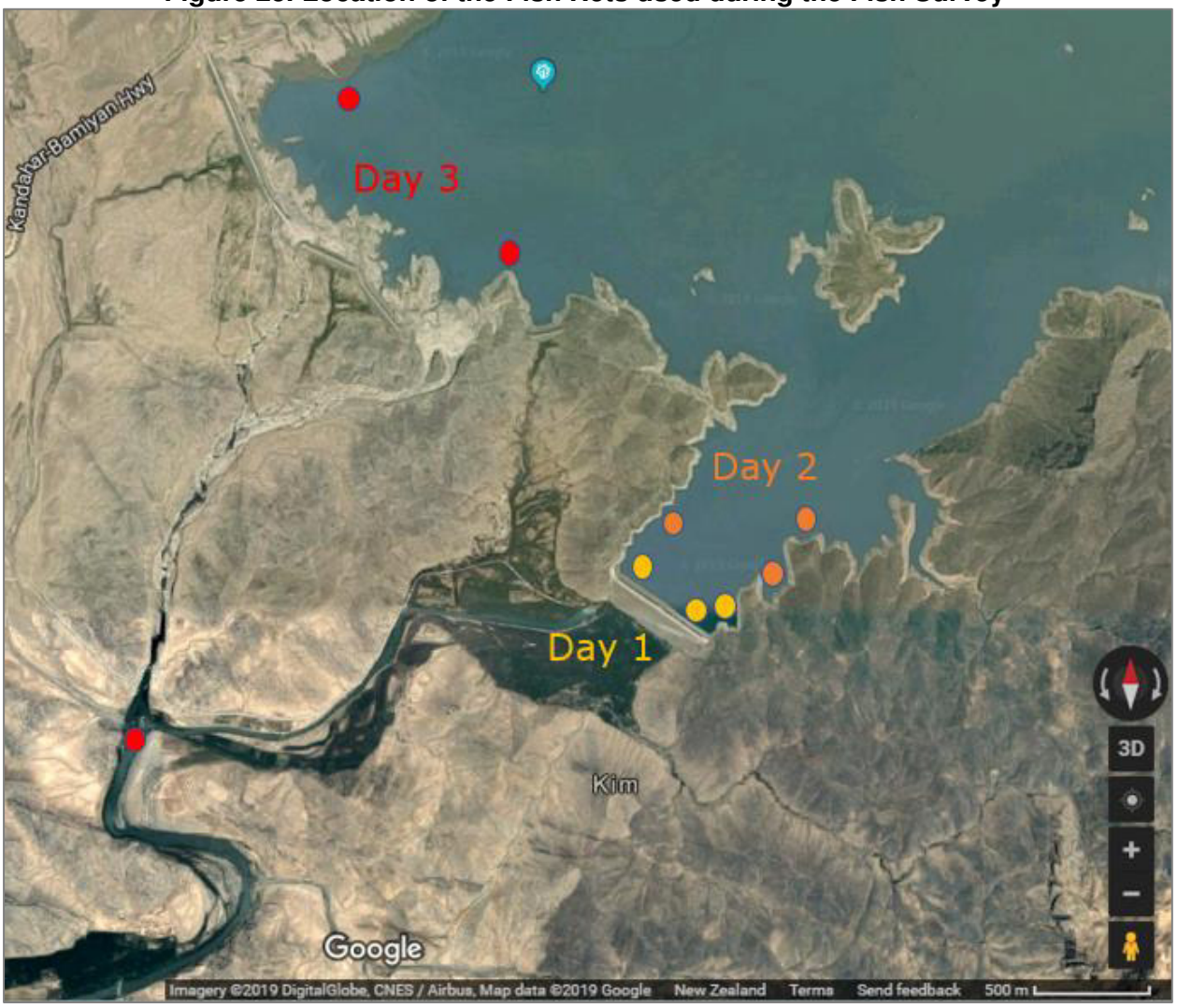
c. Aquatic Environment

229. A fish biological survey was implemented in November 2018 by the TRTA and NEPA to assess the aquatic life at the dam. The survey was conducted using three methods: (i) interviews of fisherman using a questionnaire on the fishing method used, time of the year, and main threats to fishing, (ii) meetings with aquaculture owners and related governmental organizations, and (iii) fish catches in nets at 9 different sites of Dahla Dam reservoir and 1 site downstream of Dahla Dam. The locations are shown in the figure below. On day 1, the survey team surveyed deep water zones, on day two, deep and shallow, and on day three shallow zones including one zone downstream of the dam.

230. The river south from the dam is habitat for rheophile trout (*Salmo trutta oxenesus*), which is recognized as being endemic to the region.[17] The 1953 construction of the Dahla Dam made no provision for fish ladder technology, so for 65 years there has been no upstream fish migration above the dam. However, *Salmo trutta oxenesus* is reported to exist in the river above the dam. It is anticipated that the lack of river sediment downstream of the dam will also have compromised seasonal cycles of nutrient deposits. The ARES will specifically assess the (i) effectiveness of modified “fish-friendly” hydro turbines, (ii) identify fish endemic to this river system, and (iii) evaluate the potential for a fingerling program to be introduced into the dam to replenish fish stocks.

[17] TRTA communication ASBA Kandahar.

Figure 25. Location of the Fish Nets used during the Fish Survey



Source: TRTA Fish survey, 2018

231. The ARES will specifically survey the river and dam again to collect and document in a usable form, additional information regarding the existing aquatic species (preferred habitat conditions, breeding cycle, predators, susceptibility to over-fishing along with their vulnerability to project activities). This information is an important component of understanding and improving management of aquatic species. The project has the opportunity to make very positive long-term contributions in this regard.

232. Three existing fish species were found in the dam reservoir as part of the 2018 TRTA survey. It has been observed that these species may be vulnerable to major construction and the disturbance in the water body adjacent the new walls. The ARES will specifically investigate this issue and make appropriate recommendations to mitigate. The three species concerned are:

(i) **Sheer Mahi** *(Clupisoma Naziri)*. Sheer Mahi was caught in all the fish nets used during the three days in different parts of the dam (shallow water zones and pelagic zones). The extent of occurrence of this species is high and exists in all parts of the dam. It mostly exists in the south-west part of the dam.

(ii) **Common Carp** *(Cyprinus carpio).* The Common Carp was caught in 4 out of 9 fish nets that were used to catch the fish in the dam. The specie mostly exists in the southern parts of the dam. No specimen was caught in the deep water zone.

(iii) **Mola Carplet** (*Amblypharyngodon mola*). 1,092 Mola Carplet were caught in only three of the fish nets among all the 9 nets (63% of the fishes caught) in the western part of the dam near the overflow and valve tower and eastern part of the dam. This species is likely to be most affected during the construction of the overflow and valve tower because the population of this species is very high in this part of the reservoir and is mostly found in this area.

233. The results of fish caught in the dam reservoir and downstream are summarized in the table below and the survey report is in Appendix 4.

Table 13. Quantities of Fish Caught during the Fish Survey

Local name	Common name	Scientific name	Quantity				
			Day 1	Day 2	Day 3	TOTAL	
Toghandy	Sheer Mahi	*Clupisoma naziri*	42	328	40	**410**	**24%**
Gulpam	Common Carp	*Cyprinus carpio*	12	4	210	**226**	**13%**
Yaqubyan	Mola Carplet	*Amblypharyngodon mola*	1068	24	0	**1092**	**63%**
		TOTAL	1122	356	250	**1728**	**100%**

Source: TRTA fish survey, 2018

234. Downstream, only Sheer Mahi was caught. One of the fishermen met during the survey mentioned that there were two species downstream: (i) Sheer Mahi and (ii) Dag fish. However, the survey team was not able to catch any specimen of Dag fish.

235. *Salmo trutta oxenesus* (common name: Khaldar Mahi) was not caught, although it is reported as existing in Dahla Dam.[18] This species is expected to occur upstream of the dam in river sections with high velocity due to its high oxygen demand. It is common in some rivers of Afghanistan.[19]

236. The catfish Sher Mahi (*Clupisoma Naziri*), an indigenous fish of Khyber Pakhtunkhwa, is facing serious threats to its survival due to climatic changes, water pollution, and overfishing. The species is found in Afghanistan and adjacent river basins.

237. Experts in the fisheries department of Pakistan's Khyber Pakhtunkhwa (KP) province, zoologists, and those in the fish business have observed a decrease in the population of Sher Mahi in its main habitat, the Kabul river. These experts believe extreme weather events – especially severe floods and erratic rainfall – combined with water contamination and over-fishing are the main cause of the depletion of Sheer Mahi. The construction of the Warsak Dam in 1960 blocked the migratory route of the fish upstream. *Clupisoma Naziri* cannot be reared in water ponds, or fish farms, due to its biology. Experiments of rearing the *Sher Mahi* in hatcheries were not successful.[20]

238. For the same reasons, decrease in this fish species is also expected in Arghandab River. This fish species uses Dahla Dam reservoir as their habitat. The dam contributes to the survival of this species and must not be emptied completely.

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[18] TRTA communication with ASBA

[19] Simon Funge-Smith et al. 2004. The potential for aquaculture development in Afghanistan, Asia Pacific *Fishery Commission. AD HOC Publication.*

[20] The Third Pole.net. *Understanding Asia's Water Crisis*. 2018. https://www.thethirdpole.net

239. There is no information available regarding the existing aquatic ecology of the river and of the dam. The river is expected to have a variety of substrates, mostly hard rock but also sand, silt and gravel. Habitats for different aquatic species are expected to decline due to water scarcity and the complete drying out of the ecosystem in dry years. Establishment of a sustainable, minimum environmental flow after the dam raise will boost the emergence of aquatic habitats below the dam and upstream of human settlements (benthic fauna, zooplankton, phytoplankton, fish). In times of flooding when water falls over the spillway, fish can migrate downstream of the dam. Fish species are present in the section of the Arghandab River below the dam.

240. Dahla Dam is an important habitat fish (and birds). Adequate water management will be needed to sustain and protect these species. The ARES survey will specifically survey and recommend upon ways to improve aquatic habitats in Arghandab River after the dam raise. In addition, measures to invoke water source protection will be strategically applied to the river to achieve appropriate management of human excreta and waste disposal in settlements both upstream and downstream of the dam. If not, while environmental flows may improve with increased water releases from the Dahla dam they in turn may be compromised by wastewater discharges to Arghandab River.

241. Policy recommendations from the ADB and the World Bank support the introduction of integrated sewage systems within 5 years of water reticulation being available.

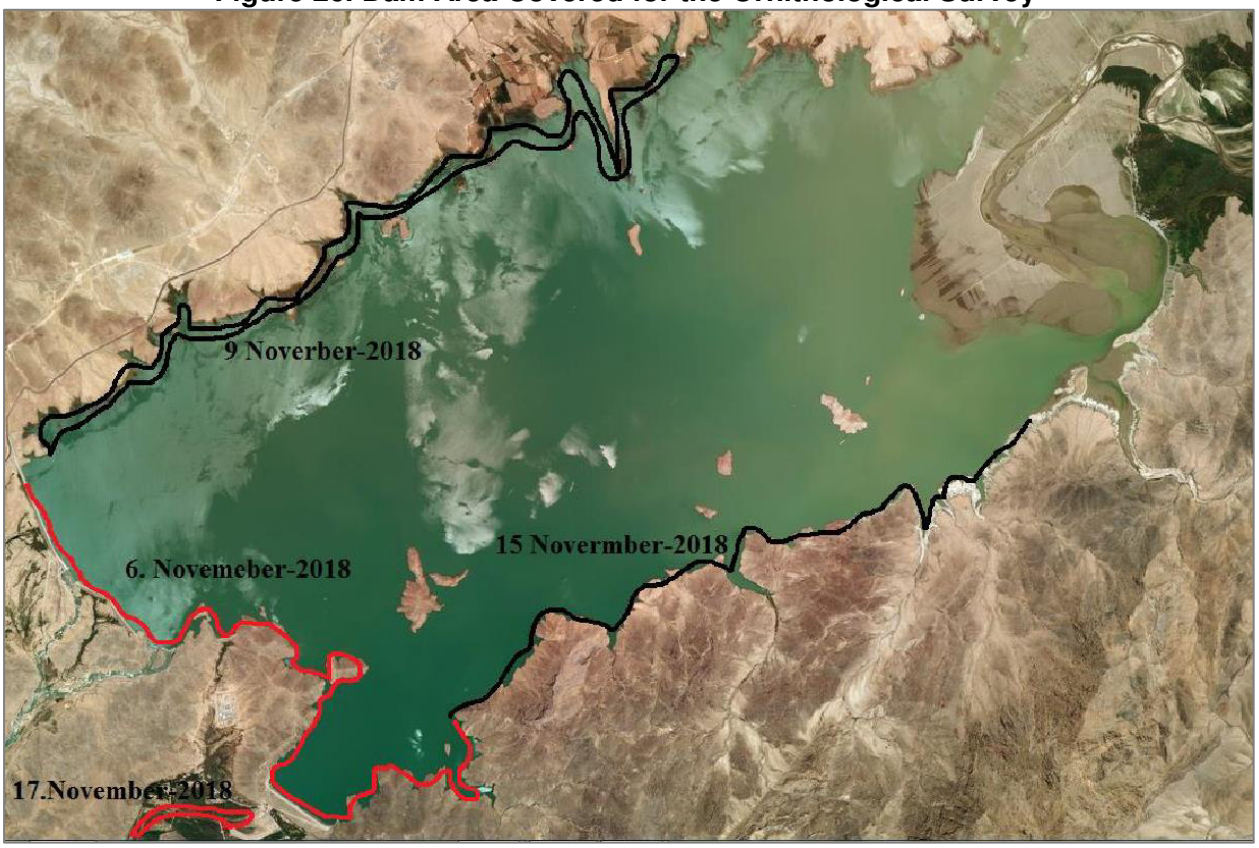
d. Ornithological Environment

242. Dense populations of waterfowl were found during the site visit of Dahla Dam (cormorant, different kinds of heron, duck, geese, etc.). The habitats of these birds are shallow swampy shores. These shores arose during the sedimentation process in the past decades. Dahla Dam is a large habitat for waterfowl that needs protection. Recommendation is also made that the site needs to be registered by NEPA Kandahar.

243. An ornithological survey was implemented in November 2018 by the TRTA and NEPA to assess the bird life at the dam. The survey was conducted using two methods: (i) collecting data through direct observations; (ii) interviewing local hunters (three hunters from surrounding villages) by using a specialized questionnaire on the presence of water birds, main threats, and hunting practices at Dahla Dam.

244. The observatory survey was conducted in November 2018. The survey team drove to Dahla Dam and conducted the survey in the shorelines (using motorbikes, boats, or walking), situated to the Northwest, West, South, and Southwest of the dam. The eastern shoreline of the dam was not included due to security issues: the dam security police did not permit walking there, but the survey team visited the eastern shoreline by using a motor boat. The figure below shows the dam area surveyed.

Figure 26. Dam Area Covered for the Ornithological Survey



Source: TRTA Ornithological Survey, 2018

245. The questionnaire investigations and direct observations showed that the inhabitants of the area extensively hunt waterfowl during fall and winter seasons. Spring and summer are breeding seasons, during which time hunting is uncommon.

246. Overall, the observations from the 2018 survey confirmed that Dahla Dam is an important area for waterfowl and other wildlife species in the south west of Afghanistan. Water birds use this area as an aquatic habitat for shelter, foraging, roosting and breeding. TA-9273 AFG will aim to establish mechanisms to enhance the water fowl species which use the dam.

247. The survey team identified 14 waterfowl species, 17 individual birds from other species, and two mammals − Jungle cat (Felis chaus) and Golden Jackal (Canis aureus): both in the Red List of Afghanistan. The Waterfowl species and other birds observed are presented in the tables below with the indication of their conservation status. The complete survey report is in Appendix 3.

248. The 14 waterfowl species identified are listed in the table below. Main habitats are presented in the figure below.

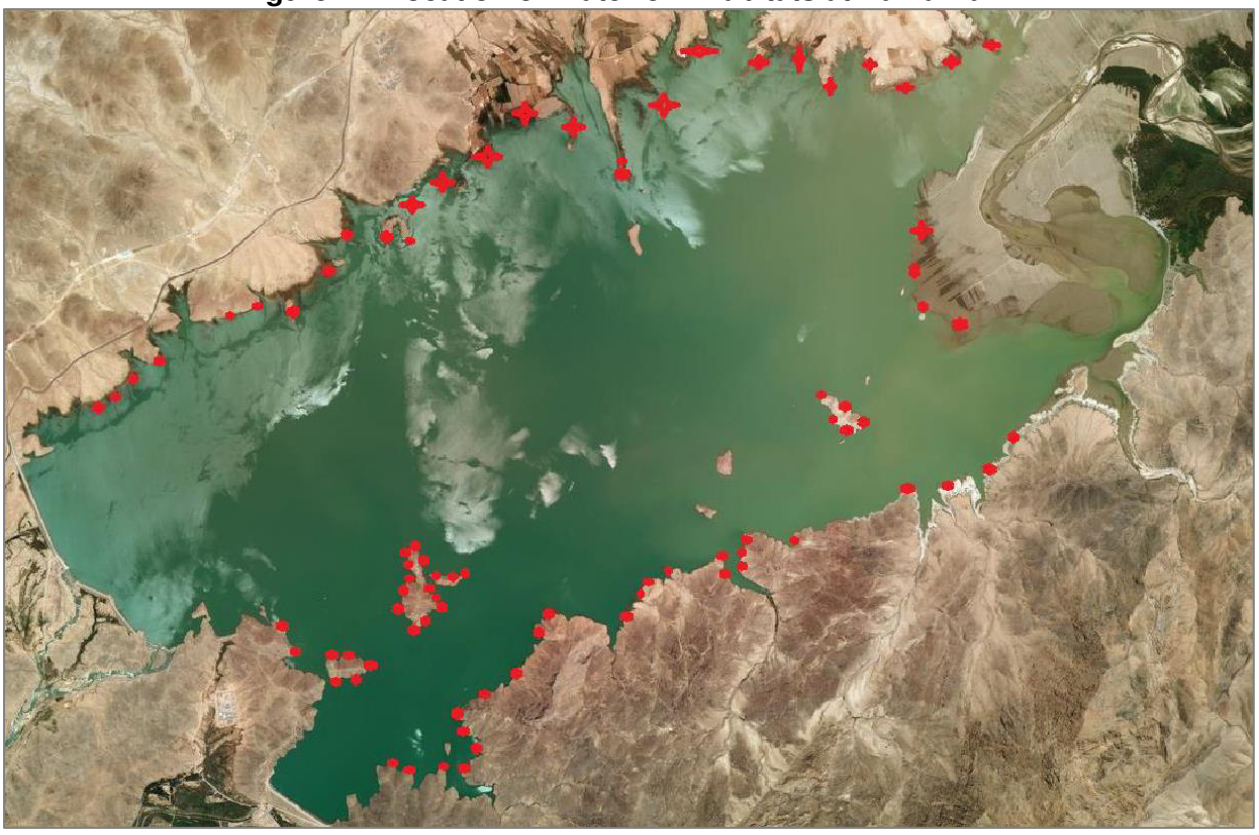
Table 14. List of Waterfowl Species Identified at Dahla Dam

Common name	English Name	Latin name	IUCN Red list	Conservation status Afghanistan
Helmandai helae	Great Cormorant	*Phalaracrocorax carbo*	LC	Not listed
Zarghon sare helly	Mallard	*Anas platyrhynchos*	LC	Not listed

Kotan	Great white Pelican	*Pelecanus onocrotalus*	LC	Listed on red list
Ghotayee helly	Red necked Grebe	*Podiceps grisegena*	LC	Not listed
Zarghon komol	Grey heron	*Ardea cinereal*	LC	Not listed
Cabkhowaronkai	Slender-billed gull	*Larus genei*	LC	Not listed
Speen komol	Great egret	*Egretta alba*	LC	Not listed
Cabkhowaronkai	Black-headed gull	Larus ridibundus	LC	Not listed
Cabkhowaronkai	Caspian gull	*Larus cachinnans*	LC	Not listed
Obez charg	Black coot	*Fulica atra*	LC	Not listed
Obez charg	Common moorhen	*Gallinula chloropus*	LC	Not listed
Dandez komol	Black -crowned night heron	*Nyclicorax nycticorax*	LC	Not listed
	Water rail	*Rallus aquaticus*	LC	Not listed
Shentaghy	Common kingfisher	*alcedo attis*	LC	Not listed

LC = Least Concern
Source: TRTA Ornithological Survey, 2018

Figure 27. Location of Waterfowl Habitats at Dahla Dam



Source: TRTA Ornithological Survey, 2018

249. In addition, 17 bird species were identified during the survey. These are detailed in the table below and locations of habitats presented in the figure below.

Table 15. Bird Species Found During the Field Survey at Dahla Dam

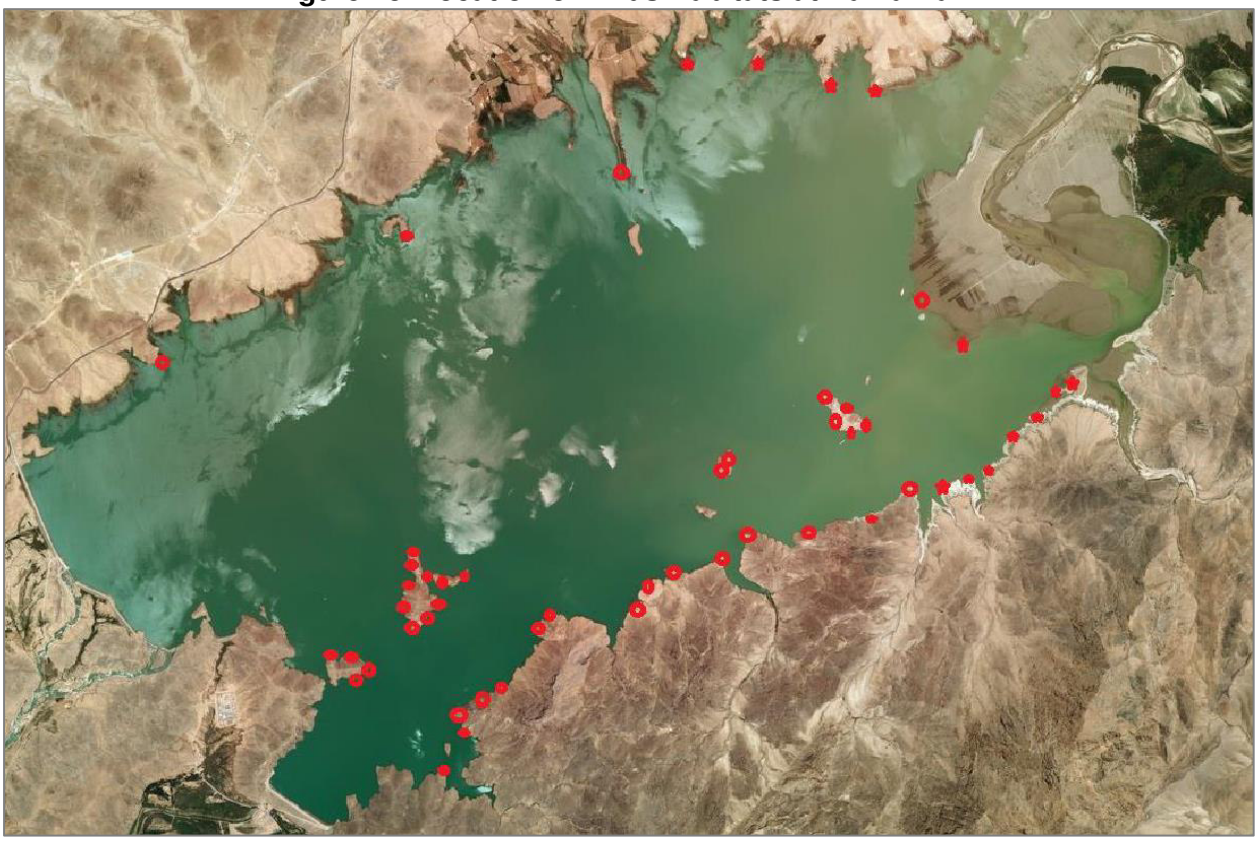
Common name	English Name	Latin name	Habitat	Conservation status Afghanistan
Jal	Crested lark	*Galerida cristatata*	Terrestrial	Not listed

Ababel	Barn swallow	*Hirundo rustica*	Terrestrial	Not listed
Balbal	White-eared bulbul	*Pycnonotus leucotis*	Terrestrial	Not listed
Jal	Eurasian skylark	*Alauda arvensis*	Terrestrial	Not listed
	Pied wheatear	*Oenanthe pleschanka*	Terrestrial	Not listed
Gul Sar	Red-fronted sarin	*Serinus pusillus*	Terrestrial	Not listed
	Hume's wheatear	*Oenanthe albonigra*	Terrestrial	Not listed
Keshkara	Eurasian magpie	*Pica*	Terrestrial	Not listed
Myna	Common myna	*Acridotheres tristis*	Terrestrial	Not listed
Totee	Rose-ringed parakeet	*Psittacula kramer*	Terrestrial	Not listed
Sangkoyake	Eastern rock-nuthatch	*Sitta tephronota*	Terrestrial	Not listed
Gorbata	**Bonelli's eagle**	***Aquila fasciata***	**Terrestrial**	**Listed on red list**
Oqabe telayee	**Golden eagle**	***Aquila Chrysaetos***	**Terrestrial**	**Listed on red list**
Sesae	See-see partridge	*Ammoperdix griseogularis*	Terrestrial	Not listed
Chatkai	Bright-green warbler	*Phylloscopus nitidus*	Terrestrial	Not listed
Basha	**common buzzard**	***Buteo***	**Terrestrial**	**Listed on red list**
Basha	Booted eagle	*Hieraaetus pennatus*	Terrestrial	Not listed

Source: TRTA Ornithological Survey, 2018

250. The raising of the water body height will, by default, remove existing perimeter habitat. The ARES survey will specifically offer recommendations regarding the redevelopment of suitable alternative habitat areas upon completion of the dam raise.

