ADB

Technical Assistance Consultant's Report

Project Number: 37697-025
September 2014

Mongolia: Darkhan Wastewater Management Project

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For the Ministry of Construction and Urban Development, Darkhan-uul *aimag* government, and Darkhan Us Suvag

Asian Development Bank

Wastewater Management for Darkhan – Project Preparation

L2301-MON: Urban Sector Development Project (Additional Financing) MON: WFMFDC00100

Ministry of Construction & Urban Development; Darkhan Us Suvag

Final Report – Appendices (Vol. 2)

September 2014

Initial Environmental Examination (Draft)

Project Number: WFPFDC00100

September 2013

L2301-MON: Urban Sector Development Project (Additional Financing): Wastewater Management for Darkhan, Mongolia

Prepared by Ministry of Construction and Urban Development for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 07 October 2013)

Currency unit	**–**	**Mongolian Tughrik (MNT)**
MNT1.00	**=**	**$0.0006**
$1.00	**=**	**MNT1,625**

ABBREVIATIONS

ADB	–	Asian Development Bank
AP	–	Affected Person
BOD	–	Biological Oxygen Demand
EA	–	Executing Agency
EHSO	–	Environmental Health and Safety Officer
EMP	–	Environmental Management Plan
EIA	–	Environmental Impact Assessment
ESS	–	Environmental and Social Specialist
GHG	–	Greenhouse Gas
GOM	–	Government of Mongolia
GRM	–	Grievance Redress Mechanism
HSMP	–	Health and Safety Management Plan
IEE	–	Initial Environmental Examination
IFAS	–	Integrated Fixed-film Activated Sludge
IWRMP	–	Integrated Water Resource Management Plan
MEGD	–	Ministry of Environment And Green Development
MCUD	–	Ministry of Construction and Urban Development
MNS	–	Mongolian National Standard
MoMo	–	Integrated Water Resources Management for Central Asia: Model Region Mongolia
NGO	–	Non-Governmental Organization
NO2	–	Nitrogen Dioxide
PCB	–	Polychlorinated Biphenyl
PCU	–	Public Complaints Unit
PIU	–	Project Implementation Unit
PM	–	Particulate Matter
PMU	–	Project Management Unit
POP	–	Persistent Organic Pollutants
PPE	–	Personal Protective Equipment
PSC	–	Project Steering Committee
RCAG	–	Research Center of Astronomy and Geophysics of the Mongolian Academy of Sciences
SE	–	Supervising Engineer
SOx	–	Sulphur Oxides
SO2	–	Sulphur Dioxide
SPS	–	ADB Safeguard Policy Statement
UNEP	–	United Nations Environment Program
UNFCCC	–	United Nations Framework Convention on Climate Change
WCS	–	World Conservation Society
WFPF	–	Water Financing Partnership Facility
WHO	–	World Health Organisation

WWF – World Wildlife Fund

WEIGHTS AND MEASURES

^{o}C	–	degree celsius
dB	–	Decibel
km	–	kilometer
KWh		Kilowatt hour
LAeq	–	Equivalent Continuous Level 'A weighting' - 'A'-weighting = correction by factors that weight sound to correlate with the sensitivity of the human ear to sounds at different frequencies
m	–	Meter

NOTES

In the report, "$" refers to US dollars;
aimag - provincial country division; *soum* – sub-district division; *bagh* – sub-division of *soum*; *hashaa* - individual's plot of land; *ger* - traditional Mongolian felt dwelling

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I. EXECUTIVE SUMMARY

A. Introduction and Purpose

1. This Initial Environmental Examination (IEE) has been prepared for the Wastewater Management Project for Darkhan city. This technical assistance project aims to help the local Government consider wastewater treatment options, evaluate these options, determine the optimum solution, and prepare a feasibility study report for this wastewater treatment plant (WWTP) solution. The general objectives of this IEE are to:

(i) Provide necessary baseline data for the project;
(ii) Provide understanding on potential impacts of the project;
(iii) Provide information on potential mitigation measures to minimize negative impacts and associated costs;
(iv) Provide information on the consultations undertaken and the project level Grievance Redress Mechanism (GRM) established; and
(v) Provide an Environmental Management Plan (EMP) including mitigation and monitoring measures, definition of institutional responsibilities, capacity building and training plans and associated budgets.

2. **Project components**. The project supports the rehabilitation and/or expansion of the existing Darkhan WWTP which is currently operating inefficiently and to a generally low standard as the current equipment is outdated and in a poor state of repair. The project components are:

(i) **Component A:** Environmental improvements through new and upgraded wastewater infrastructure and improved and more efficient treatment capacity in Darkhan as follows:

- (**A1): Wastewater Treatment Plant.** A new central wastewater treatment plant for Darkhan which will treat all wastewater from residential areas in New and Old Darkhan and (pre-treated) wastewater from Darkhan industrial estate. The new WWTP will follow the footprint of the existing WWTP.
- **(A2): Infrastructure Replacement/Rehabilitation**. Replacement or rehabilitation of existing sewer pipes, pumps and ancillary works which are currently broken or beyond their useful economic life, located at various points within the city network. All works will follow existing pipeline alignments, or be located at existing facilities (e.g. pump stations).