Figure 28. Location of Birds Habitats at Dahla Dam



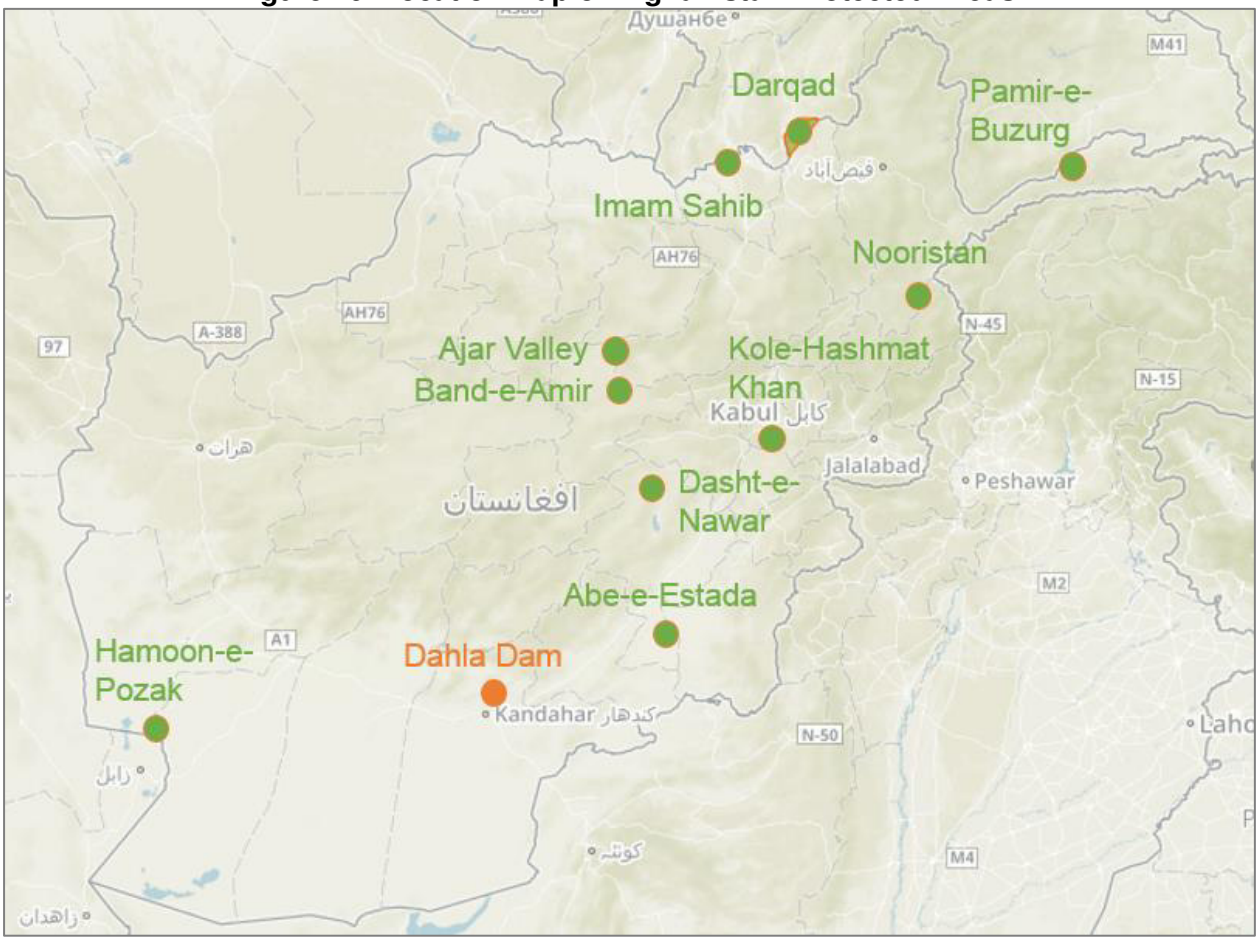
Source: TRTA Ornithological Survey, 2018

3. Nature Conservation Status of the Project Impact Areas

251. There are 10 reported protected areas in Afghanistan. A location map is presented below:[21]

(i) Darqad: wildlife reserve;
(ii) Abe-e-Estada: flamingo and waterfowl sanctuary;
(iii) Ajar Valley: national park;
(iv) Kole Hashmat Khan: waterfowl sanctuary;
(v) Hamoon-e-Pozak: waterfowl sanctuary;
(vi) Pamir-e-Buzurg: national park;
(vii) Dasht-e-Nawar: flamingo and waterfowl sanctuary;
(viii) Imam Sahib: wildlife reserve;
(ix) Nooristan: national park;
(x) Band-e-Amir: national park.

Figure 29. Location Map of Afghanistan Protected Areas



Source: United Nations Environment World Conservation Monitoring Centre, Protected-Planet, 2019

[21] United Nations Environment World Conservation Monitoring Centre, Protected-Planet, 2019

252. No protected areas are in the vicinity of Dahla Dam. This was confirmed by NEPA to the TRTA. The closest protected area to Dahla Dam is Abe-e-Estada, located 200 km North-East of Dahla Dam. Abe-e-Estada is a 270 km^2 flamingo and waterfowl sanctuary.

4. Wetlands

253. The drainage systems in Afghanistan predominantly conclude in endorheic (closed) basins.[22] The Helmand and Arghandab rivers receive their input from rainfall, snowmelt and glaciers, and create lakes and marshes which are important wetland ecosystems. The rivers are a source of water for irrigation, while the lakes raise the humidity in the surrounding areas and reduce the need for irrigation of crops – a much needed saving in arid climatic conditions. The small number of wetlands formed by these rivers support a wide variety of wetland-dependent birds, particularly migratory water birds. Most of the wetlands are used by migratory birds for feeding and resting, while some are used for breeding. It is therefore important that consideration is given to environmental flows for the system.

254. Arghandab River meets Helmand River at Qala I Bust. The Helmand River provides the hamouns (wetlands) with water in Iran after the border. These lakes are one of the main and most valuable aquatic ecosystems in Iran and are registered wetlands in the Ramsar and UNESCO Biosphere Reserve Conventions.[23]

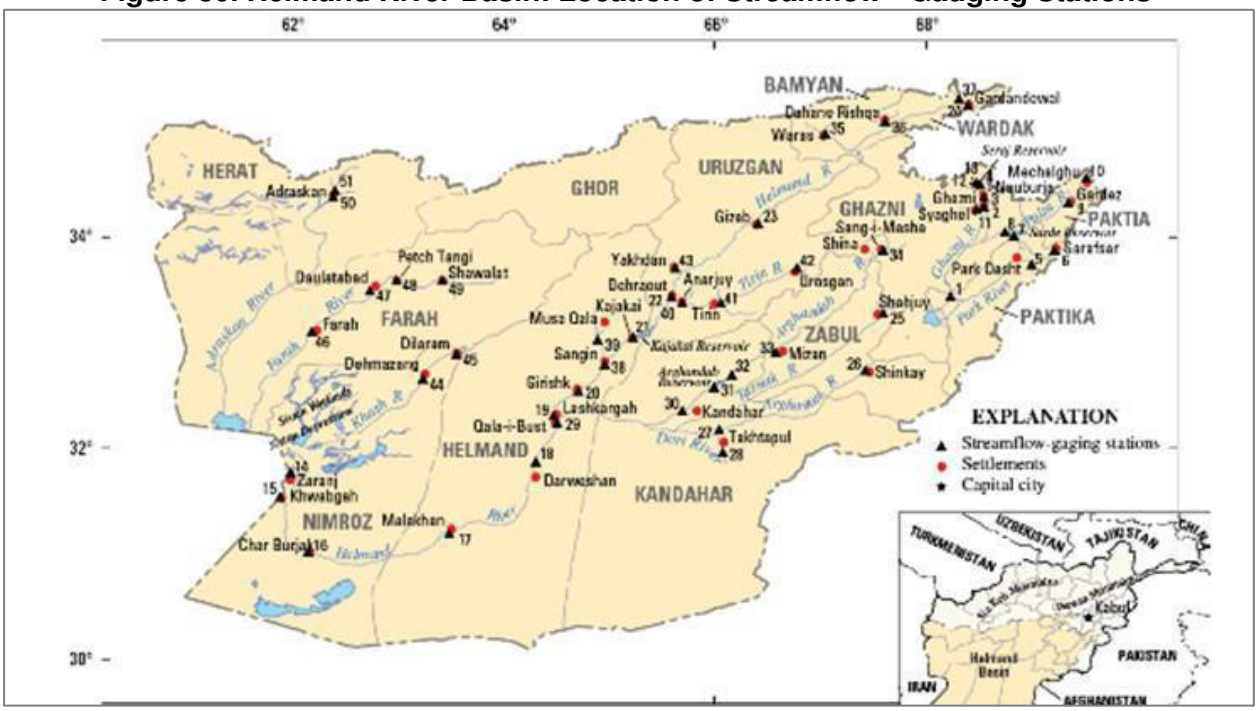
255. The basin is a closed inland delta at the lower end of the Helmand River. It consists of a delta plain (2,500 km^2) and a wetlands system (5,000 km^2). The Helmand River can completely dry up within a series of dry years. The Helmand is the main source for water for these wetlands.

256. High floods are necessary to prevent the lakes from gradually becoming saline, by intermittent flushing the contents into the terminal saline depression of the Goud-e-Zereh. Periodical droughts are needed to 'reset' the system and maintain the dominance of early succession stages of marsh vegetation.

257. Implementation of the transboundary agreement between Afghanistan and Iran has problematic during periods of the civil war. The planned EF for the Arghandab river aims to supply the approximate 17% of flow to the Helmand. At the same time, the CIA for the project will raise the issue of the need to address EF's across the entire basin. If successful, such an initiative can make a very positive contribution to the sustainability of the highly valued and registered wetlands / hamouns in both Afghanistan and Iran.

[22] UNEP. 2003. *Annual Evaluation Report*. Evaluation and Oversight Unit. September 2004.
[23] Delft Hydraulics. 2006. *Integrated Water Resources Management for the Sistan Closed Inland Delta, Iran*.

Figure 30. Helmand River Basin: Location of Streamflow - Gauging Stations



Source: U.S. Agency for International Development, Streamflow Characteristics of Streams in the Helmand Basin, Afghanistan, 2018

Table 16. List of Streamflow Gauging Stations in the Arghandab River Basin

Map number	Afghan ID number	USGS ID number	Station name
25	4-1.21R-7A	323200067280000	Tarnak River near Shahjuy
26	4-1.222R-6A	320000067180000	Lora River near Shinkay
27	4-1.22R-1A	312600065550000	Arghastan River near Kandahar
28	4-1.2L0-5A	3113000065570000	Dori River at Takhtapul
29	4-1.L00-1A	313000064230000	Arghandab River at Qala-i-Bust
30	4-1.L00-3A	313700065340000	Arghandab River near Kandahar
31	4-1.L00-4A	315000065520000	Arghandab River below Arghandab Reservoir
32	4-1.L00-5A	315700066020000	Arghandab River above Arghandab Reservoir
33	4-1.L00-6A	321000066270000	Arghandab River at Mizan
34	4-1.L00-9A	330800067280000	Arghandab River at Sang-i-Masha

Source: Delft Hydraulics. 2006. Integrated Water Resources Management for the Sistan Closed Inland Delta, Iran.

C. Environmental Flows

1. Definition, Models and Benefits

258. An environmental flow is defined as a system for managing the quantity, timing, and quality of water flows below a dam, with the goal of sustaining freshwater and estuarine ecosystems and the human livelihoods that depend upon them. There are numerous environmental flow models which can be applied, and they are determined by:

(i) Existing status of a river; pristine, modified, highly modified;
(ii) A holistic river system assessment including the ability to mimic flow variance related to the spectrum of characteristic ecological conditions (unique biota, aquatic habitat richness, aquatic species diversity, measures of flow regulation and catchment fragmentation, presence of protected areas);
(iii) Consideration of sediment movements and the lateral and longitudinal migration of biota, and;
(iv) Status of catchment, proximity and density of settlement, and livelihood dependence upon river flows.

259. Anticipated benefits of the environmental flow are as follows:

(i) Improve the ecological integrity of the river by replenishing endemic fish habitats below the dam and Kandahar (revitalization of ecomorphological structures of the river like sand and gravel banks);
(ii) Protection of existing river basin ecosystems from negative impacts while protecting critical natural habitats below the dam and in Kandahar according to the US Large Dam Legislation;
(iii) Mitigate the decline of ground water adjacent the river downstream of the dam (and Kandahar) including the upstream part of the irrigation area;
(iv) Supplementing numerous handpumps along the river with water.

2. Considerations

260. Establishing appropriate environmental flows depends on several factors, including hydrological and ecological data availability and the understanding and acceptance of the environmental flows system by the community of users. The civil war and associated insecurity have created challenges for data gathering in the project area, and a compromised plan based upon very old data is inevitable (available flow data is dated from 1950s-1978). However, maps from 2012 provided by the Canadian International Development Agency (CIDA) indicate that the Arghandab River has a natural, almost untouched morphology and numerous 'potential' habitats for ground dwelling birds, waterfowl and rheophilic fish species which could be 'reactivated'. Clear understanding and acceptance of the potential of the overall system by water users requires promoting a shared understanding of ecosystem objectives, along with carefully examining pressures and constraints in reaching these objectives. Where water availability is limited with a high dependency from adjacent settlement, it can be expected that there will be social and political realities which implementing agencies will need to be responsible for. The stakeholders involved should include water users along the river, as well as relevant ministry and agency specialists.

261. In summary, the validity of any water flow predictions and development of prescriptive environmental flow approaches will rely upon engagement of all water users and effective monitoring. Assuming the positive CIDA data regarding sections of the river, there are very positive indicators that environmental flows can have considerable positive impact, supporting the viability of existing habitat and aquatic species. Improved baseline data regarding downstream status collected thru the ARES, will aim to confirm and strengthen the impact of the anticipated environmental flows.

262. Recognition that any river flow will have its limitations is fundamental. The Arghandab River rises in the high-altitude foothills of the Hindu Kush and flows through a predominant arid zone where for some months of the year it may appear to have no flow as surface water dries up. The Arghandab is a tributary of a closed system (Helmand River) which terminates in the

endorheic Sistan basin in neighboring Iran.[24] This basin includes a series of wetlands and lakes, which equilibrate through evaporation. By effectively initiating steps to establish real-time monitoring, TA-9273 AFG can contribute to the long-term sustainability of the river

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3. Contributors and Allocations

263. The combined contributors to environmental flows are: (i) the "spill" from the dam, i.e., water which must be released (almost always through the hydropower turbines) because it cannot be stored, (ii) deliberate releases from the dam, (iii) return flows from irrigation (iv) return flows from urban and peri-urban water supply, i.e., water which returns to the river due to tailwater runoff or soil infiltration, and (iv) seepage from the dam which infiltrates into the aquifer and the river below the dam.

264. Environmental allocations from Dahla Dam should flow down the Arghandab, and be supplemented by seasonal flows from the Arghastan, Tarnak and Dori rivers which join the Arghandab at Doad. In many irrigated areas, groundwater pumping has been increasing in volume, with the consequence that the water table has fallen, reported to be as much as 180 m in some areas. Thus, some environmental flows will in practice go towards shallow aquifer replenishment, although this is dependent upon soil profiles and percolation rates. A potentially profound anomaly to the impact and efficiency of any environmental flow is that where no overarching system of management prevails, flows classed as environmental in the Arghandab may be abstracted by farmers further downstream on the Helmand River.

4. Management of Environmental Flows

265. A preliminary-pilot or benchmark environmental flow proposal is recommended as a starting point. This has been calculated as 254 million m^3 for an average year. This flow provides enough water for water supply, irrigation and hydropower development and will mimic the average monthly and annual discharges in the Arghandab. Additionally, these flows will also voluntarily percolate and accede to what has been identified as diminishing and falling groundwater table due to pumping for irrigation.

266. Environmental flows have been calculated for dry year (0%), average year (50%), and wet year (100%). Currently it is unknown whether any prescribed environmental flow will reach Qala-I-Bust where Arghandab River meets the Helmand River. The proposed environmental flow will provide the upper Arghandab River with water (area of 13 weirs below the dam and some kilometers below the last weir no 13).

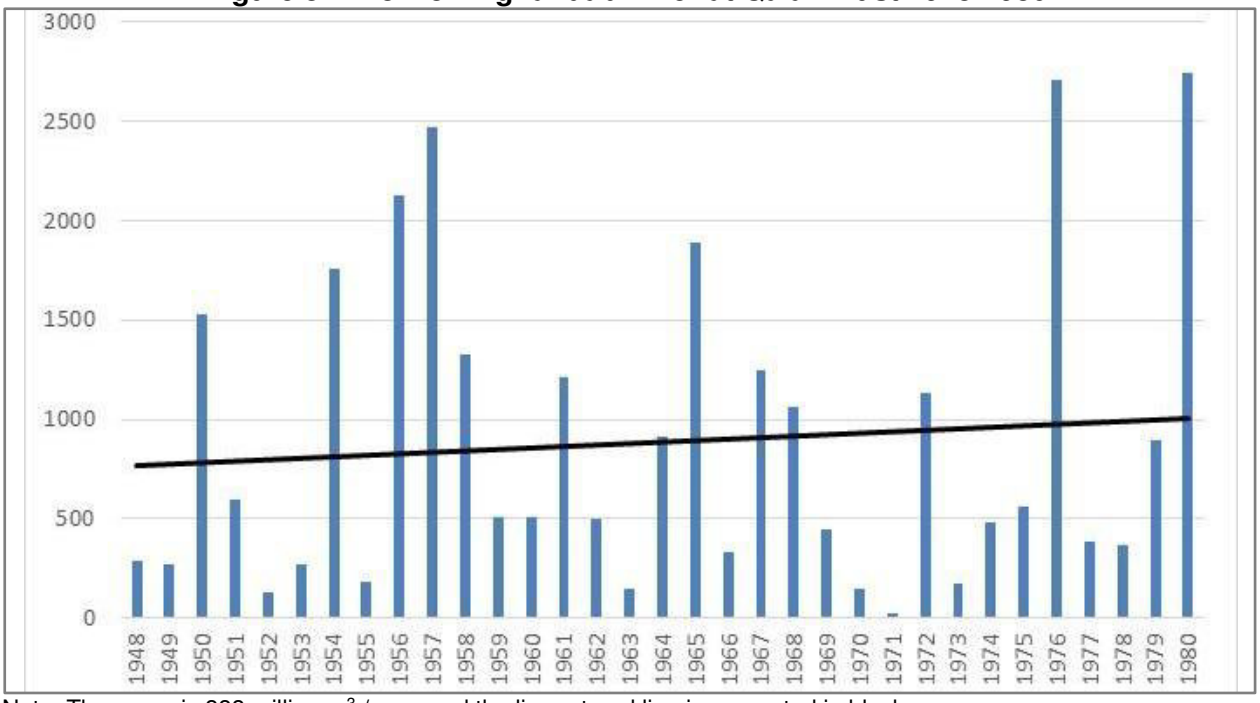
267. **Dry year.** In dry years, the water in the reservoir will be used only for urban and industrial water supply. The river will fall dry completely in summer and autumn. Almost no environmental flow will be released from the dam, which is the same process that would occur naturally. The ecosystem is adapted to droughts even when the whole river falls dry. Low annual flow has been reported in 1952, 1963 and 1971. Endemic fish species *Clupisoma Naziri* (common name: Sheer mahi, catfish) and *Salmo trutta oxenesus* (common name: Khaldar Mahi, trout) will migrate upstream if the water level will drop continuously. *Schizocypris altidorsalis* is a benthopelagic fish species that has been reported from pools in dry river beds in Afghanistan and Iran, and this fish returns to more permanent rivers when water levels drop.

[24] An endorheic basin is a closed drainage basin that retains water and allows no outflow to other external bodies of water, such as rivers or oceans, but converges instead into lakes or swamps, permanent or seasonal, that equilibrate through evaporation.

268. In drier years, when irrigation water is limited, it is unlikely that communities will allow the water to pass their offtakes, particularly if their crops are thirsty. Therefore, to avoid over-exploitation of this dedicated environmental surface water, it is imperative that all water users are involved and informed concerning the purpose behind the environmental flows.

269. **Average year.** Flow data shows an average annual flow of 888 million m^3 of Arghandab River at Qala-i-Bust where the Arghandab River meets the Helmand River (time series: 1948–1980). The flow shows a slight increase over the years (linear trend line in Figure below), probably due to the construction of the dam in 1952.

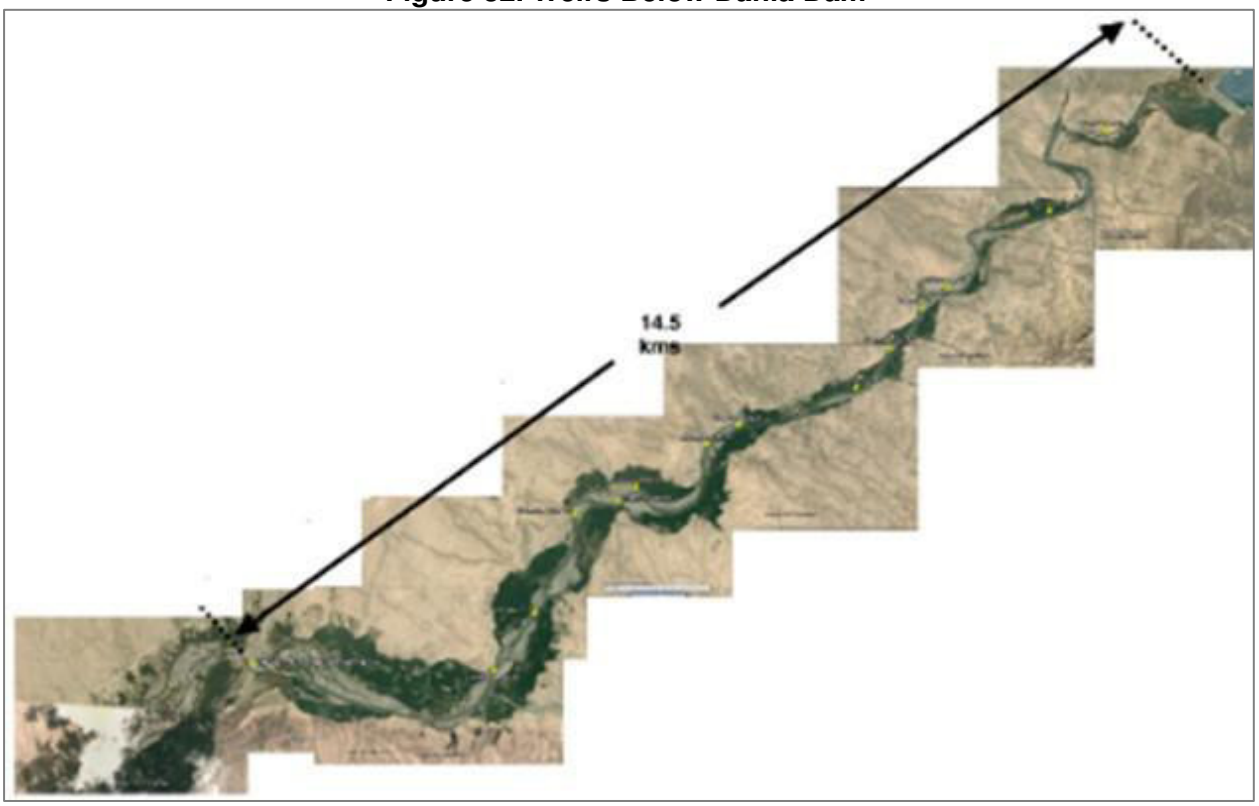
Figure 31. Flow of Arghandab River at Qala-I-Bust 1948-1980



Note: The mean is 888 million m^3 / year and the linear trend line is presented in black.
Source: MEW 2018 and TRTA Consultants, 2018

270. Unfortunately, current flow data are not available. The proposed environmental flow will provide the river with water below the beginning of the main channel (weir no 13). The river will get additional water from irrigation and water supply via drainage canals and groundwater during the irrigation season. Drainage will increase due to increased irrigation water use. Raising of the dam will improve the existing situation for the average year. Currently, a high proportion of the spring flood runs over the spillway and is thus not available for the dry season.

Figure 32. Weirs Below Dahla Dam



Source: ASBA Kandahar and TRTA Consultants, 2018

271. **Wet year**. When flows are expected to exceed the capacity of the dam over the early spring period, environmental releases can commence in early to mid-winter and river flow can be expected almost throughout the year.

272. A review of the Arghandab/Helmand on Google Earth at moderately high resolution has not identified any wetlands between Kandahar and Shila-i-Chark. This situation, combined with the lack of regular summer to winter flow at Qala-i-Bust, suggests that the environmental contribution from Dahla to the Arghandab is mainly beneficial to existing habitats in the river bed (e.g. spawning and feeding habitats) and to those settlements/communities which exist along the river for water supply for people and livestock, recreation, and for groundwater recharge.

273. Maps of Arghandab River produced by CIDA[25] indicate that in some sections, the river itself has a natural, almost untouched morphology with numerous potential habitats for ground nesting birds, water fowl and rheophile fish species. It is anticipated that these habitats in particular will benefit from environmental flows. To be successful, the proposed flows need to be activated as far as is possible in coordination with the water demand for irrigation, urban and rural water supply and the hydropower development.

Table 17. Environmental Flow Releases in Addition to Spills

%		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3
Hamal	**Apr**	16,0	20,0	27,5	35,0	42,5	50,0	52,5	55,0	57,5	60,0	66,0
Sawr	**May**	9,6	12,0	16,5	21,0	25,5	30,0	32,5	35,0	37,5	40,0	44,0
Jawzā	**Jun**	9,6	12,0	12,0	12,0	12,0	12,0	16,5	21,0	25,5	30,0	33,0

[25] Cartographic Atlas command area land use, 2012

Saratān	**Jul**	0	0	0	12,0	12,0	12,0	15,0	18,0	21,0	24,0	26,4
Asad	**Aug**	0	0	0	11,0	11,5	12,0	15,0	18,0	21,0	24,0	26,4
Sonbol a	**Sep**	0	0	0	10,0	11,0	12,0	15,0	18,0	21,0	24,0	26,4
Mizān	**Oct**	0	0	0	9,0	10,5	12,0	15,0	18,0	21,0	24,0	26,4
Aqrab	**Nov**	0	0	0	9,0	10,5	12,0	15,0	18,0	21,0	24,0	26,4
Qaws	**Dec**	0	0	0	9,0	10,5	12,0	15,0	18,0	21,0	24,0	26,4
Jadi	**Jan**	6,4	8,0	11,0	14,0	17,0	20,0	21,0	22,0	23,0	24,0	26,4
Dalvæ	**Feb**	9,6	12,0	16,5	21,0	25,5	30,0	32,5	35,0	37,5	40,0	44,0
Hūt	**Mar**	16,0	20,0	25,0	30,0	35,0	40,0	47,5	55,0	62,5	70,0	77,0
Year		**67,2**	**84,0**	**108,5**	**193,0**	**223,5**	**254,0**	**292,5**	**331,0**	**369,5**	**408,0**	**448,8**
% of inflow		**17%**	**18%**	**17%**	**24%**	**22%**	**22%**	**20%**	**19%**	**18%**	**18%**	**18%**

Source: ASBA and TRTA Consultants, 2018

274. While the environmental flows in spring in a moderate to extreme wet year will be substantial, there will be issues relating to such flows in dryer years. Kandahar farmers have a tradition of abstracting high to maximum volumes for their crops, almost regardless of downstream demand. It will therefore be difficult to persuade *mirabs* and farmers to allow water to flow down the river when they need water for their crops.

275. It is recommended that *mirabs* and farmers have the environmental flow needs fully explained to them, and that their actions in the first two or three years after project completion are monitored closely. The approach to environmental management and water releases will then be reassessed if necessary.

276. In principle it is suggested that the proposed environmental flows are added to the irrigation releases planned for a given month, and also added to the 60% of flow that passes downstream at the diversion to the Main South Canal. A proposed gauge on the Arghandab just above the Arghastan junction will be installed and will measure the flow reaching the lower Arghandab. If this is successful, environmental flow in summer can be continued. If not, it may be necessary to curtail them or revise the approach.

277. Dry to wet season environmental flows can be improved after raising of the dam due to its higher storage capacity. While significant degradation of existing critical habitats is not expected, the anticipate environmental flows will provide conditions for an increase in the viability of the riparian ecological system. However, to be successful this will require collaboration with downstream water user associations.

278. As a ballpark figure, the intention of the environmental flow must be that the Arghandab and tributaries contribute about the same proportion of Helmand flow as in the past or around 17%.[26] The raising of the dam wall will allow for a water holding capacity increase to approximately 782 million m^3. The added capacity is 500 million m^3 which is approximately equivalent to the holding when the dam was built in 1952, and a bit more. Average annual inflows are about 1,400 million m^3. Inflows of up to 2,800 million m^3 (called wet year flows) or more are typical once every 10 years. These inflows are the result of high and quick snow melt along the Hindukush and it can be expected that there will be significant outflows from spillways during such events. The raising of the dam wall cannot capture the magnitude of all the snow melt. While greater water will be immediately available, it is recommended that the issue of appropriate environmental flows be established over time.

[26] Delft Hydraulics. 2006. *Integrated Water Resources Management for the Sistan Closed Inland Delta, Iran*.

5. Limitations and Future Studies

279. The recommended preliminary-pilot or benchmark environmental flow of 254 million m^3 is a rough estimate and a starting point.[27] From this estimate, flow measurements could be carried out at existing water gauging stations monthly over a period of one year to monitor the availability of water in the river and clarify how much water can reach different sections and habitats of the river (Dahla Dam to Qala-I-Bust). Assessment can subsequently be made as to the adequacy of this flow. It is important to note that the pilot flow is not anticipated to be available every year.

280. It is recommended to conduct additional studies during the detailed design stage, and that this work be seen as a capacity building initiative for NEPA. As part of the recommended detailed Arghandab River Environmental Study (ARES), **hydraulic calculations** on Dahla Dam and the Arghandab River shall be conducted to clarify how much water will reach different sections and habitats of the river (Dahla Dam to Qala-I-Bust) and to show whether this flow is providing sufficient water to sustain riparian vegetation and aquatic life including fish and waterfowl throughout the year. The ARES Terms of Reference are in Appendix 7.

281. Assembling real-time datasets across the catchment and downstream using remote stations is considered to be an important step in refining a workable and responsive approach to environmental flows. It is recommended that the detailed design shall define the number and location of monitoring units to log with greater accuracy the needs over time during dam operation. Rehabilitation of water gauging stations will be required in advance. If rehabilitation cannot be completed, temporary measurements will be required at these locations (e.g. use of Ott SLD – side-looking doppler sensor). Procurement of mobile measuring devices would be required.

282. With the benefit of more comprehensive datasets, an **Environmental Flow Management Plan** will be developed during detailed design stage.

6. Environmental Flow Monitoring During Dam Operation

283. During the dam operation, long-term monitoring and recording in an ongoing manner is recommended. Appropriate environmental flow could be identified by (i) maintaining a record of what has voluntarily gone across the spillway - annual melt-down flooding (if any), added to (ii) flows from hydro and (iii) monitored along the downstream course of the river. Calculation of what is possible to make up any deficit each year given the compounding set of circumstance would follow. This model could deliver scenarios where a range of 4-8 years out of 10 years may see no environmental flows at all - assuming that dry conditions prevail in the mountains. It is this year-by-year range combined with the limitations in the dam which will ultimately determine the environmental flows that are possible.

284. Based on the collected data, the assessment shall include: (i) combining real-time spring time data from the Hindu Kush (detailing temperature, commencement and time interval of snow melt), with (ii) existing water held in the dam post-construction, along with (iii) downstream

[27] As outline in the introduction of this section, the variables in assessment of appropriate environmental flows in the project area present a challenge. The Arghandab River is an ephemeral system in an arid zone where increasing demands have been made on adjacent groundwater resources with the result of levels dropping dramatically in parts. The increasing demands upon the river combined with the anticipated uncharacteristic weather events and more rapid spring meltdown associated with climate change all contribute to change the potential dynamics of the river. In some areas, flows to the river can be expected to percolate to depleted groundwater levels, compromising the immediate utilization of the flows.

deficits at various nodal points to identify what flows have occurred and whether these will adequately support environmental flow requirements.

285. The results of the assessment will also help to identify: (i) how the rise in the dam can improve the contribution to water availability for the Helmand River given the arid / ephemeral characteristics of the river; (ii) the contribution and limitations required for a Helmand Basin wide response; (iii) how improved seasonal management of the flow can improve availability of environmental flows and identify a series of nodal points which could be used as indicators; (iv) how various datasets can be used to mimic and support wet/dry year phenomena through deployment of stand-alone, real-time measurement stations; and (v) how any shortfalls can be mitigated against.

7. Transboundary Water

Figure 33. Iranian Hamouns on the Border to Afghanistan

Source: Delft Hydraulics. 2006. Integrated Water Resources Management for the Sistan Closed Inland Delta, Iran.

286. Of significance to this EIA is that there is an international agreement between Iran and Afghanistan concerning the cross-border flows of the Helmand River system. According to the 1973 Treaty, Afghanistan is committed to sharing the water from Helmand River with Iran and supply it with 26 m^3 of water per second or 850 million m^3 per annum. The key questions is of timing and whether steady flows are required or whether obligations are based on minimum annual transfer. The answer to this will be based upon real-time monitoring.

287. The Arghandab River contributes about 17% of the annual discharge of Helmand River according to 2006 Delft Hydraulics study.[28] According to this study and table below, a contribution of approximately 1,000 million m^3/year is required on average to keep the sensitive ecosystem of the Iranian Hamouns (wetlands) alive.

[28] Delft Hydraulics. 2006. Integrated Water Resources Management for the Sistan Closed Inland Delta, Iran.

Table 18. Monthly and Annual Discharges in Helmand, Arghandab, Khash, Farah Rivers (million m^3)

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug	Sep	Annual	Period
Helmand at Kajaki	185	221	229	252	287	818	1509	1335	546	257	158	**5947**	**1947-71**
Arghandab at Qala-i-Bust	7	13	48	54	98	145	286	162	39	56	10	**924**	**1948-65**
Helmand at Char Burjak	165	174	258	311	409	604	1187	1348	570	290	207	**5692**	**1947-71**
Farah at Farah	2	3	18	67	237	426	519	173	54	16	3	**1519**	**1953-65**
Khash at Dilram	1	7	12	18	44	144	157	49	12	4	2	**451**	**1953-65**
Helmand at Kajaki	188	226	250	271	297	894	1648	1439	587	291	175	**6429**	**1953-65**
Arghandab at Qala-i-Bust	10	18	67	67	115	142	314	184	49	77	14	**1065**	**1953-65**
Helmand at Char Burjak	217	229	354	380	479	562	1216	1408	656	377	286	**6393**	**1953-65**

Source: Delft Hydraulics. 2006. Integrated Water Resources Management for the Sistan Closed Inland Delta, Iran.

288. The time series which Delft Hydraulics used refers to different periods, none of which are up to date (1947–1971; 1948–1965; 1953–1965). MEW flow measurements show an annual contribution of 888 million m^3 from the Arghandab River according to a time series during 1949–1980.

289. The total allocation to the Hamoons as per the 1973 Helmand Water Treaty is an average of 24m^3/s or an annual volume of about 760 million m^3. There are difficulties with the treaty, for a variety of reasons, including the natural ephemeral nature of the Arghandab River which naturally would experience years with no flow at all.

D. Socio-Cultural Environment

1. History

290. The history of the region before the coming of Islam (600-800s CE) is demarcated by the Persian Achaemenids (6th-4th century BCE), Alexander and the Greeks (4th century BCE), Asoka and Buddhism (3rd century BCE), Kanishka and the Kushans (1st century CE), the Persian Sasanians (100-600s CE), and the Iranian Huns (300-800s CE). Islamic civilization initially flourished under the Ghaznavids (900-1100s) and the Ghurids (1100-1200s) but this era ended with the Mongol invasion (1200s). The opening of the new maritime trade route between Europe and the East Indies in the 1500s sent Afghanistan and all other areas along the traditional overland silk route into economic and cultural decline. During the latter half of the 1700s, Ahmad Shah Durrani liberated the area between the Hindu Kush and the Amu Darya from Persian and Indian influence, thereby creating modern Afghanistan.

291. Modern water management was introduced to Afghanistan in the mid-20th century. Under the monarchy (1919-1973), irrigation management was significantly improved, individuals were allocated water rights, the Law on Irrigation (Qanun-i-Abyari) was published, and provincial Departments of Irrigation (Riyasat-i-Abyari) were established.[29]

[29] SMEC. 2008. "Balkh River Basin Management Plan. Report of Balkh River Integrated Water Resources Management Project". *ADB TA JFPR 9060-AFG.* Pp. 25.

292. During two decades of war from 1979 to 2001, irrigation systems and water supply fell into disrepair, and traditional community-based water management declined. Since then the government, with support of the donor community, has begun to rehabilitate and upgrade irrigation and water supply systems, and to restore community-based water management.

2. Ethnicity

293. Afghanistan is a multi-ethnic society. It consists of Pashtuns, Tajiks, Uzbeks, Hazaras, Turkmen, Pashais, Balochis, Khirgyz, Aimaqs, and others. There are also a few thousand Afghans of Indian origin.

294. Pashtun is the dominant ethnic group in Kandahar province. Farsi speaking citizens and citizens of Indian origin are also living there.

295. The religion of the majority of the Afghan population is the Sunni branch of Islam (approximately 84%). This is followed by Shia branch of Islam, approximately 15% in the country. There are also followers of other religions including Hinduism, Sikhism, etc., estimated as 1% of the total population.[30]

3. Infrastructure

296. Kandahar International Airport serves as southern Afghanistan's main airport for domestic and international flights. It is also used as a major military base as well as shipping and receiving of supplies for the NATO armies. Most international flights connect with Dubai, Germany, Turkey, Saudi Arabia, and Pakistan.

297. Kandahar is connected to Kabul by the Kabul-Kandahar Highway and to Herat by the Kandahar-Herat Highway.

4. Education

298. There were 303 schools and one University in Kandahar Province in 2003. The following table shows types of schools and number of pupils and students. Current data was not available.

Table 19. Type of School and Number of Pupils, Students, and Teachers

School		Students / Pupils		Teachers	
Type	**Number**	**Sex**	**Number**	**Sex**	**Number**
Primary	220	Female	24,000	Female	425
Secondary	51	Male	161,000	Male	2,433
High School	32				
Total	**303**	**Total**	**185,000**	**Total**	**2,858**

Source: Department of Education, Kandahar Province

299. Kandahar University, which was established in 1992, has faculties of agriculture, engineering and medicine. The Faculty of Agriculture has departments of Agronomy, Soil Science, Horticulture, Forestry, and Biology.

[30] JICA. 2004. The study on urgent rehabilitation support program of agriculture in Kandahar, Afghanistan.

5. Health

300. Only 39% of the population in Kandahar province has access to health facilities. Only 6% of the female population has skilled birth attendance coverage. 37% of the population has access to safe drinking water. Table 8 shows trend and history of health facilities' establishment in Kandahar.

Table 20. Health Establishments in Kandahar Province

Type	2004	2005	2006	2007	2008	2009	2010	2011	2012
Regional hospital	1	1	1	1	1	1	1	1	1
Provincial hospital	0	0	0	0	0	0	0	0	0
District hospital	5	2	2	1	1	1	1	1	1
Comprehensive health center	15	19	18	17	16	17	17	24	24
Basic health center	19	22	21	16	15	16	18	21	21
Sub health center	0	0	0	0	0	2	2	2	2
Mobile health center	0	0	0	0	0	2	3	2	3

Source: MoPH HMIS Department, Situational Analysis of Provincial Health Services.
Mhttp://moph.gov.af/Content/files/HMIS%20Provincial%20Profile%201391%20(English%20Version).pdf

6. Agriculture, Livestock and Fishery

301. Before 1992, or the start of the civil war, there were 31 agricultural and one livestock cooperative in Kandahar Province. These cooperatives were getting assistance from the government, NGOs, and international organizations. 17 cooperatives have been established in 2002 / 2003 with 2,300 members.[31]

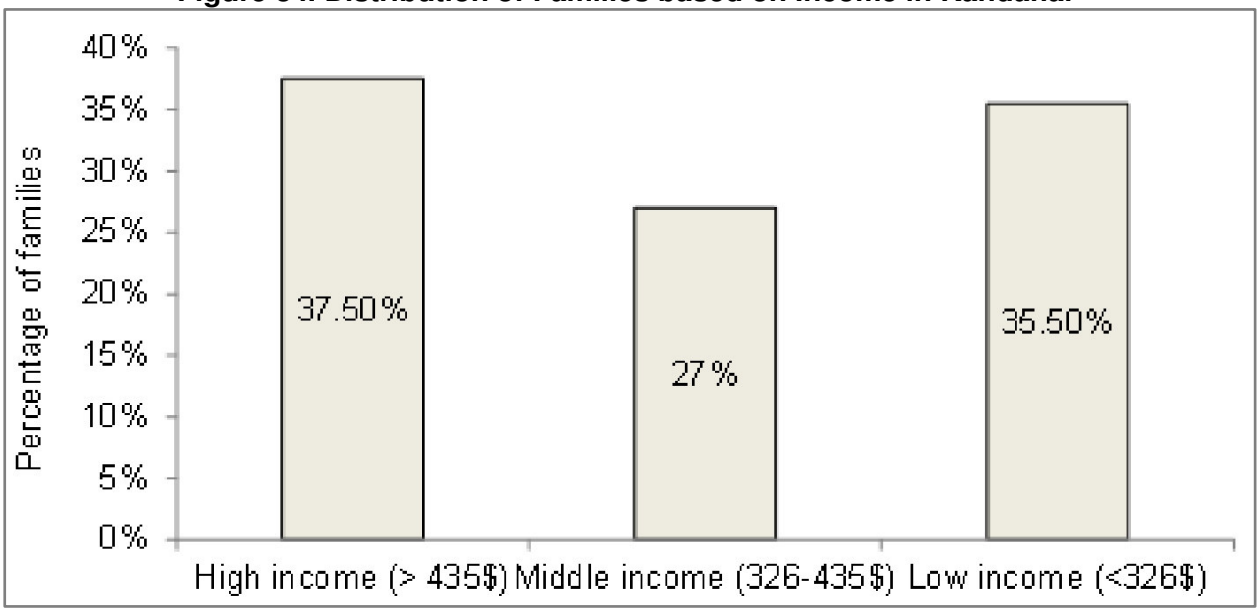
302. Fish caught in the dam are an additional source of income and food.[32] The following fish species are caught using fishing nets: Sheer mahi *(Clupisoma Naziri),* Common carp *(Cyprinus carpio)* and Mola Carplet *(Amblypharyngodon mola).*

7. Monthly Income and Economic Status

303. The national average poverty line is 1242 Afghani (AFN), i.e. ($27) per person per month and the per-capita expenditure is 920 AFN ($20).[33] Survey data from 2012 shows that about 35% of families living in Kandahar are categorized as low income (<$326/month).

[31] Directorate of cooperatives. *Department of Agriculture and animal husbandry of Kandahar.*
[32] Verbal communication, ASBA Kandahar
[33] European Union. 2009. *National risk and vulnerability assessment 2007/2008: A profile of Afghanistan.*

Figure 34. Distribution of Families based on Income in Kandahar



Sources: Consumption and Associated Factors in Kandahar City, Afghanistan. 2017. *Resources and Environment* 7(2). pp. 49-61. Distribution of Families Based on Income in Kandahar.

304. The main source of income in the study area is farming. The other key source of income includes carpentry, tailoring, and mechanics. The estimated level of income in 2004 is shown in the following table.

Table 21. Occupation and Income in the Study Area (2004)

Occupation	**Average Income/Day** (AFN)	**Monthly Income** (AFN)	**Monthly Income** (US$)
Mason	200 (4.0US$)	4,000 – 5,000	80 – 100
Tailor	140 (2.8US$)	1,200 – 3,000	24 – 60
Embroidery (women)	100 (2.0US$)	1,200 – 1,800	24 – 36
Carpenter	200 (4.0US$)	4,000 – 5,000	80 – 100
Mechanic	150 (3.0US$)	2,500 – 7,500	50 – 150

Source: JICA. 2004.The study on urgent rehabilitation support program of agriculture in Kandahar, Afghanistan – 50Afs = 1US$

305. There are three main sources of labor within villages: non-skilled labor (general agricultural labor and harvesting of grapes and wheat), semi-skilled labor (the pruning of grapevines) and non-farm work in skilled labor such as masonry and construction. The first two sources could be seen as off-farm work. According to data from 2017, the wages are in the range of US$120–150 per month, US$210 per month and US$240 - 420 per month respectively.[34]

306. In October 2018, a baseline socio-economic survey was carried out in the district of Shah Wali Kot on a sample of households selected by income group. Socio-economic data was gathered through interviews with households and focus group discussions were held with key representatives. In addition, qualitative assessments on poverty, social and gender issues were conducted using qualitative survey tools. A further socio-economic survey on 25% of the households affected by the expansion of the reservoir area is being carried out and the results will be integrated after finalization of the report.

[34] Minoia G. & Pain A. 2017. *Understanding rural markets in Afghanistan*. Working paper 58.

8. Settlement issues adjacent the dam

307. The number of households and people directly affected by the raise of the dam wall, and the resettlement and compensation processes detailed for them is to be found in the LARF. However, from the EIA perspective, there are a number of issues that are relevant regarding settlement adjacent and upstream of the dam. For a successful development and implementation of the anticipated “source protection” plan it will be necessary to change the current ways in which communities use and manage the land. An emphasis upon improved management of human waste at the household level, active stewardship of faunal habitat and revegetation areas, implementation of a long-term catchment management plan including greater care of free-range grazing, fuel wood collection and the overarching associated revegetation and bio-engineering initiatives which are envisaged for these areas will require active participation and ownership by the communities. It is recommended that the village Mirabs play an important role in the development and implementation of these initiatives.

VII. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Methodology for Environmental Impact Assessment

Scoping

308. Before formally initiating the study, the EIA team carried out internal scoping of the assignment, in consultation with the design team. The scoping aimed to avoid duplication of effort by using the information and knowledge base already available within the design consortium. The scoping exercise included the following steps:

309. **Desk review**. The desk review compiled and reviewed all the known secondary and primary references. Data obtained from these sources was utilized extensively to establish data gaps in the preparation of this EIA report and for the purpose of preliminary design. Secondary research utilized the considerable body of work which has been produced by agencies regarding previous proposals to upgrade the Dahla Dam, including the now defunct Canadian CIDA investigations and partial implementation / rehabilitation of both the Dahla Dam and irrigation network, and the DFID funded Helmand River Basin Master-Plan, a three-year study which specifically included the Arghandab river as a tributary. Simultaneously, the EIA team was drawing up the need to validate this information during its field surveys.

310. **Collaboration session**. The EIA team held meetings and discussions with design team colleagues. This meeting was geared towards introducing all team members with each other and bringing uniformity of expectations amongst all.

311. **Reconnaissance surveys**. Two brief reconnaissance surveys of the project area was conducted from during 2018. The TRTA team conducted visits to Dahla Dam in January–February by dam engineers and in July 2018 by environmental specialists. These site visits provided the TRTA team with valuable familiarization of physical site characteristics and condition and a first-hand opportunity to collect data. Further, the following surveys were conducted: (i) bathymetric survey to assess topography of bottom of Dahla Dam reservoir and estimate reservoir volume capacity in May 2018; topographic survey to refine reservoir volume capacity from September to December 2018; geotechnical survey to conduct sample tests on main dam, saddle dam 6, and borrow areas during September and October 2018; environmental ornithological and fish surveys in the Dahla reservoir area in November 2018; and environmental surveys to assess air quality (reservoir area, current highway) and water quality (reservoir, canal downstream and Kandahar groundwater wells). Subsequent to the site-based data-gathering work, the TRTA team consulted and collaborated with relevant government agencies including implementation agencies in Kandahar and Kabul. Additionally, a Kandahar based TRTA coordinator has been providing information as required.

312. Although brief, these activities were aimed at achieving a common understanding on various issues of the EIA study. This included observing and determining the areas covered under the Project Area of Influence (AOI) as per the ADB Environmental Safeguards Good Practice Sourcebook (Dec 2012). This area of influence may span:

(i) **Primary project site and ancillary facility sites** that will be developed, operated or managed by the client or its contractors. Examples of ancillary facilities include access roads, borrow pits, spoil disposal areas, pipelines, canals, tunnels, depots and construction camps.
(ii) **Associated facilities not funded by the project** but whose existence and viability are entirely dependent on the project and whose services are essential to project operation.
(iii) **Areas and communities potentially affected by cumulative impacts** from further planned development of the project, other sources of similar impacts in the geographical area, any existing project or condition, and other project-related developments that are realistically defined at the time the assessment is undertaken.
(iv) **Area and communities potentially affected by induced impacts** from unplanned but predictable developments or activities caused by the project, which may occur later or at a different location.

313. During these field visits, team members were able observe existing environmental conditions. The visits also helped in verifying various pieces of information available in the secondary sources.

314. The AOI was divided into several specific sub-areas. The following are the main parts of the AOI:

(i) Construction Site: including the water-body of the dam, the spillway, and canal;
(ii) Additional structures and immediate surroundings: (ie Re-use of previous construction camp, potential borrow pits and disposal areas, etc.);
(iii) Affected Structures: To identify if there were any structures that could be physically affected as a result of project construction;
(iv) Project Footprint: this is the area directly related to Dam, Dykes, Spillways, Reservoir and Canal Right of Way (ROW), Canal, Outlets, command area etc.;
(v) Surrounding settlement adjacent the footprint: familiarization with proximity of settlement and associated livelihoods and land use.
(vi) Status of upstream catchment: some familiarization with the issues related to catchment management, particularly relevant to the sedimentation rates.

315. **Collaborative meetings with partners and government agencies**. During the reconnaissance survey the team had very positive meetings with the key partners at the provincial level, including community representatives. These meetings were then followed up with reciprocating meetings with partners in Kabul.

316. **Drafting and identification of data gaps**. Following clarification and greater understanding which resulted from the reconnaissance survey, data gaps were established, the TOR for ARES was assembled, and the draft EIA was commenced by the consulting team.

317. A dedicated field TRTA team mission is scheduled for the summer of 2019 to conduct a part of the ARES and improve baseline data needs, specifically focused upon a more detailed environmental survey. This survey will ensure that all baseline data has been assembled and assessed to assist with the detailed design phase (e.g. detail on soils, water qualities, relevant seismic activity, appropriate flora and fauna detail including seasonality across the broader footprint beyond the existing dam), habitat for flora and fauna, details on revegetation. In addition, this survey will investigate the mechanics of instituting the two-tiered environmental flow concepts put forward in EIA.

318. **Potential impacts associated with the project**. The field visits identified potential impacts associated with the project in a range of categories, including physical, biological and socio-economic (such as occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods). The methodology adopted to analyze and assess both positive and negative impacts included utilization primary and secondary research methods. While assessment of the Dahla Dam aims to focus upon the actual footprint of construction, the function of the dam including the surface water flow through the catchment and subsequent flow beyond the dam wall is also given appropriate consideration. Presentation of the impacts has been categorized for (i) detailed design, (ii) construction, and (iii) operation, using a risk-based approach that offers impact significance with a rating.

319. Impacts identified and assessed in this section relate to the:

(i) Dahla Dam reservoir;
(ii) Upstream section of the Arghandab River above Dahla Dam;
(iii) Spillway channel from Dahla Dam;
(iv) Downstream stretch of the river below the dam;
(v) Construction lands and access roads.

320. Dahla Dam was constructed in 1952 to store 478 million m^3 of water mainly for irrigation and flood control purposes. During 66 years of dam operation, the Arghandab reservoir has lost about 40% of water storage due to sedimentation and is currently estimated to store about 288 million m^3 of water at full supply level of 1,135.4 m (WGS84 elevation).

321. The current proposal to raise the dam wall comes about after years of previous efforts by both the United States and Canadian government supported programs. Design needs to recognize the considerable on-site challenges which have both gone before and continue. This particularly includes the critical issue of upholding high standards of management during construction, implementation and longer-term infrastructure maintenance. To be successful, this EIA emphasizes that any initiatives require strong and vigorous ownership at the local community level. The positive impacts that the proposed construction can make on the health of the downstream river system, along with improvements in quality of life need to be in clear focus and balanced against at times high-risk environment from the security perspective.

B. Impacts During Detailed Design

322. **Source Protection:** Source protection is a very important issue to facilitate sustainable water quality of the reservoir in the long run, and the detailed design stage should incorporate appropriate planning for the implementation of same. Unfortunately, no Afghan law is currently available for the definition of protection zones. The EU Water Framework Directive (EU 2000/60) requires protection zones for drinking water abstraction areas without any detailed specifications. The German Water Law (WHG § 51 and § 52) defines three water protection zones. Land use of these zones accepted under this law is site specific and depends on the existing groundwater and soil conditions (soil cover and permeability for water endangering substances).

323. Three water protection zones can be established to protect Dahla Dam and to prevent eutrophication (pollution of the dam with dissolved nutrients): (i) zone 1 is the dam itself; (ii) zone 2 is the area where groundwater needs at least 50 days to reach the source in order to prevent bacterial contamination; and (iii) zone 3 is the whole catchment of the source. Identification of zone 2 would need an additional hydrological survey at each site. Since this

survey is not feasible under the TRTA, only two zones are suggested for an initial introduction of source protection. A water protection ordinance has to be developed by competent authorities (NEPA and MEW) for the reservoir according, but not limited, to the suggestions in Table 22.

Table 22. Establishment of Two Water Protection Zones at Dahla Dam

Issue	Zone 1	Zone 2
Spatial definition	Reservoir + 500 m	Whole catchment of the reservoir and Arghandab River upstream of Dahla Dam
When	Signing	Signing
Establishment of limitations	- no industry (e.g. chemical industry) - no settlement or laundry activity - no use of fertilizers and chemicals (e.g. pesticides) - no grave yards in the vicinity - no uncontrolled infiltration of human excrement - no waste dumps or waste disposal sites - no car repair shops and no car washing	Only supervised car repair shops Supervised storage of water endangering substances
Restrictions or prohibitions	No military training, no excavations in the vicinity of zone 1 No storage of water endangering substances	Settlements upstream of the source to be equipped with water tight cesspits in the long run

Source: TRTA Consultants, 2018

324. The reservoir will be used for water supply of Kandahar City and villages. Therefore, the reservoir must be protected against pollution:

(i) Human excrement of upstream settlements has to be collected in cesspits to prevent contamination of the river and the reservoir;
(ii) No washing of clothes in the river and in the reservoir;
(iii) No littering of the reservoir and the upstream river reaches with waste and hazardous substances;
(iv) Installation of cesspits in the upstream villages.

325. To adequately perform their function, cesspits need to be emptied regularly and the sludge needs to be disposed of in an appropriate manner. To raise the importance of this, a public awareness campaign is needed.

326. The importance of protecting water sources cannot be emphasized enough. Consideration should be given to recruiting the involvement of *mirabs* in an overall program of water protection, and they could assist in raising violations against citizens who offend.

327. Any storage of hazardous substances and fuel adjacent water source should require permission and environmental requirements of the competent authorities (e.g. NEPA) within the catchment of the reservoir. The storage of these substances needs to be supervised by competent authorities. Hazardous substances and fuel have to be stored in double walled tanks or in collection trays. Gas stations have to be equipped with sealed surface, sand trap and fuel separators. Annual technical supervision of storage tanks by an authorized company is mandatory.

328. Eutrophication and algal bloom are not expected if water protection measures are implemented.

329. **Historical and Cultural Artefacts**. An initial inspection of the site to identify any historical and cultural artefacts is of critical importance. Along with this is the need to map out procedures to follow should any construction work unearth similar. Unfortunately, there are negligible "as-built drawing information" of the existing dam wall. This situation requires the detailed design team to carry out additional site geotechnical investigation and make calculated assumptions on the findings of those investigations. The remedial works need to over-lay contemporary construction standards on the existing dam which presents a specification challenge with potential environmental impacts.

330. Issues considered during the detailed design phase need to include the adoption of measures to enhance the positive impact sand mitigate the negative impacts. The quantity and quality of materials used for the raising of the dam are examples. The specification of a 13.6 m raising of Dahla Dam wall will add an additional storage of 500 million m^3 to the existing 288 million m^3 reservoir. Considering a sedimentation rate of 2.7 million m^3/year, Dahla reservoir once raised should have a life of over 200 years.[35] The extension of the dam wall is proposed to be completed using similar material to the existing. One alternative source of material could be gained by removing existing sediment from the reservoir, however the cost of doing this is considered to be at \$3.00/m^3, well above the conventional excavation from a borrow pit.

331. The height of the dam wall will impact upon the surface area, thus potentially impacting upon existing informal settlement and associated subsistence level farming which is practiced around the perimeter of the dam's water body.[36] Likewise, the realignment position of the Route Bearer Highway to the west of the dam will also be impacted, providing the opportunity for the road position and surface to be enhanced.

332. Detailed design could also include consideration of sedimentation flushing technology, however it is understood that to retrospectively install this equipment is prohibitively expensive requiring a combination of diversion channels and modification to the existing dam wall. Although there may be some downstream benefits whereby sediment laden water could lessen impact of erosion and benefit farming land with fine sediment depositing upon land, the cost and difficulty of rehabilitating the existing configuration of the dam means this alternative is not viable.

333. **Upstream Catchment Stabilization**. Assessment through Google Earth and verified by flying over the Hindu Kush between Kabul and Kandahar indicates that the landscape supports limited grass and shrub plant material. Although it is unlikely that much can be done to stabilize the soil, it is suggested that at least a preliminary overview is undertaken in order to (i) define if particular areas are contributing large volumes of sediment to the Arghandab system, and (ii) assess if stabilization is feasible in some of these areas at least on a pilot basis. As stated, security can present a serious problem in much of the upper catchment, and this will need to be taken into account in defining whether such a component is feasible or not.[37] Detailed design should therefore highlight the need for appropriate survey work to be carried out to assess viability of longer-term catchment stabilization programs, and strategically identify where those programs should be best focused.

334. **Subsequent Flow Beyond the Dam Wall**. With an average annual rainfall of just over 170 mm, agricultural activity in the Kandahar region is totally dependent upon supplementary irrigation. While anticipated climate change impacts upon rainfall, combined with both variance

[35] TRTA Feasibility Study Report: Component 1 - Raising Dahla Dam and Six Saddle Dams

[36] These issues are dealt with in a separate LARP document.

[37] If however, a peace agreement is reached during the project period, more detailed assessment could be considered.

in occurrence of snow and the speed of meltdown, will contribute to uncertainty regarding flows into the dam, the foreseeable impact of the construction is positive for downstream livelihoods immediately beyond the dam wall. Agronomic strategies to adapt to changing dynamics will be of value. The raising of the dam wall will increase the opportunity to manage with greater efficiency the dynamic nature of the surface water flows downstream of the dam wall.

335. **Environmental Flows**. Of major consideration to the detailed design stage is the resolution of environmental flows to the river. The strongest indicator of the sustainability of those flows is the status of the Sistan Basin wetlands in Iran. The Arghandab River contributes approximately 17% to the flows of the Helmand River, which in an ephemeral and arid-zone system is an important quotient. TRTA's Multisector Water Allocation Options Study sets out to define water releases from the dam for various uses and highlights that further study needs to be completed as part of the detailed design in order to determine appropriate environmental flows.

336. **Flows During Construction.** Detailed design stage will identify ways in which diversion canals can be used to maintain downstream water supply during construction with consideration given to livelihoods as well as flora and fauna.

337. TRTA performed two dam safety inspections, reviewed the dam failure reports prepared by USACE and prepared its own Dam Failure Analysis Report. Existing dam safety has to be further reviewed during detailed design phase and by an independent engineering panel to avoid any potential future disasters (e.g. floods, dam failure).

338. Quarry sites / borrow pits will be identified and agreed with NEPA and verified with community leaders during the design phase to prevent uncontrolled sourcing of construction material.

339. Soil/spoil disposal sites will be identified in advance and agreed with NEPA to mitigate any environmental impacts (e.g. erosion).

340. Standard construction environmental safeguard clauses will be part of the tender documents to avoid / mitigate construction related impacts (e.g. dust prevention, noise prevention).

341. Transportation routes for construction material and heavy machinery and parking areas for heavy machinery will be identified by the contractor before construction phase in order to avoid / mitigate environmental and social impacts. These routes have to be agreed with the local community, police and the local government in advance.

342. Detailed design shall identify suitable locations for construction work camps, stockpile areas, storage areas, and disposal areas and other facilities near to the project locations. However, if it is deemed necessary to locate elsewhere, sites to be considered shall not promote social instability and result in destruction of property, vegetation, irrigation, and water bodies. None of these temporary facilities shall be located within 500 m of residential areas and rivers. Though the contractor will be free to decide locations, a list of feasible locations shall be included in the design specifications and plan drawings for approval by the Project Management Unit. These potential locations will have been discussed with representatives of community groups.

343. Working hours during the construction phase have to be agreed with the police and the local government in advance, especially for residential areas. In general, construction works shall be implemented during the day (e.g. 7.00 – 19.00 hours) to avoid unnecessary

disturbances. Working during day time is recommended due to security and road safety reasons but all times are to be verified with local communities.

344. Non-objection-certificate (NOC) will be applied at NEPA before construction activities to avoid and mitigate any additional foreseen environmental impacts in advance. NEPA queries and comments will be reviewed and included in a revised Environmental Management Plan (EMP). EMP and EIA will be part of the tender documents and part the contract.

345. The EMP and the subsequent Site Specific EMP (SSEMP) developed by contractor aims to prevent and / or mitigate any environmental impacts as listed in described in the EIA report and the EMP. It becomes the contractual responsibility of the contractor to implement and monitor the EMP through the SSEMP. Incorporated into the SSEMP, the contractor will assume responsibility for all occupational health and safety issues on the site. A detailed waste management plan (WMP) will be a component of the SSEMP, and specifically focused on avoiding uncontrolled dumping of all construction waste, and domestic waste associated with construction camps.

346. **Risk-Based Management Approach**. The risks associated with the detailed design stage proposed raising of the dam wall are tabled and illustrated in Table 23. A recommendation of this EIA is that a review by a panel of experts at the 80% detailed design stage should be conducted to ensure quality control of engineering, operation and safety needs.

Table 23. Summary of Risk Management for Detailed Design and Pre-Construction Phase

Risk	Potential impact significance No-Action			Mitigation / Monitoring / Notes	Potential Impact significance Post Action
	Low	Med	High		
Deterioration of water quality in dam from upstream settlement			XXX	Design stage needs to clearly establish the steps to institute firm protection procedures.	**Low**
Key environmental assets not managed through lack of environmental flows			XXX	Design incorporate two stage environmental flow concept which requires real-time data gathering from significant nodal points up-stream & down.	**Low**
Planning for security of personnel and infrastructure for life of project			XXX	Design team need to seek skilled advice on mechanisms and procedures to ensure safety and security during life of project.	**Med**
"Build-neglect-rebuild" cycle		XXX		Design recognizes that a difficult & insecure regime of inferior monitoring and maintenance currently prevails but will change in time.	**Low**
Loss of established vegetation and habitat on perimeter of dam.	XX			Develop re-vegetation program as required & constant vigilance essential for program success.	**Low**
Sedimentation of dam floor	XX			Given timeline, considered of minor significance, however major catchment management	**Low**

Risk	Potential impact significance No-Action			Mitigation / Monitoring / Notes	Potential Impact significance Post Action
	Low	Med	High		
				program required.	
Potential failure of dam wall	XX			(i) Develop enhanced specification & emergency response / contingency plan, and (ii) conduct independent review of by expert panel to ensure structural integrity and safety of dam at 80% into detailed design stage.	**Low**
Incidence of flooding increase due to rapid snow melt		XXX		Develop and apply early warning system for potential flooding based upon real-time monitoring	**Low**
Incidence of tectonic and seismic activity in region	XX			As per USGS 2005, activity in Kandahar region is low *	**Low**
Encroachment onto informal settlements surrounding dam		XX		LARP or equivalent in place	**Low**
Specific details on water quality, noise, dust	XX			Baseline data collated and monitoring system in place from day one of construction	**Low**
Independent monitor to ensure compliance with EMP objectives			XXX	Appointment of independent "external environmental monitor" in contract implementation from day one	**Low**
Inferior communication with local communities		XXX		Ongoing, routine and transparent two-way communication with communities and partners	**Low**

[a] Wheeler et al, (2005) Seismotectonic Map of Afghanistan, with Annotated Bibliography. USGS (Afghanistan Project Product No. 011).
Source: TRTA Consultants, 2019

347. The NOC should provide the basis of a Residual Impact Statement whereby the design integrity, safety measures incorporated, the strength of liaison with all partners and the conditions and expectations placed upon contractors can be shared with all.

C. Impacts During Construction Phase

1. Introduction

348. On-site management of environmental impacts during construction require a comprehensive approach to be successful. Much of the day-to-day management needs to be the responsibility of the contractor, who is responsible for developing, implementing and closely monitoring the performance of a Site-Specific Environmental Management Plan (SSEMP). The scope of this document mirrors the following table, Environmental Management Plan and Mitigation Measure Summary. The contractor's SSEMP manifests as both a site management

tool and a legal document. The implementation of the SSEMP will be managed by the contractor's dedicated Environmental Officer.

349. Important potential impacts requiring systematic management, and which are individually itemized in the EMP, range (chronologically) from the siting, detailing and maintenance of the construction camp including access roads, storage of materials including fuels, tools and machinery, management of quarrying and associated works excavation, transportation and stewardship of all goods across the footprint of the site, impacts from excavation including protocols for managing any archaeological and cultural artefact, loss of vegetation and incorporation of subsequent re-vegetation plans. Additional important considerations include the mitigation of noise, dust, effects to air quality, occupational health and safety, disturbance to water quality, aquatic and bird life.

350. **Excavated Material Required from the Adjoining / Quarried Area.** The amount of fill required for construction could present a considerable impact upon the site. About 7.3 million m^3 overall volume will be required from 'borrow areas'. The components include (i) clay core of 1.2 million m^3, (ii) sandy gravels of 4.8 million m^3, and (iii) riprap / filters 1.3 million m^3 in total. It has been identified within the feasibility study that material for the dam construction will be harvested from the extended reservoir area along existing Route Bearer Highway and thus will be inundated when the dam level rises**.**

351. **Contractor's Camp.** No impact on the biological environment is expected due to the installation of the contractor's camp. The dedicate area has already performed a utility function and shows human impact (no trees, almost no vegetation, soil surface already paved). Access roads to the camp area and the dam already exist.

352. **Timing.** Construction will be implemented during the autumn and winter months when the water level of the reservoir is expected to be low. The existing foundations of the dam will be used as the foundation on which to raise the dam wall. It is not envisaged that any blasting at the existing dam structure will be required.

353. **Socio-economic Impacts and Employment Opportunities.** Overall, the socio-economic impact is expected to be positive. Wherever possible, priority will be given to employment of local people in the construction of the dam.

2. Impacts on the Biological Environment

354. Construction activity and the impact from that construction is highly localized around the perimeter of the dam wall and the subsequent larger footprint of the body of water when the dam fills. Most parts of the reservoir are not affected by construction activities. However, it can be assumed that flora and fauna in close vicinity of the dam will be affected by construction activities (turbidity, vibration, noise, inundation).

355. **Fish / Aquatic Life Within Reservoir.** The fish survey undertaken in 2018 caught more than 1,000 individuals of the predominant species. The catfish (Sheer mahi) is noted as being under serious threat from climate change, water pollution and overfishing.[38] Attempts are farm raising Sheer mahi in hatcheries are reported to be unsuccessful. This situation raises concerns regarding all aquatic life in the dam. Knowledge concerning other fish species which inhabit the reservoir and their preferred habitat (be it shallow shoreline or deeper waters) defined by

[38] Construction of the Warsak dam in 1960 also blocked the upstream migration of this species.

temperature and less light could therefore be improved upon, and will be included in the subsequent ARES proposed for the summer of 2019.

356. Fish may be expected to occupy substitute habitats in a safe distance from the construction site and further expert opinion will be sought on this. The dam itself provides what has been assessed as a low-value fish habitat, where limited submersed vegetation nor areas for fish to shelter appear to exist (deadwood, roots, reed).

357. **Previous survey method:** The 2018 survey utilized two methods: (i) collecting data through direct observations; (ii) interviewing local hunters (three hunters from surrounding villages) by using a specialized questionnaire. The questions concerned the presence of water birds, main threats, and hunting practices at Dahla Dam.

358. The survey team identified 14 waterfowl species,17 individual birds from other species, and two mammals − Jungle cat (Felis chaus) and Golden Jackal (Canis aureus) (both in the Red List of Afghanistan).

359. The questionnaire investigations and direct observations showed that the inhabitants of the area extensively hunt waterfowl during fall and winter seasons. Spring and summer are breeding seasons, during which time hunting is uncommon.

360. Overall, the observations confirmed that Dahla Dam is an important area for waterfowl and other wildlife species in the south west of Afghanistan. Water birds use this area as an aquatic habitat for shelter, foraging, roosting and breeding.

361. **Flora.** The shore / edge of the dam includes some areas of 'volunteer' aquatic re-growth. It is assumed that these areas may provide valuable feeding and occasional habitat for aquatic life. During construction, all flora that is removed will be accounted for in a re-vegetation plan and be replanted at a minimum ratio of 1:5. Greater detail on species and propagation will be included in the Arghandab River Environmental Study (ARES) planned to be conducted by TRTA during summer 2019.

362. **Birdlife - previous survey:** The 2018 survey utilized two methods: (i) collecting data through direct observations; (ii) interviewing local hunters (three hunters from surrounding villages) using a specialized questionnaire. The questions concerned the presence of water birds, main threats, and hunting practices at Dahla Dam. Fourteen waterfowl species were identified,17 individual birds from other species, and two mammals − Jungle cat (Felis chaus) and Golden Jackal (Canis aureus) (both in the Red List of Afghanistan).

363. The questionnaire investigations and direct observations showed that the inhabitants of the area extensively hunt waterfowl during fall and winter seasons. Spring and summer are breeding seasons, during which time hunting is uncommon.

364. Overall, the observations confirmed that Dahla Dam is an important area for waterfowl and other wildlife species in the south west of Afghanistan. Water birds use this area as an aquatic habitat for shelter, foraging, roosting and breeding.

365. What the survey did not investigate was how the project may go about minimizing the impact of lost habitat during the construction of the dam. ARES will therefore specifically examine the possibilities of restoring habitat in what will be the high water mark of the new water body. The process will include analysis of speciation, soils, propagation techniques along with ideal timing.

366. The ARES will identify habitat associated with permanent and migratory bird species which are to be found in the area and wetlands. The ARES will aim to prepare details regarding the generation of alternative habitat. A major impact is that feeding and nesting habitats will be deliberately disrupted during the construction activities at the main dam. Due to sheer depth of the water body, the dam itself is not considered to be an ideal feeding nor breeding habitat. However, waterfowl can be expected to be affected by construction activities at the dam (such as noise, vibration, dust) and they may leave the site and search for alternative habitats in the vicinity of the reservoir. Without the survey, this impact on water fowl has been evaluated as "minor" and limited to the construction phase.

367. **Grouting or Bentonite Cut-off Wall Construction Works** for the reaches of the saddle dams will be implemented during the dry season. No impact on aquatic life is expected. The water body of the reservoir will be far from the construction site.

368. **Raising of the Dam Wall by 13.6 m** will result in an extension of the main dam and six saddle dams from an approximate length of 2,250 m to 3,000 m. The Terms of References of the ARES is specifically focused on determining the presence and status of wildlife, animal habitat and associated riparian vegetation which could be affected by the rise in the dam wall.[39]

369. As per Google Earth imageries and as verified/confirmed by NEPA Kabul and NEPA Kandahar, there will be no impact on existing vegetation at the reservoir and on the river banks,[40] as vegetation along the river has been routinely cleared for household use and/or grazed. Vegetation status is expected to be verified by the ARES planned for summer 2019.

370. **Water Quality Impacts.** Impact on water quality within the confines of the dam is likely during the construction phase. Turbidity will increase during construction works at the main dam. This impact is expected during the whole construction stage.

371. Geotextile bags will be applied to prevent construction material including rocks, stones, riprap and gravel from falling into the water to prevent increased turbidity. The impact will also be reduced as construction works will be carried out during the dry season as the water level of the reservoir will be low at that time. Construction works at the saddle dams will not intersect with the water body of the reservoir.

372. Generally, water quality of the river below the dam is not expected to be affected by construction activities, however short-term turbidity is expected in the river stretch below the dam during installation of turbines at the Dahla Dam substation.

373. There are a range of typical impacts associated with construction which are identified and listed in the risk table as well as the EMP. The mitigation measures include addressing the full range of typical construction phase impacts; stewardship of the use of all resources including machinery, care of the natural resources on the site (water, vegetation, flora and fauna), occupational health and safety of workers.

374. One important issue concerns the prevention and mitigation of soil erosion by the following measures:

(i) Covering of stockpiles to prevent wind erosion;

[39] Although NEPA Kabul and NEPA Kandahar confirmed that there will be no impact on existing vegetation at the reservoir and on river banks, and that negligible vegetation has been found in the close vicinity of the dam during the field surveys, this will be specifically verified by the ARES

[40] TRTA communication with NEPA at ASBA office, Kandahar, July 2018

(ii) Proper storage of top soil and reuse for landscaping;
(iii) Planting / landscaping of slopes;
(iv) fixing of slopes using concrete, geotextile.

375. **Dust** will occur during construction phase at the dam but will be short-term, localized in nature and specifically itemized and managed by the SSEMP. Dust will impair the air quality but not the water quality of the reservoir.

376. Run-off from stockpiled materials and chemicals from fuels and lubricants during construction works can contaminate surface water quality (Arghandab River, reservoir, irrigation channels). Project area receives rainfall, although mostly confined during the winter and spring months. It is important that runoff from the construction areas, which may contain silt and chemical traces, does not enter these water bodies. Impact will be temporary but it needs to be mitigated. As per the SSEMP, the construction contractor will be required to:

(i) Ensure that all earthworks be conducted during the dry season (summer, autumn) to prevent the problem of soil run-off during winter months;
(ii) Implement stockpiling of earth fill in the dry season and cover by tarpaulins;
(iii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, only designated disposal areas shall be used;
(iv) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
(v) Place storage areas for fuels and lubricants away from any drainage leading to water bodies;
(vi) Store fuel, construction chemicals etc., on an impervious floor, double walled tanks, also avoid spillage by careful handling;
(vii) Use collecting trays under containers / drums containing hazardous material;
(viii) Dispose any wastes generated by construction activities in designated sites; and
(ix) Conduct surface quality monitoring and inspection according to the SSEMP.

377. **Air Quality.** Construction work, especially from earthwork activities, coupled with dry and windy working conditions, material and debris transport, and works along the public roads carrying significant traffic, have high potential to generate dust. Emissions from construction vehicles, equipment, and machinery used for excavation and construction will induce impacts on the air quality. Additional anticipated impacts include dust and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons. Dust generation will be significant during construction of Route Bearer Highway. Increase in dust/ particulate matter in ambient air is detrimental and may have adverse impacts on health and environment. To mitigate the impacts, construction contractors will be required to adopt and follow procedures, all of which will be included in the SSEMP:

(i) Barricade the construction area in the vicinity of settlements;
(ii) Initiate site clearance and excavation work only after barricading of the site is done;
(iii) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.), to the barricaded area;
(iv) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area;
(v) Implement water spray during construction on roads and the construction site;
(vi) Clean wheels of heavy machinery and trucks before they leave the construction site;
(vii) Use tarpaulins to cover loose material and soil.

378. **Noise and Vibration Impacts.** The works to be implemented are in a rural setting in the vicinity of the dam, with an absence of settlement and population. Noise and vibration impacts will mostly be attributed to blasting, rock cutting, pneumatic drills, excavation and construction activities for fill along the previous alignment of the Route Bearer Highway.

379. However, construction of the newly aligned Route Bearer Highway is located partially adjoining habitation areas in the vicinity of houses, religious places and close to business. The sensitive receptors are the general population in these areas. Increase in noise level may be caused by operation of construction equipment and the transportation of equipment, materials, and people. Vibration generated from construction activity, for instance from the use of pneumatic drills, will have impact on nearby houses/buildings but can be expected only over a short term and will be done in consultation with the community elders. The negative impact is therefore expected to be short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan activities in consultation with the Project Management Unit and in collaboration with community so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance;
(ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimize sound impact to surrounding sensitive receptor;
(iii) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
(iv) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach;
(v) Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

380. **Impact on Waste Stream.** There will be an increase in waste generated from the construction camp combined with all the associated activity. The contractor will have full responsibility to incorporate a Waste Management Plan into the SSEMP for the life of the project. As the project becomes operational waste is not considered to be a major issue.

381. **Impacts on Community.** Overall impacts on community are considered to be positive. A small degree of agricultural activity which currently is conducted on land adjacent the high-water mark of the dam will be affected with the rise in reservoir water level. Dedicated efforts to support farmers to find alternative lands and compensation will be managed as part of the LARP. Impacts from road construction, quarrying and the dam wall construction are considered to be minimal as they are not close to settlement nor livelihoods areas.

382. **Impacts on Workers - Occupational Health and Safety**. The day-to-day construction work at the site will conform with contemporary best practice when it comes to occupational health and safety practices. Given that local people will be offered precedence on employment opportunities, this scenario offers a positive set of conditions for workers.

Table 24. Summary of Risk Management Procedures for Construction Phase

Risk	Potential impact significance No-Action			Mitigation / Monitoring / Notes	Potential Impact significance Post Action
	Low	Med	High		

Risk	Potential impact significance No-Action			Mitigation / Monitoring / Notes	Potential Impact significance Post Action
	Low	Med	High		
Management of any potential impact of contractor's camp, machinery, fuel and oil spills.		XXX		All details regarding responsibility of contractor is to be detailed in the SSEMP.	Low
Inappropriate contractor management of use of heavy machinery, excavation, deposition of spoil, top soil, deposition and compaction of fill material during construction		XX		Detailed design will work with the SSEMP to clarify and specify all construction details.	Low
Harvesting of fill material could create major impact upon landscape.	X			A site for harvesting of material has been identified adjacent Saddle dam 1 extension up to Shahjuy village which has low significance.	Low
Water quality in and below the dam maybe compromised during construction.		XXX		Water quality monitoring will be conducted in the reservoir and river during dam construction and operation.	Low
On-site safety for all employees and community addressed.		XXX		Occupational health and safety will be specified in the SSEMP and be a core contractor responsibility	Low
Management of aquatic life, bird life, re-vegetation not adequate.	XX			ARES will identify key environmental assets with specific flora and fauna requirements.	Low
Disturbance to roads from haulage, dust, noise and air quality.	XX			Contractor will have specific guidelines to conform with regarding management and monitoring.	Low
Employment opportunity of local people not given preference.		XX		Preference will be given to local people for all employment opportunities.	Low
Contractor performance needs to be adequately monitored.		XX		Monthly reports and oversight of day-to-day management monitored by PIO.	Low

Source: TRTA Consultants, 2019

D. Impacts During Operation Phase

1. Impacts on the Physical Environment

a. Impacts on River Morphology, Spillway Channel, and Reservoir

383. **River Morphology.** Most of the Arghandab River bank structure in the reach from the tailrace to the reservoir is dominated by larger stones and boulders and thus is less at risk to bank erosion and slumping. Some bank erosion at sandy banks cannot be excluded entirely. Increasing erosion is not expected. The existing estuary of the river will be flooded and shifted upstream over the years. Erosion is not expected due to this change in river morphology.

384. **Spillway Channel.** No improvements to the existing spillway channel stability made of native rock material is proposed. The existing rock lining is sufficient for stability without installing any additional channel lining, cut-off wall, or similar type feature. The downstream channel has large cobble sized bed material and stable vegetated banks. For these conditions, stability is likely in the downstream channel between the dam and the spillway entrance.

385. In order to assess future risk, detailed monitoring of the spillway and the channel is recommended. The monitoring has to be implemented periodically after spillway flow in spring.

386. **Reservoir**. Approximately 72% of the basin has slopes greater than 30%.[41] Most sediment enters reservoirs as a consequence of rainfall erosion and subsequent transport by streams. The areas contributing the highest sediment yields are those with the steepest slopes that also have increased runoff rates and therefore more overland sheet and rill erosion. High sediment yields in these areas are expected as the terrain is mostly unvegetated and steep. In arid-zone rangeland conditions, amounts of sediment in surface water can also be accelerated where long-term and uncontrolled grazing of animals leaves areas denuded. The reservoir can basically be considered as a large sediment trap and the sediment captured in the reservoir is missing below the dam in Arghandab River. A long-term increase of sediments is expected in the future due to climate change and due to the increase in maximum discharge events (TRTA Hydrological Study Report, 2018). Greater sedimentation is predicted due to the anticipated increase in uncharacteristic weather events.[42]

387. With a sedimentation rate of 2.7 million m^3/year, Dahla reservoir once raised should have a life increase of over 200 years which is positive, but which could be enhanced further should techniques to arrest sedimentation be strategically introduced over time. It is anticipated that during high inflows, sedimentation flushing should be performed through irrigation outlets. The irrigation outlets should be kept fully open. During detailed design, consideration should be given to re-assess the discharge capacity and changing the type of the outlet channel.

388. Due to the lack of data in the Arghandab drainage basin, the erosion processes are not observed. Erosion is expected to continue after raising of the dam. The river banks below the dam have already been stabilized by stones and rocks to prevent erosion. Annual control of the river banks is suggested in the EMP, in order to mitigate and prevent future erosion of the river.

389. While in some situations, total annual rainfall may not change, one significant possibility will see rainfall of greater intensity, the results of which will erode and mobilize sediments.

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[41] US Army Corps of Engineers, 2012. Waste water master plan Kandahar City, Afghanistan

[42] Details are provided in various section of the feasibility study report and in the hydrology report. Sedimentation rate in dam is 2.7 million m^3 per year as described in the feasibility report

Improving stewardship of rangelands could mitigate these effects, but to implement such programs will require greater levels of security than presently exist.

390. Raising of the dam by 13.6 m will not significantly impact the landscape, as the dam is already in existence, however the surface area of the water body will increase from about 29 km^2 to around 45 km^2. The existing dam wall consists of stones, rock and concrete. The grey color of the raised dam will not be distinguished from its natural surroundings. No impact is therefore expected in terms of aesthetics.

391. **Water Quality.** Increasing the water depth in the reservoir after raising the dam can cause limited mixing of surface and deep reservoir waters, low dissolved oxygen content, and the generation of hydrogen sulphide on the bottom under anaerobic conditions. Changes in hydrology will cause major and sometimes permanent changes in water quality, aquatic life, and habitats. Fish and aquatic organisms will move to lower depths in case of low oxygen concentrations above the bottom of the reservoir especially in the summer months when high water temperatures and low oxygen concentrations are expected. Seasonal changes in temperature in spring and autumn and wind cause additional re-aeration of deep-water layers of the dam lake.

392. Monitoring of the water quality of the reservoir at various depths has been suggested in the EMP.

393. Changes of the water quality of the river below the dam is not expected. Arghandab River is a mountain river characterized by high velocity, rapids, coarse gravel banks, and boulders linked to high self-purifying capacity. Oxygen concentration is expected to be high below the dam during operation of the turbines.

394. Monitoring of the water quality within the dam and below the dam will occur during construction and operation has been suggested in the EMP.

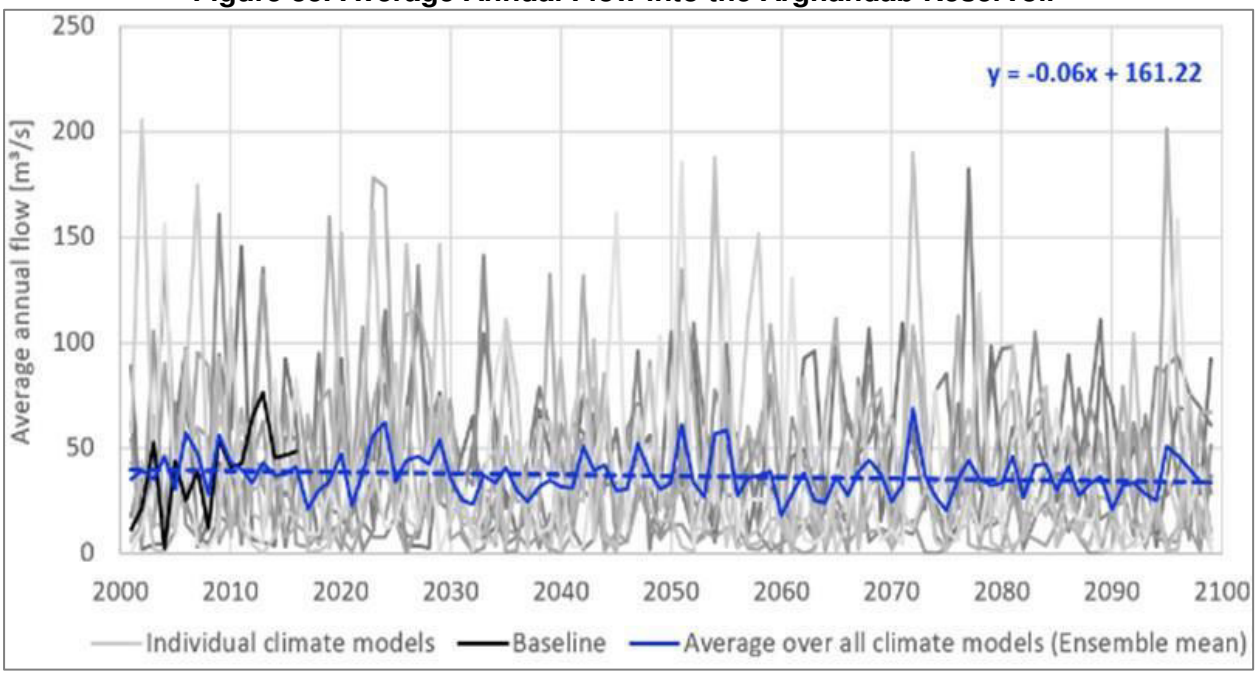
395. **Groundwater.** Raising of the dam will cause a rise of the groundwater table around the reservoir. The level of groundwater will change dependent on season, precipitation, water supply, hydropower production and irrigation activity. Groundwater quality in the vicinity of the reservoir will not be affected.

396. The groundwater level close to the river below the dam is not predicted to drop significantly during the dry season in average and in wet years due to provision of the environmental flow, and greater availability of water throughout the year. Groundwater quality is not expected to be affected. Decline of the ground water level is expected for dry years.

b. Impacts from Climate Change

397. The trends of the hydrological study show slightly decreasing average and minimum inflows to the reservoir and an increase in extreme inflow events. A change in the erosive force of the discharge events is expected.

Figure 35. Average Annual Flow into the Arghandab Reservoir



Source: Hydrological study, TRTA. 2018.

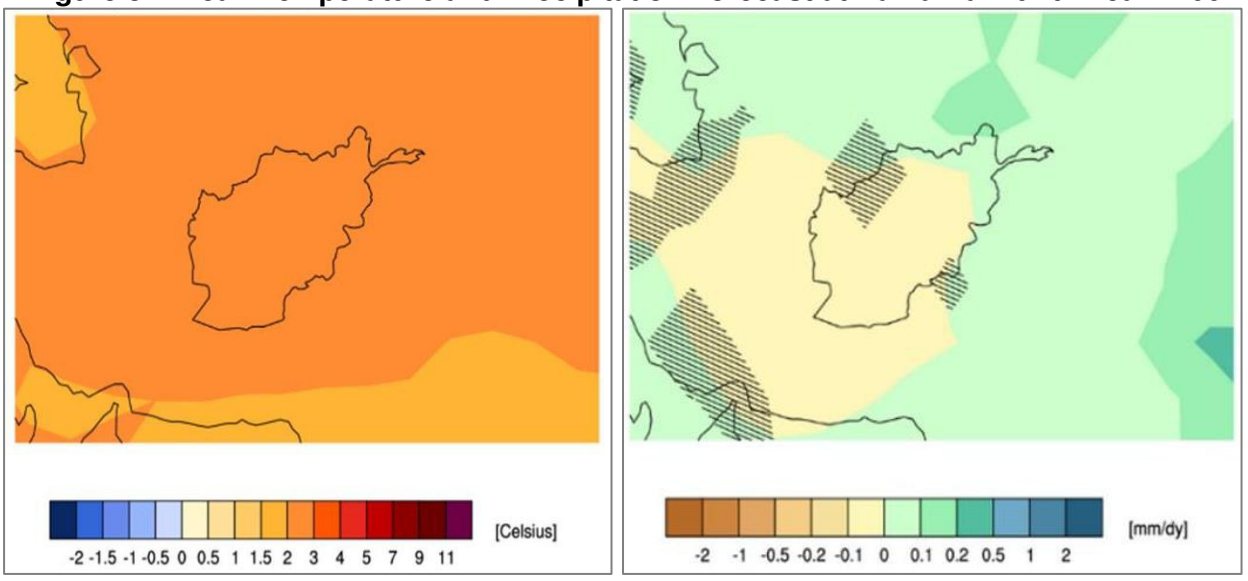
398. The occurrence of unexpected and changing weather patterns including heavy rain events and the incidence of drought can be expected to increase in future. For example, at the beginning of March 2019 heavy rain, wind and flash floods occurred in Kandahar District. All rivers and canals were full. Many houses were destroyed in Shah Wali Kot, Arghandab, Zheray, Panjwayi, and Dand districts including Kandahar City. Floods increased water level in Dahla Dam around 2.31 m. Currently there is only around a 4 m gap between level of existing water level and spillway and the dam overflowed.

399. As a result of this weather event, the OCHA (No 6) reported: "4,698 households (more than 33,000 people) have been identified as requiring humanitarian assistance as a result of flooding". Across eight provinces and Kandahar City, 1,855 houses have been destroyed and 2,841 houses have been partially damaged by flooding. There was further rain on 10 March, although no new flooding incidents have been reported.

Figure 36. Heavy Rain and Flood in Arghandab River Valley below the Dam, March 2019

Source: TRTA Consultants, 2019

Figure 37. Mean Temperature and Precipitation Forecast at Dahla Dam until Year 2100



Source: KNMI Explorer 2018. https://climexp.knmi.nl/start.cgi

400. The mean annual temperature has increased at a rate of +0.5°C per decade over the last 30 years. Future projections from global climate models suggest a strong increase in temperature. For the end of the century, a warming in the range of +2.1 to +5.6°C (compared to the reference period from 1971 to 2000) linked to an increase in evaporation is likely. Furthermore, a strong increase in the duration of heat waves as well as a medium-strong reduction in the length of cold spells is projected. As a result, the period over which melt-down occurs is becoming shorter, a phenomenon which will have a great influence upon river dynamics.

401. For the annual total rainfall amounts, no substantial changes were observed over the last 30 years. Climate models project no clear trends for future annual total precipitation, however globally it is recognized that an increase in uncharacteristic weather events will have greater incidence. For the end of the century, a change in annual total precipitation in the range of -12% to +8% (compared to the reference period from 1971 to 2000) is likely. Furthermore, projections suggest a tendency towards more intense and considerably more frequent heavy rainfall events as well as a slight increase in the duration of dry spells.

402. For the climatic water balance (precipitation and evaporation), a tendency towards a decrease is projected for the future in Afghanistan. Regarding annual mean wind speed, global climate model projections show a slight tendency towards a decrease, whereas for solar irradiance the projections suggest no clear trend over the 21st Century. However, the skill of the global models in reproducing mean wind speed and solar irradiance is limited.[43]

403. The following figures show climate graphs of KNMI climate explorer for Afghanistan. Changes in mean temperature and precipitation are shown. The climate projection is based on CMIP5 data ensemble. The periods during 1934–2018 and during 2018–2100 were compared (84 years into the past and 82 years into the future from 2018).

404. The following scenario is analyzed: RCP4.5 (Representative Concentration Pathway 4.5): quicker action to limit greenhouse emissions with emissions peaking in 2040 and strong decline until 2080.

405. Under the RCP4.5 scenario, a temperature increases of up to 2°C is expected for Afghanistan until the end of the 21st Century, linked to a slight decrease in precipitation.

406. It cannot be excluded that climate change, especially reduction of annual rainfall and temperature rise, will reduce biodiversity and initiate desertification in Afghanistan and in the project area. Worldwide reduction of greenhouse gas emissions could mitigate this scenario.

407. Afghanistan generates 44.7% of its electric energy from fossil energy sources (coal, wood and fuel[44]). A reduction of fossil energy sources and increase of renewable energy sources (wind and hydropower) would decrease the release of greenhouse gases (e.g. carbon dioxide).

c. Impacts from Greenhouse Gases

408. Afghanistan currently generates 44.7% of power from fossil energy sources. Reduced reliance on fossil fuels and increased utilization of renewable energy sources would reduce CO_2 emissions.

409. With a dam raise of 13.6 m, the hydropower component will generate approximately 143,038 MWhr. GHG savings will be 49,348.11 tons per year assuming that the import of electric power from Turkmenistan will be reduced. Electric power in Afghanistan is generated from fossil energy (natural gas) in Turkmenistan.

[43] Climate Fact Sheet Afghanistan. 2018. Climate Service Centre Germany.
[44] Worldata.info. *Energy Consumption in Afghanistan*. https://www.worlddata.info/asia/afghanistan/energy-consumption.php

Table 25. Greenhouse Gas Emissions in 2014 and Future GHG Savings for Average Year

	1 X 28 MW Francis or Kaplan Units	3 X 9.5 MW Francis or Kaplan Units	1 X 0.9 MW Francis or Kaplan Units
Estimated annual power production (MWhr)	117,330	135,940	7,097
Total (MWhr)			143,038
Generation of GHG from burning of natural gas (t CO_2/MWhr)			0.345
Annual GHG savings from hydropower (t CO_2)			49,348.11

Source: TRTA Hydropower Report and Energy Consumption in Afghanistan: http://www.irena.org/climatechange/Avoided-Emissions-Calculator

2. Impacts on the Biological Environment

410. The immediate watersheds surrounding the dam and its reservoir are seriously denuded and the upper catchments are completely degraded. This is understood to be the result of the practice of annual free-range grazing combined with an annual harvest of woody shrubs for fuel wood. While a National Rangelands Management Strategy has been produced some considerable time ago, the challenges, resources and time required to implement such a strategy during a period of civil emergency has meant that although there are models of improved catchment management, they are unfortunately piecemeal.

411. No national, provincial or regional flora species of significance or their habitat were reported within the area potentially affected by the project. No registered wetlands are located within areas potentially affected by project activities according to information of NEPA Kandahar.

412. Waterfowl has been observed and assessed during the site visit of the dam and during the ornithological study in November 2018. Existing bird populations are used to seasonal changes in water level and habitats especially at the Arghandab estuary of the reservoir.

413. Raising the dam will flood existing wetlands and habitats. Over time, wetlands will develop due to siltation and sedimentation processes of the river, especially within the upstream estuary. The Arghandab River Environmental Study will specifically explore ways to facilitate alternative habitat for birds pre flooding of existing.

414. It is expected that fish, especially trout (*Salmo trutta oxenesus*) and sheer mahi (*Clupisoma naziri*) will migrate upstream between Qala -I-Bust (location where the Arghandab meets the Helmand) to a point below the dam wall during the spawning season in late winter and spring. Since the construction of the dam in 1952 migration from below to upstream of the dam has not been possible. The height of the dam wall makes it difficult to facilitate fish passages and although fish friendly turbines will be installed, it is acknowledged that these devices fall short of providing a 100% migration. However, the ARES will specifically investigate the viability of a fingerling program initiated for the dam water, and providing fish stocks for the upper reaches of the river.

415. The ARES will also investigate and assess mitigation measures which could be applied to the fish habitats in the existing river estuary. These areas will be flooded and similar habitat conditions will need to be replicated upstream in what will be a new ‘estuary’.

416. Likewise, the ARES will also investigate and make recommendations as to whether downstream fish habitat can be enhanced with accelerated sedimentation in the suitable areas (e.g. shallow water zones, reeds).

417. Depending upon outfall source and relative temperature differentials, the increased flow throughout the year combined with environmental flows (after the raising of the Dahla Dam) will improve potential habitats below the dam compared to the existing situation.

418. Environmentally friendly management of the reservoir is required during operation to sustain breeding and feeding habitats of existing fish populations.

419. Monitoring of water quality is required, especially during dry years and in the dry season when water will be scarce. A water quality monitoring program has been suggested in the EMP.

420. Regular monitoring of oxygen concentrations is required.

421. Operation of the dam is linked to changes in water level of the reservoir.

422. While the existing aquatic fauna and waterfowl are already used to these changes, a water management plan has to be developed to address ecological requirements of the existing fauna. The management plan shall focus on the following:

(i) Minimum water level and volume required to satisfy the ecological requirements of the aquatic biocenosis. The water level shall not drop below 6 m at the dam (immersion depth) according to information received from ASBA.
(ii) Minimum oxygen concentration of the water to guarantee the survival of aquatic organisms.

423. A fish biological study and an ornithological study will be implemented as part of the ARES during the detailed design, to assess existing bird and fish species and habitats throughout the year. The detailed fish survey shall cover the whole river. The survey shall be implemented at the start of the summer season to confirm preliminary survey findings. The ornithological study shall include monitoring of at least half a year because migratory birds are expected. Breeding habitats, feeding habitats, resting habitats, indicator species have to be monitored. Especially, breeding activities in spring and activities of migratory birds in autumn and spring have to registered. The detailed environmental study shall focus on species using the reservoir and the river as their habitat. In addition, breeding (shallow water zones) and feeding habitats shall be identified. The existing fish diversity and occurrence of fish shall be estimated.

3. Impacts on the Socio-cultural Environment

424. **Raising of Dahla Dam.** Impacts on land use are expected. A rapid due diligence was conducted in collaboration with project affected persons, which revealed that for a 13.6 m dam raise and due to the expansion of the reservoir area, an estimated 22 villages with a population of approximately 6,500 will be affected. Approximately 596 out of a total of 778 houses in these villages will be affected.

425. It is also estimated that the inundation will cause a loss of about 800 hectares of arable land and 300 hectares of pasture land. The inundation will cause a loss of 643 orchards with 92,241 fruit trees and 16,000 wood trees. Resettlement activities will compensate losses of agricultural land and settlements.

426. The infrastructure on 6 saddle dams and two spillways will have no land acquisition or resettlement impacts as the proposed land is state owned land.

427. **Route Bearer Highway Realignment**. The proposed realigned highway is 9.3 km long and pass mostly through barren hilly terrain.

428. A rapid impact assessment was carried out in March 2019 on the proposed road realignment. The new route alignment crosses three villages:

(i) **Landai Showraw village** (Chainage 0+000 to 3+400): the route will cross rainfed and pastures land of the village (85 jeribs: 170,000m2). No structure, irrigated land and orchards will be affected.

Figure 1. Rainfed and pasture land of Landai Showraw village

Source: TRTA Consultants, 2019

(ii) **Lowar Arab village** (Chainage 5+300 to 9+300): the route will cross rainfed and pastures land of the village (100 jeribs: 200,000m2). No structure, irrigated land and orchards will be affected.

Figure 2. Rainfed and pasture land of Lowar Arab Village

Source: TRTA Consultants, 2019

(iii) **Shay Joy village** (Chaimage 3+500 to 5+300): the route will cross pasture land (Chainage 3+500 to 6+300, 25 jeribs: 50,000m2), agriculture land (Chainage 4+500 + 5+000, 12.5 jeribs: 25,000m2) and pomegranate orchard (Chainage 5+000 + 5+300, 7.5 jeribs: 15,000m2). No structure will be affected.

Figure 3. Rainfed Land, Irrigated Agricultural Land, and Orchards of Shah Joy village

429. The 600m long strip of private agriculture land in the village of Shah Joy for the construction of the new road is seen in the figure below.

Figure 38. Shay Joy Village and the Proposed Route Realignment

Source: TRTA Consultants. 2019

430. More precise data about the social and resettlement impacts will be gathered during the consultative workshops in April 2019 and at the detailed design stage.

4. Impacts on Physical Cultural Resources

431. Several cultural resources are found in Kandahar City and in its vicinity. The resettlement rapid due diligence showed that there will be a loss of cultural assets due to the expansion of the reservoir area on:

(i) Cemeteries;
(ii) Karez (water systems);
(iii) Mosques (in the villages being relocated, mosques will be required to be demolished and relocated to new resettlement sites;
(iv) Pastoralist sites (where Kuchi and other pastoralists lived and kept their animals).

432. The following table shows the cultural resources that known to be affected due to the expansion of the reservoir area.

Table 26. Location of Affected Cultural Resources

Village	Cemeteries	Karez/Water Systems	Mosques and Madrasas	Pastoralist sites
Karmullah	1	2	1	1
Kochani	1		1	
Khalil Qala/Sarwar Jan Kali	1			
Baitel/Haji Karim Dad		1		1
Sofi/Mohammad Qudos Kala		2	1	1
Siahsang		1	1	
Khawaja Zai/Zor			1	1
Haji Paiyo Kali			1	
Biana			1	
Lal Khan			1	
Sher Jan Kali			1	
Dad Mohammad				1
Shah Joi			1	
Anar Kali				1
Tehsildar			2	
Khali Qala			1	
Total	**3**	**6**	**13**	**6**

Note: There are several different pastoralist sites affected in each of the marked villages.
Source: TRTA Consultants, 2019.

433. Based on the TRTA consultations in March 2019 with APs Committee members and Kandahar Government officials, Dahla Dam upstream villages have a very long history. Dahla Dam is situated in a very strategic location that has always been used with the government of Afghanistan.

434. There is some evidence that the following cultural resources might be affected, but the exact location and number of these sites are presently unknown:

(i) Stone age sites;
(ii) Prehistoric sites;
(iii) Caves and rock shelters containing cultural materials;
(iv) Mounds indicating the presence of villages and community structures;
(v) Open sites consisting of lithics, debitage, and ceramic scatters.

435. The exact figures of key impacts including cultural resources will be agreed upon during the consultative workshop with affected persons and other stakeholders to be held during 6-9 April 2019.

436. There are 10 identified archaeological monuments that are located to the East and South of the project area that will not be affected by the raising of the dam wall. The following maps show the 10 archaeological monuments in Kandahar Province that are not expected to be affected by the raising of the dam wall due to their distance from the project area according to information of the Archaeology Institute Kabul.

Figure 39. Archaeological Monuments in Shah Wali Kot District

Source: Archaeology Institute Kabul and TRTA Consultants, 2018

Figure 40. Archaeological Monuments South of the Project Area

Source: Archaeology Institute Kabul and TRTA Consultants, 2018

437. Construction activities must be coordinated by local religious leaders and the Archaeology Institute Kabul before the construction phase. An archaeological survey will be required under the leadership of the Archaeology Institute Kabul.

438. **Landmines**. Afghanistan has more landmines than any other nation, and one difficult challenge has been clearing project surrounding areas. Topographic survey along the dam reservoir and proposed highway route had been performed successfully by the TRTA in 2018. Although no landmines were noted, the contractors must ensure that the sites are clear from landmines in close consultation with the relevant agencies. Previously air samples from the sites were collected and sent to labs, where mine detection dogs identified high-priority areas for de-miners. It shall be the responsibility of the contractor to confirm that the technical survey/clearance of landmines/UXOs has been properly achieved. If it is not yet completed for any given section, the Contractor shall request the Afghanistan Mine Action Centre (AMAC) Kandahar in due course to complete the remaining demining works for all sections. In addition, the Contractor shall also submit requests to AMAC Kandahar for any additional survey/clearance of landmines/UXOs whenever and wherever it is deemed necessary for the safe conduct of his works.

439. **Impacts on Fish Catch.** Impacts on fish catch are not expected.

440. A **Water Management Plan** shall be developed after implementation of the detailed environmental study during detailed design stage. A minimum water volume will be provided throughout the year to sustain aquatic life and habitats. Fish catch will not be impaired after raise of the dam. Currently, ASBA maintains at least 6 m of water depth at the dam.

441. A **Fish Management Plan** shall be developed after raising the dam, including:

(i) Acceptable fish catches related to species (maximum annual catches in tons / year);
(ii) Closed season for different fish species in the dam lake;
(iii) Minimum mesh size;
(iv) Protected areas where fishing is not allowed (spawning habitats, breeding habitats);
(v) Fishing methods to be applied and not to be applied.

442. Water availability for downstream water users will depend on yearly flows and rainfall. Water availability for downstream users is expected to be low in dry years and even average years when the crops of upstream users are thirsty. Water user associations, Department of Agriculture, Irrigation, and Livestock, and Department of Rural Rehabilitation and Development representatives and *mirabs* need to collaborate to get the best feasible water allocation for all water users.

443. **Increase in Water Borne Disease.** No increase of water borne diseases is expected due to the raising of the dam since water quality of the reservoir and below the dam will be monitored. While the surface area of the dam will increase and the opportunity for the incidence of malaria could follow, it is a reality in Kandahar that the current water borne health issues are more related to diarrhea associated with groundwater e-coli levels. Introduction of water protection zones will maintain water quality upstream of the dam and mitigate water borne diseases.

444. **Emergency Response.** In the event of any on-site accident or natural hazard occurring, it is necessary to have a prepared approach. In Appendix 8, a framework for the development of a plan is presented. The plan needs to be detailed by the Project Management Unit in collaboration with all implementing agencies, the contractor, and relevant communities.

Table 27. Summary of Risk Management Procedures for Operation Phase

Risk	Potential impact significance No-Action			Mitigation / Monitoring / Notes	Potential Impact significance Post Action
	Low	Med	High		
Environmental flows may be inadequate for downstream needs.		XXX		ARES to survey more rigorously the environmental needs along river. Sequential flow gauges to be installed to measure river and capacity building program with NEPA established to institute ongoing environmental flow management.	Low
Negative impact upon dam, the spillway or the channel after annual flows.		XX		A detailed water quality monitoring of the dam, spillway, channel and dam performance after each flow in the Spring.	Low
Continued erosion of river downstream during operation	XX			Annual control of the river banks is suggested in order to mitigate and prevent future erosion of the river.	Low

Risk	Potential impact significance No-Action			Mitigation / Monitoring / Notes	Potential Impact significance Post Action
	Low	Med	High		
Water Quality will vary with changes in hydrology, temperatures & winds.		XX		Monitoring of the water quality of the reservoir at various depths	Low
Farmers can interpret environmental flows as being available for their use.			XX	On-going education campaign to raise the understanding of environmental flows by all.	Low

Source: TRTA Consultants, 2019

E. Summary of Impacts

445. Impacts are summarized and listed in the EMP. Mitigation measures are proposed accordingly. The main impacts are as follow:

(i) Adverse impacts are related to the inundation of settlements and agricultural land adjacent to the dam lake. It is anticipated that there is only minor impact on wildlife and vegetation due to raising of the dam.

(ii) Impact on aquatic life (fish) and birds will be assessed by additional detailed environmental surveys. No major impact is expected as fish and birds are already used to changes in surface water level.

(iii) Impact on water quality due to raise of the dam will be monitored (reduction of oxygen content on the bottom of the reservoir).

(iv) Increased in seasonal surface water flows due to shorter melt-down periods, as well as associated increase in sedimentation and evaporation are expected due to climate change.

(v) Erosion in the channels below the spillways is not expected. Raising the dam will reduce flows over the spillways and increase the hydropower production.

(vi) Realignment and construction of Route Bear Highway will have a minor and short-lived impact on the environment.

(vii) The proposed phase one environmental flows are expected to positively contribute to aquatic habitats below the dam throughout the year and will have an overall positive impact on the river aquifer. However, they will be qualified and enhanced by findings and inputs from the detailed environmental survey to be conducted during the detailed design stage.

(viii) Impacts on the socio-cultural, physical and on the biological environment have been described. The impact with highest significance and highest magnitude will be loss of agricultural land and loss of settlements. Compensation measures including revegetation programs and relocating of residents have been taken into consideration.

(ix) Construction related impacts as noise generation and dust generation have been described as short-term limited to construction duration. Mitigation measures including installation of noise barriers and application of water spray, use of tarpaulins, cleaning of wheels have been suggested accordingly.

(x) Maintenance of good surface water quality during operation has been described. This will be implemented during operation of Dahla Dam through proper water management, source protection and water quality monitoring.

(xi) Community health and safety will be provided during construction and operation through provision of adequate health and safety equipment such as ear protection, helmets, inflammable working suits, safety shoes, breathing protection, and safety barriers.

F. Cumulative Impacts

446. The cumulative impact assessment and management (CIA) process acknowledges that over time there will be, as a result of all the components of any project initiative, a compounding of both direct and indirect, positive and negative impacts on valued environmental and social components (VECs). These impacts are invariably operating at a level which is considered either outside of, or beyond the actual project footprint, or will emerge overtime. It is assumed with any CIA that mitigation measures applied at project level are successfully put in place and adhered to. The CIA aims to then assemble and scope the foreseeable impact the project can have at a macro level on VECs.

447. Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not perhaps been identified nor expected in the case of a stand-alone development. Such impacts may include, for example:

(i) Increased pressure over-time on the carrying capacity or the survival of an indicator species in an ecosystem, possibly an indirect result of project success;
(ii) Reduction of water flow in a watershed due to multiple withdrawals;
(iii) Secondary induced social impacts, such as in-migration, or greater traffic and accidents along community roadways owing to increases in transport activity in a project's area of influence.

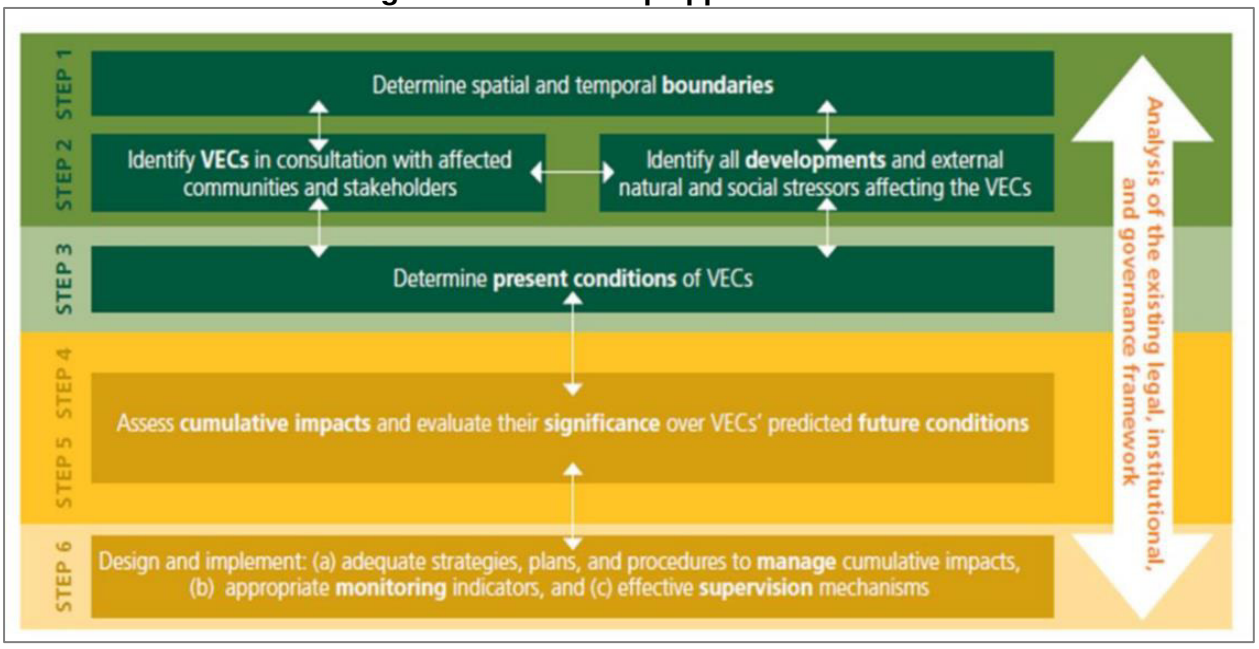
448. The four components of the project will have impacts upon (i) the eco-system health, (ii) the sustainability of resource use, and (iii) the living conditions of people upstream and downstream of the Dahla Dam. The remodeling and operation of the Dahla Dam will initially result in the loss or at best, fracturing of existing habitat and this will have an incremental change in population carrying capacity of a habitat, merely as a result of a loss of habitat. This can then result in population size being forced into small areas which can have significant changes on predator prey relations and domination between different predators. Overtime, over population can also result in disease which will incrementally increase the mortality rate of fauna. It is critical to understand and to be able to measure what these changes mean.

449. To manage and positively overcome the above foreseen issues, multi-disciplinary approaches will be required. For any revegetation and re-establishment of renewed habitat to be sustainable, it will require careful establishment of alternative habitat, education programs regarding the importance of the birdlife, the aquatic life, the status of the catchment and importance of the multiple steps involved in achieving "source protection" etc. Over time, factors such as increasing and competing water use demands, threats to species biodiversity, degradation of ecosystem services, climate change and unpredictability of climate patterns as well as changing socio-economic circumstances all add complexity to risk assessment and management. All such variables will be part of a CIA assessment.

450. The CIA process aims understand in a more systematized manner the interactions of these variables and the potential systemwide consequences resulting from the combination of individual effects of multiple actions overtime. The CIA is therefore an essential framework to

improve risk management.[45] The IFC Good Practice Handbook lays out a six-step process illustrated in the following figure.

Figure 4. The Six Step approach to CIA



Source: IFC Handbook Six Step Process for undertaking CIA.

451. This EIA process is currently still completing Steps 1-3 and has some indications as to Steps 4 & 5. In addition, the draft EIA has made some firm recommendations regarding the needs outlined in Step 6, including strategies for improved understanding and stewardship to positively address catchment management, the adoption of an action-based research, monitoring and real-time data usage to refine the concept of environmental flows in the river, engagement of government partners and communities in the recommended "source protection" mechanisms. The EIA points to the need for long term capacity building both within government and at the community level.

452. A number of examples of issues a CIA would be focused upon include mechanisms to achieve greater management of water against increase pressure upon the resource. Component 2 promotes the need for careful stewardship of reticulated domestic water system thru user-pay mechanisms. Over the previous three years (2016-2018) the city of Kandahar has experienced a population growth average of 2.4%.[46] A considerable proportion of the growth has been attributed to in-migration due the war. However, should this growth continue there will be a doubling of population in 30 years, a scenario which places added pressure on the water resource. The "No increase in the irrigation command area" policy for Component 2 is an example of directives which can promote greater resource stewardship and increased productivity; which in this case could be seen to be following the "more crop per drop" mantra. Component 4 will have some positive influence upon the current dependency on fossil fuel energy sources. The projected dam raise of 13.6 m will generate approximately 143,038 MWhr. GHG savings will be 49,348.11 tons per year assuming that the import of electric power from Turkmenistan will be reduced. Afghanistan currently generates 44.7% of power from fossil

[45] IFC (2013) Good Practice Handbook: Cumulative Impact Assessment and Management.
[46] worldpopulationreview.com/countries/afghanistan-population/

energy (natural gas) in Turkmenistan. Reduced reliance on fossil fuels and increased utilization of renewable energy sources would reduce CO2 emissions.

453. **Sistan Basin**. At the catchment level, the major VEC recognized thru an international agreement between Afghanistan and Iran is the Sistan Basin and the Hamoons which require water.[47] To positively address such an issue requires an integrated intra-government approach, and previous projects including dams on the Helmand, as well as the Dahla Dam, have compromised the flows to the Hamouns. Water impoundment developments across the Helmand river basin over the last 70 years have provided water for irrigation, hydro-power generation and, initiated in a few places, reticulated domestic water supply. The environmental impact and cost of these achievements, along with the processes to mitigate against them, is a very good example of the applicability of CIA. The evolving EF regime which is recommended for the Dahla Dam should aim to be contributing a minimum of 16% to the flow of the Helmand. Similar will be required for all dams. Government and regional planners have the ultimate responsibility for CIA, and projects such as the project can be a vehicle to create change.

454. **Summary**. A successful CIA process will identify and engage all relevant stakeholders to agree on VECs, and on each and all parties' responsibilities in the:

(i) management of the expected impacts on VECs;
(ii) monitoring and/or supervision of the overall condition of the VECs; and
(iii) appropriate implementation of agreed mitigation measures.

455. Direct and immediate impacts are identified as part of the current EIA process and the methodology for assessing the CIA from the project is reflected in this document. However, it is recommended that a longer-term perspective which scopes those issues that will be compounding over time, some of which the proposed project may have limited immediate ability to influence, will be a component of the ARES.

456. The planned ARES will be used, for example, to identify VEC's and, combined with the feedback from both community consultation and relevant social data, will assist in identifying the critical key social issues which are inextricably linked to increased pressure upon those environmental components. The methodology for the CIA, particularly how the impact significance will be provided, will be detailed in the ARES TOR.

G. Limitations of the EIA

457. Project EIAs are generally limited to the direct impacts of the project. This approach directly distances itself from a wider range of impacts, including:

(i) **Cumulative impacts:** The environmental impacts of multiple plans, projects and other actions;
(ii) **Indirect, secondary or induced impacts:** These are impacts that occur several steps away from the original action;
(iii) **Global impacts:** Impacts that go beyond the local, project level, for instance climate change.

[47] Once the home of the Hamoun wetlands, an 800-square-mile (2,000-square-km) oasis fed by the Helmand River, has now become one of the driest in the world. Until the 1990s, the area was booming in agriculture and full of flora fauna. Located in southern Afghanistan, the Sistan Basin has been consistently dammed and used for irrigation for decades. That, coupled with one of the most severe droughts registered in the area ever, has turned the once thriving wetlands into a dust bowl. Precipitation has dropped 78%, and efforts to remedy the situation have been hampered by the war.

458. Cumulative impacts have been discussed. In addition, future environmental impacts in the project area could not be accounted for, due to fast population growth:

(i) Illegal settlements and increasing discharge of human excrement can affect water quality of the dam;
(ii) Deforestation; and
(iii) Illegal ground water and surface water abstraction.

459. The impacts of climate change have been assessed in this report. However, given the uncertainty around projections of climate change impacts in Afghanistan, it is difficult to model future environmental conditions (e.g. annual precipitation, intensity of rainfall patterns, temperature changes, and levels of atmospheric dust). The impact of climate change in the future is essential for water availability in the project area.

460. Ecological surveys such as the fish biological survey and the ornithological survey at the dam are snapshots of the baseline environment. They give only a good indication of the baseline environment. Additional indicator species (e.g. migratory birds) and their respective habitats might not have been assessed and will not be considered in the water management plan of the reservoir.

461. The security situation is an essential limiting factor of ecological surveys at the dam. There is high risk that assessment of habitats and wild life will be incomplete due to security reasons. Access to existing wetlands, shallow water zones, reed and the estuary of the river is limited or not possible.

462. Baseline information regarding the physical, biological and the sociocultural environment is incomplete or not available. Data gaps have been recognized in the project area, such as:

(i) Data on flora and fauna including species lists;
(ii) Endangered species;
(iii) Sensitive and unregistered habitats;
(iv) Current flow data of Arghandab River and its tributaries;
(v) Water quality data of water courses (dam, canals, and the Arghandab River).

463. Identification of project impacts is limited and can be incomplete. A sustainable water management plan for the dam can be developed only after completion of detailed biological and ornithological surveys. Each survey has to be conducted for at least half a year to assess migratory birds, nesting habitats and breeding habitats for birds and fish. Any changes in the seasonal occurrence of species shall be recorded.

464. Impacts on the Arghandab and on the Helmand River basin could not be identified due to a lack of data including:

(i) Registration of all water intakes;
(ii) Flow measurements and water consumption of existing water intakes;
(iii) Drainage and backflow into the river;
(iv) Registration of waste / human excrement discharge points.

465. As suggested in the following section, a master plan for the whole river basin is required.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

466. Impacts and proposed mitigation measures summarized and described above are itemized in the Environmental Management Plan and Mitigation Measure Summary. It is expected that the EMP will be reviewed and developed to a greater level of detail as required during the detailed design stage. Responsibilities for mitigation implementation (pre-construction to operation) are shown. The major responsibility for implementing construction mitigation measures will rest with the contractors selected to implement civil works packages. These contractors will work under the supervision and overall management of the Project Management Unit.

467. Mitigation of operation-phase impacts involves capacity building of responsible institutions (ASBA, DABS and MEW), and the implementation of mitigation measures by these strengthened institutions. Capacity building to implement operation-phase mitigation will be planned by MEW. The planned capacity building activities will be delivered by staff or contract trainers under their supervision to staff/members of the ASBA, who will be responsible for implementing operation-phase mitigation. A detailed program for capacity building will be developed during the detail design stage.

468. The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; sensitivity, scale, nature, and magnitude of its potential impacts. Significance (degree) and magnitude (geographical extent) of the impacts have been evaluated and included in the EMP. Further, the EMP provides adequate opportunities towards course correction to address any residual impacts during construction and operation.

A. Summary

Table 28. Environmental Management Plan and Mitigation Measure Summary

Project activity	Potential impacts	Mag	Sig	Proposed mitigation	Responsibility	Cost
Detailed Design and Pre-construction						
Procedures to protect water source	The Dahla Dam body of water needs protection from all potentially harmful agents	H	H	Commence steps to highlight procedures which will protect the water source from potential contamination by the construction, adjacent settlement, surrounding and up-stream land-uses etc both within and beyond the life of the project.	MEW, PIU Mirabs, NEPA.	Part of detailed design.
Identify historical artefact	Historical artefact discovered during construction phase will result in interruption of construction activities	L	L	Implement archaeological survey before the construction phase and identify procedures to follow should same be unearthed.	MEW, PIU, Archaeology Institute Kabul	Part of detailed design
Complete site geotechnical investigation	Assessment should be made of the existing dam wall including	H	H	Results from investigation to inform the structural and safety requirements of any upgrading of existing structure.	MEW, PIU,	Part of detailed design

	structural requirements and safety of proposed wall.					
Identification of borrow pits for construction material	The size of the material required for the dam walls will leave considerable cavity.	M	M	Location of all borrow pits need to be canvassed with community leaders with a clear explanation of “impact and make-good” practices communicated.	MEW, PIU,	Part of detailed design
Construction activities	Impacts on environmental sensitive areas and on environment	H	H	Apply NOC at NEPA before construction activities.	NEPA, PIU, MEW, ASBA, DABS	Part of design costs
Define expected high-point of new water body	Existing informal settlement and agricultural activity will be impacted	H	H	LARP will be put into action.	MEW, PIU,	Part of detailed design
Realignment of Route Bearer Highway	New route for Highway may present problems	L	L	New road alignment needs to be communicated with community.	MEW, PIU,	Part of detailed design
Transportation of construction material	Unorganized transportation of construction material will cause social impacts	H	J	Identification of transportation routes and parking areas for heavy machinery and truck.	MEW, PIU, contractor	Part of design costs
Consideration of sedimentation flushing technology	Technology which liberates sediment and provide positive downstream benefits	L	M	Investigate further if such technology can be cost-effective.	MEW, PIU,	Part of detailed design
Assess appropriate catchment management plan	Implementation of a plan to minimize surface sediment flows would be positive	L	M	Complete an assessment of potential catchment management plans as part of the ARES.	MEW, PIU,	Part of detailed design
Medium to longer term change in downstream water conditions	Agronomic practices may benefit from greater levels of ‘extension’ and advice.	L	L	Consideration given to practices which may assist farmers using modified systems.	MEW, PIU, DAIL.	Part of detailed design
Flooding	Uncharacteristic weather events may increase	M	M	Assessment of vulnerability of downstream settlement and farming areas	MEW, PIU,	Part of detailed design

	including flooding					
Institute diversion canals	To avoid any cessation of water supply during construction	H	H	Design to incorporate diversion canals in order to maintain downstream water needs.	MEW, PIU,	Part of detailed design
Location of construction camps and storage facility	Construction camp and stockpile area need to be located where they will have minimal impact	M	M	Location of camps to be identified in consultation with community leaders during design phase. This sites are expected to be downstream of saddle dam 6 where previous construction camps where located.	MEW, PIU,	Part of detailed design
Working hours	The timing of activities may have social impact upon farming and community life.	M	M	Design will incorporate the specific need to communication with community on all relevant issues. Construction sites are at least 1,000m away from any villages for the dam raise but only 150m away for one village for the route bearer highway realignment.	MEW, PIU, Contractor	Part of detailed design
Design of construction activities	Impacts on environmental sensitive areas and on environment	H	H	Standard construction environmental safeguard clauses will be part of the tender documents to avoid construction related impacts. Apply NOC at NEPA before construction activities.	NEPA, PIU, MEW, ASBA, DABS	Part of design costs
Construction activities	Uncontrolled disposal of waste	H	H	Preparation of SSEMP including waste management plan to manage proper disposal waste on designated landfill	MEW, PIU, contractor	Part of design costs
Excavation of soil	Uncontrolled disposal of soil	H	H	Development of soil management plan as part of the SSEMP	MEW, PIU, contractor	Part of design costs
Construction						
Operation of contractor's camp	Impact on groundwater, surface water, soil at the contractor's yard	M	H	Layout plan of the work camp including description of precautionary measures. SSEMP developed by Contractor including workers sanitation management plan, comprehensive waste management plan. Description and layout of equipment maintenance area. Description of lubricant and fuel storage facilities area.	PIU, Contractor	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Historical, archaeological findings during excavation	M	M	Contractor shall have protocols in SSEMP regarding any excavation work, to ensure that any archaeological or culturally significant findings are recognized and measures are taken to ensure they are protected and conserved.	Contractor, PIU	Part of construction costs

				This will involve: (i) Having excavation observed by a person with archaeological field training; (ii) Stop work immediately to allow further investigation if any findings are suspected; (iii) Calling the state archaeological authority if a finding is suspected and taking any action they require to ensure its removal or protection on site.		
Construction site clearance including tree removal	Loss of ecological services and aesthetic value of trees removed from construction sites	M	M	Develop and implement revegetation strategy.	Contractor, PIU	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Impact on soil	L	L	Dispose roadway rubble on a waste disposal site. Avoid scheduling of excavation work during heavy rain. Complete the excavation and foundation during dry weather. In unavoidable circumstances, protect open trenches from entry of rain water by raising earthen bunds with excavated soil.	PIU, contractor	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Risk due to high risk seismic intensity zone	M	M	Apply design and construction norms of low-risk seismic zone. Select appropriate material and design according to seismic intensity of project area.	Design consultant, contractor	Part of design costs
Construction phase; Dahla Dam and six saddle dams	Loss of top soil	M	M	Top soil of approx 0.3 m shall be removed and stored separately during excavation work, and after construction the same soil shall be replaced on the top.	PIU, contractor	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Erosion due to excavation/refilling	M	M	No vegetation shall be removed from the slopes; clearing of shrub, bushes and grass shall be limited to actual construction area only; no clearance is allowed for activities such as material/waste storage, concrete mixing, etc as per SSEMP. Ensure proper compaction of refilled soil and there shall not be any loose soil particles on the top; the material shall be refilled in layers and compacted properly layer by layer.	PIU, contractor	Part of construction costs
Construction phase; Dahla Dam and six	Impact on ambient air quality due to dust generation	M	M	Cover or damp down by water spray on the excavated mounds of soil to control dust generation in populated areas as per SSEMP.	Contractor, PIU	Part of construction costs

saddle dams				Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process. Bring the material (aggregate and sand) as and when required. Ensure speedy completion of work and proper site clearance after completion. Damp down unsurfaced/bad condition roads to avoid dust generation while using for transport of waste/material. Use tarpaulins to cover loose material that is transported to and from the site by truck. Control dust generation while unloading the loose material (particularly aggregate and sand) at the site by sprinkling water/unloading inside barricaded area. Clean wheels and undercarriage of haul trucks prior to leaving construction site. Don't allow access in the work area except workers to limit soil disturbance and prevent access by fencing.		
Construction phase; Dahla Dam and six saddle dams	Impact on air quality due to emissions from construction equipment/ vehicles	M	M	Ensure that all equipment & vehicles used for construction activity are in good condition and are well maintained as per SSEMP. Ensure that all equipment & vehicles confirms to emission and noise norms.	Contractor, PIU	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Removal of vegetation/trees for construction and impacts due to presence of open trenches	M	M	Avoid tree cutting and small changes of layout plan/alignment. In unavoidable cases, plant five trees of same species for each tree that is cut for construction as per SSEMP. Bushes and grasses shall be cleared only in actual construction area, all other preparatory works (material storage) shall be conducted on barren lands without vegetation	Contractor, PIU	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Disturbance/nuisance/noise due to construction activity including haulage of	M	H	Plan transportation routes in consultation with rural authorities, road department, and Police as per SSEMP. Schedule transportation activities by avoiding peak traffic periods. Use tarpaulins to cover loose	Contractor, PIU	Part of construction costs

	material/waste			material that is transported to and from the site by truck. Control dust generation while unloading the loose material at the site by sprinkling water. Clean wheels and undercarriage of haul trucks prior to leaving construction site. Educate drivers: limit speed between 20-25 km/h in settlements and avoid use of horn. Earmark parking place in town for construction equipment and vehicles when idling; no parking shall be allowed on the roads, that may disturb the traffic movement. Prepare a traffic guiding concept for the construction period. Provide prior information to local people about work. No night time construction activities including material/waste haulage.		
Construction phase; Dahla Dam and six saddle dams	Socio-economic benefits from employing local people in construction work	H	H	To the extent possible labour force must be drawn from the local community.	Contractor, PIU	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Safety risk – public and worker	H	H	Follow standard and safe procedures for all activities – such as provision of shoring in deep trenches (>2 m) as per SSEMP. Exclude public from the site – enclose construction area, provide warning and sign boards, security personnel. Provide adequate lighting to avoid accidents. Ensure that all workers are provided with and use appropriate Personal Protective Equipment - helmets, hand gloves, boots, masks, safety belts (while working at heights etc.). Maintain accidents records and report regularly.	Contractor, PIU	Part of construction costs
Construction phase; Dahla Dam and six saddle dams	Cumulative impacts – repeated disturbance to roads and people	M	M	Schedule the construction activities in harmony with the other ongoing works. Schedule works before road work.	Contractor, PIU	Part of construction costs
Construction phase; Dahla Dam and six	Contamination of surface water	H	H	Store fuel tanks away from surface water on a safe location - minimum 50 m distance to surface water. Provide modern non-leaking	Contractor, PIU	Part of construction costs

saddle dams				equipment. Refuel engines at minimum distance of 50 m to surface waters. Provide adhesive agent for mineral oil. Excavation and disposal of waste and contamination.		
Extension of existing saddle dams and main dam wall by 13.6m	Existing reservoir area is about 29.54 sq. km, once raised, the reservoir area will be around 45.81 sq. km.	L	L	Construction material (stones, rocks, rip rap, gravel) will originate from adjacent licensed quarries - no impact on landscape expected. Any removed vegetation due to permanent inundation will be considered part of the revegetation program.		
Construction works during raise of the dam and saddle dams	Impact on water quality (turbidity)	L	M	Construction works to be implemented during dry season - no increase of turbidity at saddle dams as water body of reservoir will not touch saddle dams; geotextile bags provided at main dam to mitigate turbidity.		
Construction works during raise of the dam and saddle dams	Impact on existing aquatic life within dam (turbidity, vibration, noise)	L	L	Fish will migrate to untouched areas of the reservoir. No underwater blasting is expected to be required and no blasting is envisaged at the dam site at all. (Blasting maybe needed to quarry material along the existing Route Bearer Highway).		
Construction works during raise of the dam and saddle dams	Impact on bird life (vibration, noise)	L	L	Birds will leave the construction site and search for habitats close to the reservoir, no mitigation measures are required.		
Construction roads	Crop damage from temporary construction roads, cutting of trees	H	H	Community consultation. road siting and timing. If significant impact, compensation to be implemented, if tree cutting is expected five trees of the same species will be planted.		
Operation of vehicles and equipment; generation of liquid and solid waste	Excessive noise, dust, air / water pollution, fuel/oil spills, pollution from improper liquid/solid waste disposal	M	M	Routine construction housekeeping measures per contractor all detailed and monitored in SSEMP.		
Operation and maintenance						
Release of water below the dam into Arghandab River	Erosion of the river bed and embankments, sedimentation upstream of weirs	M	M	River bank structure from the tailrace to the reservoir is dominated by larger stones and boulders, regular inspection of the river bed in spring, sediments have to be excavated and stored, no	MEW PIU ASBA contractor	Included in MEW staff costs

				flushing of sediments as sediments will clog the gap system of the river and destroy spawning habitats and aquatic habitats.		
Release of water over the spillway	Erosion of spillway channel	M	M	The existing rock lining is sufficient for stability, regular monitoring of the spillway required to prevent further risks, regular inspection of channels in spring.	MEW PIU ASBA contractor	
Recharge of the reservoir	Sedimentation of the reservoir and increased sedimentation due to climate change	M	M	Construction of upstream dam would reduce sedimentation (Hasanzay dam).	MEW	
Rise in dam wall	Flooding of existing bird habitats and wetlands	M	M	Ornithological survey will identify existing habitats and bird species, no impact expected as new wetlands will arise due to ongoing sedimentation, birds can move to estuary of Arghandab river.	MEW, PIU	
Rise in dam wall	Flooding of settlements, agricultural land	H	H	Compensation and resettlement due to resettlement action plan.	MEW, PIU	
Water depth of the reservoir will increase	Loss of oxygen on the bottom of the reservoir	M	M	Oxygen concentration on the bottom has to be monitored, concentration <4 mg/l threaten aquatic organisms, fish will move to higher water layers where is more oxygen.	MEW, contractor	
Decrease in water level of the reservoir due to water release	Reduced water volume threatens aquatic organisms	H	H	Minimum water volume is required to keep aquatic organisms alive, minimum volume to be determined after fish survey.	ASBA MEW contractor	
Operation of turbines	Fish losses are expected during the passage through turbines	H	H	Sustainable environmental flow will create aquatic habitats below the dam.	ASBA, PIU	Part of construction costs
Operation of Dahla Dam	Contamination of water source, eutrophication of the dam lake	H	H	Installation of water protection zones. Elimination of point pollution sources alongside open water sources for example inflow pipes for street run-off water, other forms of wastewater and garbage disposal. No settlements at a distance of at least 500 m to the lake.	MEW, PIU, ASBA	
Construction of Route Bearer Highway						
Discovery of physical/ heritage	Destruction of physical/ cultural	M	M	Stop activity, prepare "chance" find procedures.	Contractor, PIU	Part of construction

resources	resources					costs
Construction of Route Bearer Highway	Erosion or sedimentation caused during clearing or earthworks	M	M	Implement water spray to prevent wind erosion, revegetation of cleared areas, protect side slopes use gabion baskets	Contractor, PIU	Part of construction costs
Construction of Route Bearer Highway	Soil contamination from spillage of oil or other chemical substances	M	M	Store chemicals in secure area / compound, with concrete floor and weatherproof roof. Ensure construction plant is maintained in good condition and any leaks are quickly repaired. Remediation of soil spills. Storage of hazardous substances at minimum distance of 100 m from water courses.	contractor	Part of construction costs
Construction of Route Bearer Highway	Disposal of surplus soil, excavated material	L	L	Disposal at designated site (mining pits, mining galleries); storage of topsoil to be used for re-vegetation, reuse of surplus material for road construction.	Contractor, PIU	Part of construction costs
Construction of Route Bearer Highway	Air pollution from dust or exhaust emissions (CO, NOx, SOx, etc)	M	M	Implement dust suppression measures including watering of exposed surfaces. Cover all trucks carrying dispersible materials to or from the construction site. Minimize size and duration of cleared areas. Ensure all construction vehicles and equipment are well maintained.	Contractor	Part of construction costs
Construction of Route Bearer Highway	Interference with existing infrastructure (telecommunication., electricity, water, waste water)	M	M	Research of underground cables and pipes.	Contractor	Part of construction costs
Construction of Route Bearer Highway	Exploitation of local resources incl. poaching	L	L	Poaching or felling trees that are not required to be cleared or removed by the project within the project areas will be forbidden Contractor will impose sanctions on any worker for poaching for felling trees unnecessary for the project	Contractor	
Construction of Route Bearer Highway	Noise from construction machinery and equipment	M	M	Ensure all construction vehicles and equipment are well maintained. As far as possible limit noisy construction activities to day time hours in the vicinity of houses and hospitals and to night time hours in the vicinity of schools; construction	Contractor, PIU	Part of construction costs

				activities from 7.00 am to 7.00 pm to be discussed with local stakeholders. Concrete and asphalt mixing stations must not be located nearby residential areas, schools and hospitals. Inform nearby community of schedule and duration of construction works. Provide workers with noise abatement equipment (ear-plugs etc).		
Construction of Route Bearer Highway	Changes to road safety / traffic movements, property access			Install signage and lighting in vicinity of works on public roads. Install temporary access to affected properties. Rebuild good quality permanent access to affected properties on completion of construction works. Inform nearby community of schedule and duration of construction works. Limit construction vehicle movements to main transport routes as far as possible. Development of a traffic control plan.	Contractor, PIU	Part of construction costs
Construction of Route Bearer Highway	Interference with commercial activities on roadside	M	M	Install temporary access to affected properties. Rebuild good quality permanent access to affected properties on completion of construction works. Notify nearby community of schedule and duration of construction works not less than two weeks in advance of works.	Contractor, PIU	Part of construction costs
Construction of Route Bearer Highway	Employment or livelihood benefits from employment of local people	H	H	Maximize the number of local people involved in the construction works	Contractor, PIU	Part of construction costs
Construction of Route Bearer Highway	Visual and landscape impacts	M	M	Re-vegetation measures, use of stored topsoil. Only material from licensed borrow pits to be used for construction; excavated material to be used as fill material for base layer and embankments if suitable to reduce volume of surplus material.	Contractor, PIU	Part of construction costs
Construction of Route Bearer Highway	Risks to public or construction worker health or safety	M	M	Provide safety equipment to workers and train them in its use.		Part of construction costs
Construction of Route	Felling of fruit trees in Shah	H	H	Replant / replace fruit trees, five trees for each tree to be felled.	Contractor, PIU	Part of construc

Bearer Highway	Joi village and adjacent agriculture land					tion costs
Operation of Route Bearer Highway						
Operation of Route Bearer Highway	Changes to road safety	H	H	Installation of road safety/speed limit signage where accidents are likely to occur.	PIU, contractor	Part of operation costs
Operation of Route Bearer Highway	Environmental damage from accidents involving spills of chemicals or other hazardous substances	H	H	Install speed limits and warning signs in areas of difficult driving conditions; no transportation of hazardous substances in water protection areas; development of emergency plan.	PIU, contractor	Part of operation costs
Operation of Route Bearer Highway	Changes in dust levels or air quality	M	M	Upgrade / rehabilitation of the road decreases dust generation. Vehicle emissions must be monitored according to national standards. Work with local authorities to ensure regular cleaning of the road surface. Work with local authorities to implement regulations for trucks to wheel washing and covering of dispersible loads.	PIU, contractor	Part of operation costs
Operation of Route Bearer Highway	Erosion at water courses crossings (bridges and culverts), or in areas of fill or embankments	L	L	Implement stabilization and anti-scouring measures as required at bridges and culverts.	PIU, contractor	Part of operation costs
Operation of Route Bearer Highway	surface water or groundwater pollution from contaminated road surface runoff	L	L	Undertake regular maintenance and cleaning of roads; construction of water retention measures. Work with local authorities to restrict movements of polluting vehicles. Maintenance of road drainage system.	PIU, contractor	Part of operation costs

H-High; M- Medium and L-Low; Mag-magnitude; Sig-significance
PIU: Project Implementing Unit
Source: TRTA Consultants, 2019

B. Environmental Monitoring

469. A program of monitoring will be required to ensure that all concerned agencies take the specified action to provide the required mitigation and assess whether the action has adequately protected the environment, and to determine whether additional measures may be necessary. Regular monitoring of mitigation measures by contractors will be conducted and overseen on behalf of MEW. Monitoring during the operation stage will be conducted by the contractor in line with ADB requirements.

470. Environmental monitoring involves: (i) sampling program for systematic collection of data/information relevant to environmental assessment and project environmental management; (ii) analysis of samples and data/information collected, and interpretation of data and information. Environmental monitoring is carried out before, during, and after the construction phase. Environmental monitoring will be implemented to detect changes in the key quality parameters. The results of the monitoring program are used to evaluate the following: (i) magnitude and significance of the environmental impacts; (ii) efficiency of the environmental protection measures.

471. Environmental monitoring includes a sampling program. The collected data will show whether objectives have been achieved (e.g. effectiveness of mitigation measures). The monitoring program has to consider its practicability considering the technical, financial, and capability of the institutions that will carry out the program and period of monitoring that will be needed to achieve the objectives.

472. The EMP includes implementing institutions. Locations and frequency of monitoring are also listed.

473. Most of the mitigation measures are standard methods of minimizing disturbance from building in rural and urban areas (maintaining access, planning work to minimize public inconvenience and traffic disruptions, finding uses for waste material, etc.). Monitoring of such measures normally involves making observations in the course of site visits, although some require more formal checking of records and other aspects.

474. The following table shows the proposed EMP for this project, which specifies various monitoring activities to be conducted. It describes: (i) mitigation measures, (ii) parameters to be monitored, (iii) location, (iv) measurement method, (v) frequency of monitoring and (vi) responsibility (for both mitigation and monitoring). Monitoring will be implemented on the following parameters: all design and construction related mitigation measures, water quality, air quality, ground water, noise, and flow of Arghandab River.

475. The water quality monitoring will detect trends of water quality and minimum and maximum values of water quality parameters. Needs for mitigation will be detected (e.g. for oxygen depletion). The focus of the water quality monitoring program will be to document the water quality changes resulting from the construction and operation of Dahla Dam. Monitoring during operation of the dam will be important for the judging whether the natural aeration of the dam will be sufficient, especially in dry years and during low water levels of the dam. A conventional water sampling and laboratory analysis approach is considered the most reliable monitoring method at this point.

476. Two monitoring locations are suggested at this stage in the area of influence of Dahla Dam: upstream and downstream of the dam. Parameters relevant to the oxygen and the eutrophication situation have been given priority.

477. A monthly monitoring frequency is recommended at this stage and might have to be adjusted during construction and operation. Monthly reports should present aggregate data in table and figure format, accompanied by narrative explanation and interpretation. A separate section should summarize the water quality situation and changes related to the project and project activities.

478. Monitoring will be implemented by an independent consultant. The consultant will prepare monthly monitoring reports during construction and operation. Reports will be submitted to NEPA for final approval.

479. Environmental training will be conducted before the beginning of construction activities. The training will involve the construction supervision, environmental engineers and work force. The training will focus on implementation of mitigation measures as listed in the EMP, waste management, storage of hazardous substances, oil spill prevention, noise and dust prevention soil management, noise and air quality monitoring, etc.

480. The Project Implementing Unit (PIU) will consist of responsible parties as ASBA, MEW, local government of Kandahar, DABS and the contractor.

Table 29. EMP Construction Phase – Dahla Dam

Mitigation measures	Parameters to be monitored	Location	Measurements	Frequency	Responsibility
All construction related mitigation measures	Implementation on site	All construction sites	Observations on/off site; interviews with people and workers	Weekly	Contractor, PIU, MEW
All design related mitigation measures	Inclusion in the project design	-	Design review	As needed	Contractor, PIU, MEW
Water quality measurement during and after construction	Turbidity, pH, conductivity, temperature	Upstream and downstream of the dam		Before and during construction	Contractor, PIU, MEW
Mitigation measures related to air quality	Air quality monitoring (NO_2, SO_2, CO, $PM_{2.5}$, PM_{10})	Construction site, Camp site	According to WB – IFC standards	Monthly before and during construction	Contractor, PIU; MEW
Mitigation measures related to noise	Noise levels monitoring	Construction site, Camp site	According to WB – IFC standards	Monthly before and during construction	Contractor, PIU; MEW

Source: TRTA Consultants, 2019

Table 30. EMP Operation Phase – Dahla Dam

Mitigation measures	Parameters to be monitored	Location	Measurements	Frequency	Responsibility
Conduct water quality monitoring	Turbidity, conductivity, temperature, oxygen, transparency (Secchi-depth), BOD5, COD, heavy metal, colour, Total Alkalinity (as CaCO3), Alkalinity P (as CaCO3), Alkalinity M (as	Upstream and downstream of the dam, in the dam at water surface and on the bottom		Once per month	Contractor, ASBA

	CaCO3), Bicarbonate HCO3-, Carbonate-Hydroxide OH-, Chloride Cl-, Taste Sulphate SO4, Taste Sulphite SO3, Sulphide S2, Fluoride F, Fluorosis, Nitrate NO3-, Nitrite NO2-, Phosphate PO4, Boron B, Bromide Br-, Total Hardness: (as CaCO3), Calcium Hardness: (as CaCO3), Sodium Na+, Taste Potassium K+, Calcium Ca2+, Chromium Cr6+, Cancerogenic, Magnesium Mg2+, Ammonium NH4+, **Odour - taste threshold**, Manganese Mn2+, Copper Cu total, Taste Aluminium, Total iron Fe2+ and Fe3+, Taste and odour, Total Arsenic				
Conduct groundwater monitoring	Ground water level	Wells of Kandahar Water Supply Agency		Monthly	Contractor, Kandahar Water Supply Agency
Monitoring of flow in Arghandab River basin	Flow	Gauging stations of MEW on the Arghandab River		Monthly	MEW
Planting of trees as compensation measure	Counting and assessment of planted trees	On site	Qualified assessment of establishment	At planting and monitoring during establishment.	Construction supervision

Source: TRTA Consultants, 2019

Table 31. EMP Construction and Operation – Route Bearer Highway

Mitigation measures	Parameters to be monitored	Location	Measurements	Frequency	Responsibility
Construction					
Conduct monitoring of	Visual inspection to ensure quarry	quarries	Visual inspection	Weekly	Environmental construction

quarries	rehabilitation as per EMP				supervision, PIU
Conduct air quality monitoring in Shah Joy village.	Monitoring baseline particulate to the standard PM2.5	At village which is 150m from the road realignment	PM2.5	Before works commence and weekly during construction.	Environmental construction supervision, PIU
Ensure vegetation clearance has been minimized.	Visual inspection of the vegetation.	Material Storage Sites	Visual inspection	Weekly	Environmental construction supervision
Minimize erosion	Visual inspection of prevention measures per EMP and occurrence of erosion	Road corridor / slopes	Visual inspection	Weekly	Environmental construction supervision, PIU
Minimize / prevent rockfall	Visual inspection of rock fall sites	Active rock fall sections, steep slopes	Visual inspection	As required	Environmental construction supervision, PIU
Minimize soil and water contamination, storage in double walled storage tanks / bins / drums. Provide collecting tray	Visual inspection of storage areas	Storage of hazardous substances, contractor's camp	Visual inspection	Weekly	Environmental construction supervision, PIU
Supervised proper waste management, provide waste management plan	Visual inspection of waste storage areas	Waste management	Visual inspection	Weekly	Environmental construction supervision, PIU
Minimize / prevent oil spills	Visual inspection of culverts and bridges	Surface Water Quality bridge sites, culverts	Visual inspection	As required	Environmental construction supervision, PIU
Location of plant out of residential areas > 500m away	Air quality	Asphalt plant	Visual inspection	monthly	Environmental construction supervision, PIU
	Dust suppression; PM	Road alignment	Visual inspection	Daily / weekly	Environmental construction supervision, PIU
dBA at sensitive areas as per EMP, use of silenced equipment,	Noise and vibration	Construction site	Visual inspection of mitigation measures, monitoring of	As required	Environmental construction supervision, PIU

blasting and hammering, rock cutting to be implemented during the day			noise as per EMP		
Operation					
Noise mitigation measures: no night time heavy vehicle traffic in residential areas	noise	Road alignment	noise	As required	Contractor
Air quality: regular road cleaning	Air quality	Road alignment	Air quality	Monthly, as required	Contractor
Erosion: regular inspection of slopes	Visual assessment of erosion resulting from project	Road alignment	erosion	Monthly, after rainfall	Contractor
Water quality	Road corridor and culverts during rainfall	Culverts and bridges	Water quality as per EMP		Contractor
Road safety	Road corridor	Road alignment	Collect road accident data	Twice / year for 3 years or after complaint. Midterm monitoring	Contractor, PIU

Source: TRTA Consultants, 2018

C. Implementation Arrangements

481. The EMP is divided into the three critical stages of the project: (i) detailed design, (ii) construction / implementation and (iii) operation. It is critical for the success of the EMP that the contractors understand and implement the SSEMP with competence and conviction. Monitoring of the contractor will be the responsibility of the PIO, however the assumption behind the EIA is that there is a professional obligation which the contractor must assume for implementation to be successful. It is therefore critical that the contractor has the technical capability to develop and implement day-to-day management systems related to the complete range of physical and social issues.

D. Performance Indicators

482. The desired outcome from the implementation of the EMP is that there is both understanding and confidence that the full spectrum of potential issues foreseen during the project feasibility and formulation have been addressed. The following table summarizes and outlines a spectrum of indicators and targets which can be tracked over time.

Table 32. Performance Measurement Indicators

Issues	Inputs (resources)	Outputs (activities)	Intermediate outcome	Final outcome (environmental impact)

Construction mitigation measures on biophysical minimised	Base-line data sets established and monitored	Any variance in data established	Range of potential impact verified	Systematic evidence of success or otherwise through data
Contractor completes construction with attention to potential impacts.	Implementation of SSEMP	Implement monitoring and inspections	Site variables managed appropriately	Foreseen Impacts resolved through SSEMP
Removal of vegetation and revegetation	Development of revegetation strategy	Replanting and establishment	New vegetation communities established	Vegetation begins to perform habitat functions
Water quality and quantity threatened during life of project.	Diversion canals, water monitoring process.	Water quality and quantity maintained and enhanced during life of project	All partners acknowledge success.	Long term source protection put in place
Steady involvement and participation by local community	Liaise with community groups and *mirabs*	Clear expectations and understanding with community	Involvement and commitment to success of project.	Local ownership and support of construction process

Source: TRTA Consultants, 2019

E. Budget

483. The environmental monitoring costs covers the environmental monitoring for air, water quality and noise, onsite testing instruments, logistic support and maintenance costs. Total estimated costs for environmental monitoring implementation at Dahla Dam. The breakdown of monitoring costs of construction and operational phases of the dam are also calculated and shown in the following tables.

Table 33. Cost Estimate for Environmental Monitoring Team

Position	**Remarks**	**Number**	**Tentative salary** (AFG)	**Construction phase (36 months)** (AFG)
Environmental expert	Engineer or scientist with sufficient experience dealing with environmental issues	1	45,340	1,632.24
Junior environmentalist	Engineer or Environmentalist having experience of dealing with environmental issues at project level	1	22,670	816.12
Administrative and support staff	One computer operator, one admin officer, one office assistant and one driver	4	40,000	5,760.00
	Total	**6**	**108,010**	**8,208.36**

Source: TRTA Consultants, 2019

Table 34. Environmental Monitoring Cost for Construction Phase (36 months)

Monitoring parameters	**Monitoring locations/ sources**	**Monitoring frequency**	**No of sites**	**No of samples**	**Unit rate** (AFG)	**Total amount** (M AFG)
Water Physiochemical and chemical parameters	Upstream and downstream of the dam	Monthly	2	72	5,668	408,096

Air quality Monitoring (NO_2, SO_2, CO, PM)	Construction site, Camp site	Monthly	7	252	5,668	1,428,336
Noise levels monitoring	Construction site, Camp site	Monthly	7	252	850	214,200
					Total	**2,050,632**

Source: TRTA Consultants, 2019

Table 35. Environmental Monitoring Cost for Operational Phase (5 Years)

Monitoring parameters	**Monitoring locations/ sources**	**Monitoring frequency**	**No of monitoring sites**	**No of samples**	**Unit rate** (AFG)	**Total amount** (M AFG)
Water quality physiochemical and chemical parameters	Dam	Monthly	3	120	5,668	680,160
					Total	**680,160**

Source: TRTA Consultants, 2019

IX. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Ongoing consultations

484. Project communities have been consulted and informed in an ongoing, continuous process involving meetings with heads of villages and discussions with individual persons. The consultation process will continue throughout the project implementation phases. A similar procedure will be carried out throughout all project phases.

485. The team of environmental and social experts have been and will continue to conduct public consultations. Consultations have been arranged with the consent of the local stakeholders and according to the Afghan Administrative Guidelines for the Preparation of Environmental Impact Assessments (Jun 2008), the Environment Law (Article 19), and ADB's Public Communications Policy (2011). People have the right to be informed about and to participate in ADB projects.

486. Three consultative workshops and stakeholder meetings were held on Dahla Dam Multi-Sector Water Allocation Options in Kandahar and Kabul in November 2018, December 2018 and January 2019; during which environmental concerns were raised by participants.

487. The key environmental concerns raised by participants during the workshops can be summarized as follows:

(i) The participants thought that they are already facing water shortages;
(ii) Most of the bio-diversity is found upstream and in or around the dam, where water is available during all months of the year;
(iii) Downstream lands are mostly private and people irrigate their crops when they need using their own boreholes;
(iv) Some species of birds living downstream fly to the upstream areas, when there is no water in the downstream areas. When an amount of water is allowed in the river for the environment, people will use that amount for irrigation;
(v) The participants thought that unless a strong water management system is created, environment flows will not be effectively utilized;
(vi) The Dahla Dam area is a picnic spot, families from all Kandahar city gather there on Thursdays. Participants requested the project to further improve the recreational area. For financial sustainability of the project, the government should collect a fee for admission to the park;
(vii) Conduct awareness campaign on the environmental issues and raise the awareness of people;
(viii) Train law enforcement agencies on environmental issues and enforcement, for example people illegally cutting trees and hunting protected species of birds.

488. A Consultative Workshop on Component 1 Key Land Acquisition and Resettlement, Environmental Impacts is planned for 6-9 April in Kandahar City. The Project's anticipated environmental impacts and extent of impacts will be presented to affected people's representatives and other stakeholders and public concerns will be discussed and evaluated. Further consultation sessions to be held during the detailed design and construction phase will be agreed upon during the workshop.

489. Baseline socio-economic surveys for all components have included household level questions to gauge how much people agreed or disagreed with the following statements:

(i) I am worried that water pollution may be affecting the health of my family;
(ii) Litter and garbage are a big problem in the area where I live;
(iii) I am worried that air pollution (either inside my house, or outdoors) may be affecting the health of my family;
(iv) I want to learn more about what I can do to make the environment better for myself and my family;
(v) People in my community are not aware of or concerned about the environment;
(vi) Climate change is making it more difficult for me to earn a livelihood.

B. Consultations During the Detailed Engineering Design Stage

490. The following criteria and methodology will be used for carrying out public consultations according to ADB's Public Communications Policy:

(i) Local communities and individuals who are directly or indirectly affected, are identified;
(ii) The local communities will be informed through public consultation, with briefings on the project interventions, including its benefits;
(iii) The environmental concerns and suggestions made by the participants are be listed, and discussed, and suggestions accordingly incorporated into the EMP.
(iv) Some other disclosing information methods to be considered are:
(v) information campaigns, the media;
(vi) public meetings;
(vii) focus group discussions;
(viii) household/individual interviews/discussions;
(ix) workshops/seminars;
(x) project websites; and
(xi) local information boards.

491. The most commonly used approaches to consultations, information sharing and engagement with stakeholders are outlined as follows:

(i) Wide community consultations include a broad representation of the communities;
(ii) Targeted Stakeholders Consultations include specific groups of affected persons such as affected business owners, APs losing agricultural land, etc.
(iii) Workshops include representatives of local authorities and representatives of the project communities;
(iv) Focus group discussions include representatives of local authorities, communities, women groups, youth groups, and any other third parties to discuss specific project-related issues and gather participants' opinions, suggestions and concerns.
(v) Key informant interviews are conducted mostly during the project preparation phase to generate information and ideas about project.
(vi) Face-to-face meetings with the APs are held to clarify confidential information on the compensation amount, particular entitlements related to the APs' affected assets, complaints or concerns related to the project, as needed.
(vii) Questionnaires/interviews may include socioeconomic questionnaires, census questionnaires, poverty assessments, gender-related interviews, etc.

492. Consultation proceedings should be properly documented. The essential documents should include:

(i) Summary,
(ii) List of the key issues raised by the participants,
(iii) Agreed actions,
(iv) Photographic records, and
(v) List(s) of participants.

493. Careful coordination and cooperation among the various stakeholders in the Project will be necessary. Key stakeholders include the Government of Islamic Republic of Afghanistan, MEW, MAIL, DABS, ASBA, NEPA, Archaeology Institute Kabul, Afghanistan Urban Water Supply and Sewerage Corporation (AUWSSC), Afghan Land Authority (ARAZI), and the Governor of Kandahar. Additional key stakeholders will include directly project-affected persons, farmers of the area to be inundated, and residences who will suffer from inundation. NEPA will supervise compliance of environmental standards during the construction phase and operation phase (noise, air quality, water quality).

494. The minutes of the consultations, together with scanned signatures of the participants should be included in the monthly reports. The data should be disaggregated by gender, with the key information recorded at the top of the minutes, stating the number of participants, the number of men and the number of female participants.

495. The active involvement of NGOs and organizations representing women and other vulnerable groups is seen by MEW as essential in fostering positive community participation in the program and ensuring that the views and wishes of the disadvantaged are heard and acted upon.

C. Public Disclosure

496. ADB SPS (2009) requires the provision of relevant project information in a timely manner, at an accessible place and in a form and language(s) understandable to the affected persons and other stakeholders. Information disclosure involves delivering information about a proposed project to the affected people and other stakeholders. The purpose of the information disclosure requirements specified under ADB SPS (2009) is to facilitate engagement of people so that a constructive relationship between the parties is established at the outset and maintained over the life of the project. Special efforts should be made to reach vulnerable groups lacking access to public media and information exchange.

497. A copy of the final, MEW and ADB approved EIA in English will be disclosed on ADB's website, while a copy of the final LARP in Pashto will be disclosed on the MEW website and at the District Governor's and other local authorities' offices. The LARP in Pashto will also be disclosed to the APs at the relevant local elders' offices in the project communities.

498. The public consultation and disclosure program with all interested and affected partied will remain a continuous process throughout the Project implementation during pre-design, design and construction phase.

X. GRIEVANCE REDRESS MECHANISM

499. **The Afghan Law on Land Acquisition 2017,** Article 34, 'Objection against Decision of Technical Panel' stipulates the grievance redress mechanism as follows:

(i) Whenever the owner or his/her legal representative is not satisfied regarding compensation of the expropriated property, he/she may present his/her objection statement with the reasons, within (60) days after the date of receiving information about compensation, to the Expropriating Authority.
(ii) The Expropriating Authority shall assess the objection stated in paragraph (1) of this article within 30 days and take appropriate decision.
(iii) Whenever the claimant is not satisfied with the decision of the Expropriating Authority, the issue shall be referred to a jury. The jury consists of: representative of relevant Union of Engineers, representative of Afghanistan Chamber of Commerce and Industries and representative of the people of the expropriated area.

500. The decision of the jury is final if the parties agree; otherwise the issue shall be referred to a competent court.

501. The existing grievance redress system may be used in conjunction with the project-related grievance redress mechanism (GRM). A project-specific GRM will be established to receive, evaluate, and facilitate the resolution of affected parties' concerns, complaints, and grievances about the social and environmental performance at the level of the project. The GRM will function during all phases of the project implementation. The GRM will aim to provide a time-bound and transparent mechanism to address and resolve social and environmental concerns linked to the project.

502. The GRM is a formalized way for the PMU (MEW) to identify and resolve concerns and people's grievances. It offers the displaced and affected people a forum to voice their concerns, seek clarifications to their queries, or register complaints related to the project's performance. The scope of the GRM addresses issues related to involuntary resettlement, social and environmental performance, and information disclosure.

503. The displaced people (DP) will have the right to file complaints and/or queries on any aspect of the project, including land acquisition and resettlement. Under the adopted grievance mechanism, the DPs may appeal any decision, practice or activity related to the project. All possible avenues will be made available to the DPs to voice their grievances. The PMU will ensure that grievances and complaints on any aspect of the project are addressed in a timely and effective manner.

504. The fundamental objectives of the Grievance Redress Mechanism are:

(i) To reach mutually agreed solutions satisfactory to both, the project and the DPs, and to resolve any grievances locally, in consultation with the aggrieved party;
(ii) To facilitate the smooth implementation of the LARP, particularly to cut down on lengthy litigation processes and prevent delays in project implementation;
(iii) To facilitate the development process at the local level, while maintaining transparency as well as to establish accountability to the affected people.

505. The GRM will cover issues related to social, environmental and other safeguard issues under the ADB safeguard covenants and Afghan law. The affected people will be fully informed of their rights and of the procedures for addressing complaints whether orally or in writing during

the consultations and surveys. Care will be taken to prevent grievances rather than relying solely on the redress process. This will be achieved through careful design and implementation, by ensuring full participation and consultation with the Affected People and by establishing extensive communication and coordination between the affected communities, the EA, and local governments in general.

506. The GRM consists of the project-specific systems which will be established at the project and district levels and as a regular system established at MEW. Grievance Redress Committees (GRC) will function for the duration of Project implementation.

507. MEW follows ADB's Grievance Redress Procedure (GRP) to address any dissatisfaction and complaints by residents regarding its activities. This procedure will be applied to address any complaints or grievances during the implementation of the project.

508. The project will establish a grievance redress mechanism (GRM) to ensure greater accountability immediately after the loan becomes effective. MEW will prepare a grievance redress mechanism, acceptable to ADB, and establish a special committee to receive and resolve complaints/grievances or act upon reports from stakeholders on misuse of funds and other irregularities, including grievances due to resettlement. The special committee will (i) make public the existence of this grievance redress mechanism; (ii) review and address grievances of stakeholders of the project, in relation to either the project, any of the service providers, or any person responsible for carrying out any aspect of the project; and (iii) proactively and constructively respond to them.

509. The GRM will be established at three levels: (i) Project/District level; (iii) Province level and (iii) General Governor's office level. If the complaint cannot be resolved at these three levels, a complaint will have a choice to lodge his/her complaint at the related court. MEW is oriented towards resolving complaints at the project level through negotiations with community leaders and representatives of affected persons. These discussions will be conducted by the PMU and will involve the affected groups and members of the relevant grievance redress committee (GRC), and the site manager and chief engineer of the construction contractor, if necessary. If a case cannot be resolved in this way it will be submitted to MEW grievance redress committee, led by the PMU Director. The GRM for the project is outlined below and consists of three levels with time-bound schedules for addressing grievances.

510. The committee consists of representatives of the community districts, elders and Mirabs; and representatives of the governmental offices in Kandahar, such as ASBA Kandahar, MEW, Shura, PMU, Supervision Engineer site manager, social and environmental safeguard officer's complaint officer.

511. The first level and most accessible and immediate venue for the fastest resolution of grievances is the Shura and the District Governor representative. The District Governor representative with help of Shura and other GRC members, convenes a meeting of the GRC in the project area and conducts proceedings informally to reach an amicable settlement between the parties. The report of the committee is recorded in writing, and copies are provided to the parties involved. For this program, the GRC will be required to meet and reach a decision within 14 days of receiving a complaint (verbally or in writing) from an affected person or his representative.

512. Should the grievance remain unresolved or the AP is not satisfied with the decision, the grievance can be lodged with the Province Governor office which will make a decision within 45 days.

513. If a person is dissatisfied with the ruling of the Province Governor Office decision, s/he or her/his representative may lodge their grievance with the General Governor's Office in Kabul which will make a decision within 60 days. If the appellant is still not satisfied, s/he has the right to take his case to the public courts.

514. At the project level, the PMU environmental/social officer will be responsible for processing and placing all papers before the PMU GRC, recording decisions, issuing minutes of the meetings, and taking follow-up action to see that formal orders are issued, and decisions carried out. In the event that a grievance is not addressed at the previous levels, the affected person can seek legal redress of the grievance in the appropriate courts. The following table summarizes the envisaged grievance resolution process.

Table 36. Grievance Resolution Process

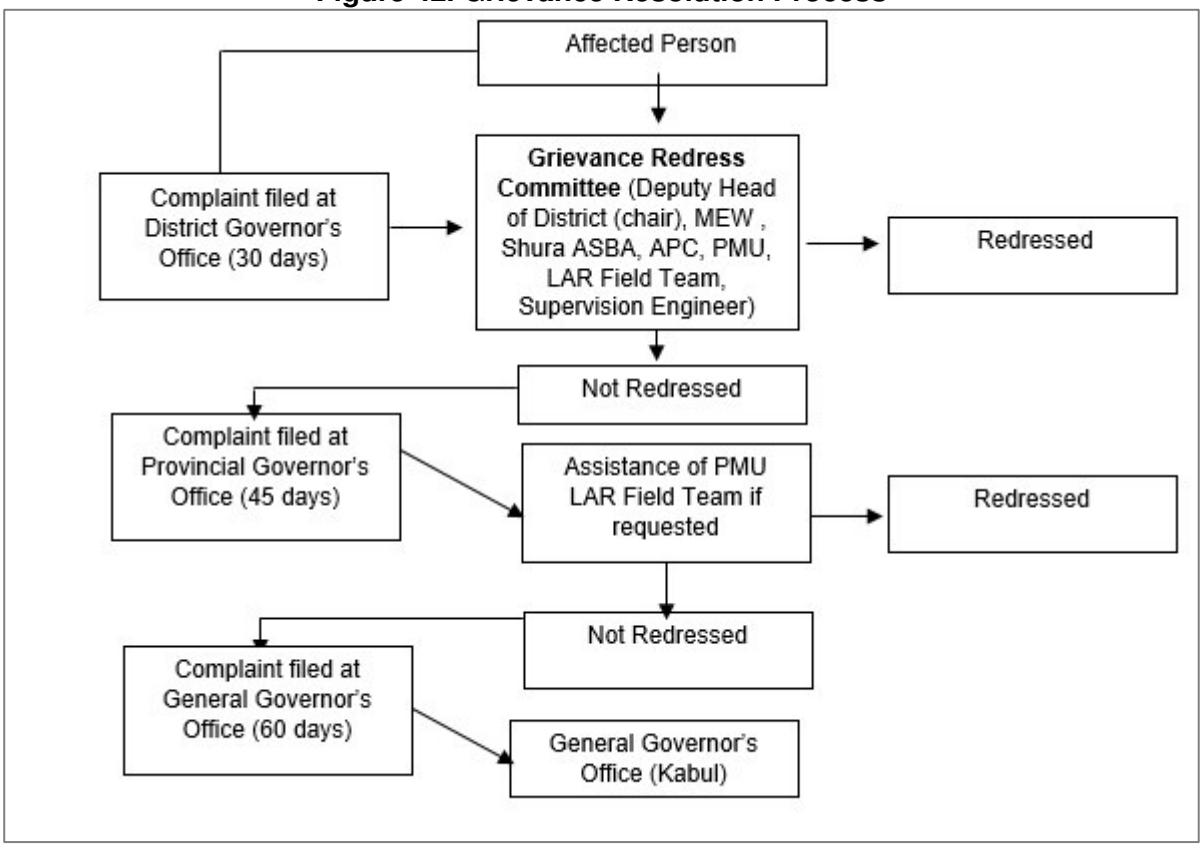
Steps	Process
Level 1	The complaint is informally reviewed by the GRC at the District Governor office with assistance of Shura, affected persons' representative and other GRC members, which takes all necessary measures to resolve the dispute amicably.
Level 2	• If the grievance is not solved at the previous level, the GRC at the Provincial Governor's Office will review the grievance and make a decision within 45 days. • The decisions will be issued by the conveyor and signed by other members of the GRC. The case record will be communicated to the complainant by the GRC at the provincial level. The grievance redress at this stage shall be completed within 45 days.
Level 3	If the aggrieved person is unsatisfied with the GRC decision at the provincial level, the next option will be to lodge grievances with the Grievance Redress Committee at the General Governor's Office (Kabul). The Governor's Office will convey its decisions to the aggrieved person within 60 days after receiving the complaint.
Level 4	If the decision fails to satisfy the aggrieved person/s, they can pursue further action by submitting their case to the appropriate court of law (local courts) without reprisal. The aggrieved person can take legal action over the amount of compensation or any other issues, e.g. occupation of their land by the contractor without their consent, damage or loss of their property, restrictions on the use of land/assets, environmental concerns such as dust caused by the contractor's machinery, etc.

Source: TRTA Consultants, 2019

515. In addition, the complainant can appeal the decision and bring the case to the ADB Accountability Mechanism. The project level GRM does not in any way, impede the access of the complainants to the ADB Accountability Mechanism (AM)[48] or the country's judicial or administrative remedies. Should the complainant wish to register a complaint with the ADB AM, the focal person should provide the complainants the ADB AM contact information. The grievance redress process is shown in the following figure.

[48] ADB. 2017. "ADB Accountability Mechanism: Annual Report". Manila. Accessible at: www.adb.org/site/accountability-mechanism/main

Figure 42. Grievance Resolution Process



Source: TRTA Consultants. 2019

XI. CONCLUSIONS AND RECOMMENDATIONS

516. The environmental impacts of Component 1 have been assessed and described in the previous sections of this document. Potential impacts were identified in relation to detailed design, construction and operation of the components. Mitigation measures have been developed to reduce potential identified negative impacts to acceptable levels.

517. Major mitigation measures identified have been categorized into three phases: detailed design, construction and operation of the dam. The critical matters can be summarized as:

(i) Mechanisms to protect the water resource, the catchment and the associated bio-physical elements associated and potentially impacted by the project;
(ii) Implementation of additional ARES bio-physical survey to strengthen baseline data required for the detailed design phases (including existing aquatic populations and their migration and habitat requirements, flora surveys across riparian and surrounding catchment, and a bird survey to include increased details regarding migratory species and their habitat requirements);
(iii) Ensuring contractor has the capacity and management skills to produce, monitor and deliver on an SSEMP;
(iv) Targeted releases of environmental flows for aquatic habitats;
(v) Development, refinement and maintenance of appropriate environmental flows to ensure river aquifer recharge and sustainability of important ecological services provide by the river are established;
(vi) Long-term monitoring of water quality in the reservoir and beyond to preserve aquatic life;
(vii) Application of appropriate occupational health and safety for all workers associated with the construction;
(viii) Addressing of social concerns including loss of property (settlement and agricultural land) and enterprise opportunity, and appropriate compensation instituted same and addressed through the LARP;
(ix) consultation to establish clear communication with the community regarding management of working times, dust, noise and impacts from vehicular movements;
(x) Avoiding night time construction activities;
(xi) Additionally, social consideration is given to maximizing work opportunities for local communities.

518. Irrespective of the actions taken during the EIA process and in the design of the project, it is anticipated that there will still be impacts on the environment during construction. However, the appropriate avoidance, monitoring, mitigation and enhancement measures put in place will assist to minimize and manage these foreseen impacts. These steps have been summarized in the EMP.

519. The EMP deals with a range of typical impacts associated with construction which are also identified and listed in the risk management tables. The mitigation measures include addressing the full range of construction phase impacts; stewardship of the use of all resources including machinery, care of the natural resources on the site (water, vegetation, flora and fauna), occupational health and safety of workers.

520. When it is in operation, the new dam will have overall beneficial impacts to the environment and livelihood of farmers compared to the existing situation. The following preconditions have to be followed up for a sustainable operation of the dam:

(i) Introduction of a waste collection system in villages and settlements around the dam (waste segregation, safe disposal of waste without endangering water resources, design of waste concept, and introduction of waste fees);
(ii) Registration and safe disposal of existing waste dumps;
(iii) Enhancement of waste management, especially littering of waste in open water courses to be addressed through the process of long-term education campaigns;
(iv) Long-term measures through awareness campaigns to protect vegetation and water resources including source protection. Implementation of management steps to monitor and improve vegetation and water quality downstream (e.g. prohibition of laundry in the Arghandab River and irrigation canals);
(v) Appropriate disposal and treatment of human excrement (design of decentralized technical simple solutions like reed beds, wetlands, septic tanks with gravity-based systems);
(vi) Reuse of untreated sewage sludge as fertilizer in agriculture will lead to a reduction of commercial fertilizers and a reduction of risks of nutrients (phosphate, nitrate, bacteria) to contaminate the groundwater.

521. Project EIAs are generally limited to the direct impacts of the project. This approach directly distances itself from a wider range of impacts, including:

(i) Cumulative impacts: the environmental impacts of multiple plans, projects and other actions;
(ii) Indirect, secondary or induced impacts: these are impacts that occur several steps away from the original action;
(iii) Global impacts: impacts that go beyond the local, project level, for instance climate change.

522. The impacts of climate change have been assessed. However, given the uncertainty around projections of climate change impacts in Afghanistan, it is difficult to model future environmental conditions (e.g. annual precipitation, intensity of rainfall patterns, temperature changes, and levels of atmospheric dust). The impact of climate change in the future is essential for water availability in the project area.

523. Baseline information regarding the physical, biological and the socio-cultural environment is incomplete or not available. Data gaps have been recognized in the project area, such as:

(i) Data on flora and fauna including species lists;
(ii) Endangered species;
(iii) Sensitive and unregistered habitats;
(iv) Current flow data of Arghandab River and its tributaries;
(v) Water quality data of water courses (dam, canals, and the Arghandab River).

524. Impacts on the Arghandab and on the Helmand River basin could not be identified due to a lack of data including:

(i) Registration of all water intakes;
(ii) Flow measurements and water consumption of existing water intakes;
(iii) Drainage and backflow into the river;
(iv) Registration of waste / human excrement discharge points.

525. The recommended Arghandab River Environmental Study (ARES) to be conducted during the detailed design in 2019 shall address data gaps and allow for an update of the EIA. These gaps include more detailed information on habitat, viability, propagation, management

and protection of flora, fauna, aquatic and terrestrial species, as well as the broader-acreage physical and social issues associated with enhanced catchment management. Additional information concerning potential community mobilization to implement programs such as revegetation establishment and protection of the bio-physical elements is also a component of the ARES. The terms of references are in Appendix 7.

526. A master plan for the whole river basin is required and shall be developed. A sustainable water management plan for the dam shall be developed after completion of detailed biological and ornithological surveys during the summer season.

527. It is highly recommended that the two-stage process to establish environmental flows is implemented: establish and verify pilot environmental flows and then refine the data gathering process during the dam operation phase. Not only does this approach recognize the current limitations and the biophysical challenges, it needs to reap the benefits of local participation and ownership.

528. The challenges and limitation of working in Afghanistan cannot be underestimated. Afghanistan is recognized as being one of the most insecure environments in which such a study can be conducted. Although there has been generous cooperation between the TRTA, partners and government agencies, the insecurity has been a major driver in determining the limitations of what could be done. Firmly associated with both the insecurity and the lengthy period of the civil war, is the lack of contemporary data on which analysis and conclusions can be made. While government agencies are willing partners in assisting with the TRTA, both their human resource capacity and lack of physical resource add to the general state of inferior data. These issues can be overcome but they require longer time than what logical planning would determine. This EIA has been a victim of such shortfalls.