(ii) **Component B:** Institutional reform and capacity development of Darkhan Us Suvag (the water undertaking) to improve management efficiency, develop management skills and support a range of in-house and outsourced management arrangements to optimise the cost effectiveness of wastewater treatments in Darkhan-Uul.
(iii) **Component C:** Project management support to the project executing and implementing agencies (Ministry of Construction and Urban Development (MCUD) and Darkan-Uul *aimag*) to ensure smooth and timely execution of project components.

B. ADB and Domestic Environmental Due Diligence

3. **Environmental categorization.** Based on ADB's Rapid Environmental Assessment checklists the project is classified as environmental category "B", requiring an IEE. This IEE report is prepared in accordance with ADB's Safeguard Policy Statement (2009).

4. The Mongolian EIA process is set out in local law. The domestic EIA requirements will be met for this project. A request for a General EIA was issues to the Ministry of Environment and Green Development (MEGD) in September 2013. A detailed EIA was undertaken by a Mongolian company in March 2014 and approved by MEGD in August 2014.

C. Key Findings - Baseline Conditions

5. **Environmental Policies**. Mongolia has a comprehensive policy and legal framework for environmental assessment and management. It has policies, legislation and strategies in place to manage the protected areas such as national parks, to satisfy its international obligations, and to protect the quality of the environment for the health and well-being of its citizens[1].

6. The EIA requirements of Mongolia are regulated by the Law on EIA (1998, amended 2002[2] and amended 2012). The terms of the law apply to all new projects, as well as rehabilitation and expansion of existing industrial, service or construction activities and projects that use natural resources.

7. The purpose of the EIA law is environmental protection, the prevention of ecological imbalance, the regulation of natural resource use, the assessment of environmental impacts of projects and procedures for decision-making regarding the implementation of projects. Under this law, the project was subject to a Detailed EIA.

8. **Baseline Environmental Conditions**. The physical, biological, socioeconomic, and cultural resources in the project area have been examined and the baseline environmental conditions determined. This allows assessment of the direct, indirect, cumulative and induced environmental impacts on and risks to these resources. In order to develop an environmental baseline, site visits were undertaken which identified potential receptors in the project area which may be impacted on by the project. The receptors are given in **Table 1**

Table 1: Potentially Affected Receptors and Resources in Component Sites

Component Site	Affected Receptor/Resources and Distance (meters)
Component A1 - Central WWTP	Soil / Ground - contamination and erosion Water - Kharaa River from effluent WWTP operators/staff - noise and dust Air - dust Waste disposal site Resource use - materials and energy
Component (A2): Infrastructure Replacement/Rehabilitation	**Sewer Replacement at old Darkhan hospital** Socio-Economic- Street sellers outside hospital / market and two businesses in apartment blocks (3 m and 20 m) Residents - apartment blocks (20 m) Social services - School (5 m), Hospital (15 m)

[1] UNDP. 2008. Institutional Structures for Environmental Management in Mongolia. Ulaanbaatar and Wellington.
[2] Law of Mongolia on Environmental Impact Assessments (1998, amended in 2002). Unofficial translation available from http://cdm-mongolia.com.

Component Site	Affected Receptor/Resources and Distance (meters)
	Cultural Resources - Temple (100 m Soil / Ground - contamination and erosion Health and Safety - community Waste disposal site Resource use - materials and energy
	Sewer Replacement & Power Distribution at Secondary Pumping Station Soil / Ground - contamination and erosion Water - Kharaa River from effluent Air - dust Residents - gers (130 m from pipe, 30 m from pumping station) Socio-Economic - pastureland Health and Safety - community Waste disposal site Resource use - materials and energy
	New south pumping station Soil / Ground - contamination and erosion Socio-Economic - pastureland Air - dust Residents - ger (50 m) Health and Safety - pumping station caretaker Waste disposal site Resource use - materials and energy

Source: ADB Study Team

9. **Climate**. The Kharaa river basin climate is characterized as a dry winter continental climate. Mean annual temperatures are around 0 °C with long cold winters; mean monthly temperatures in January range from -20 to -25 °C with minimum temperatures reaching - 40 °C). The summer season is short and warm, with average temperatures for July exceeding 15 °C[3]. The Kharaa river is continuously covered with ice between November and March.

10. **Soil**. Soils in the project area to be dominated by (i) fluvisols - typically found on flat land associated with flood plains, (ii) Kastanozems - are humus-rich soils that were originally covered with early-maturing native grassland vegetation, which produces a characteristic brown surface layer, found in relatively dry climatic zones[4]. Around the city, where the ground is not covered with vegetation or paved such as in unpaved ger areas, dry friable soils are visible, with gulleying caused by stormwater flow on slopes. A Detailed EIA undertaken for the project included soil sampling at six locations in the project area. The analysis confirmed that two samples are of alluvial soil, three are of sandy dark brown soil and one is a dark brown soil. The Detailed EIA also concludes that all the samples tested for chemical contamination meet the relevant Mongolian National Standard.

11. **Precipitation**. Specific rainfall data for Darkhan Uul, showing that the project area receives about 320 mm of precipitation annually, of which over 90% occurs in summer months5. However, precipitation patterns in Mongolia are showing evidence of change. Between 1940 and 2008, evidence shows an increasing trend of winter precipitation and a decreasing incidence of

[3] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report

[4] United Nations Food and Agriculture Organization

[5] Environ LLC (2014) A Detailed Environmental Impact Assessment Report for Expansion Project of Central Treatment Plant in Darkhan-Uul Province [*sic*].

summer rainfall.[6] although for Mongolia, over the longer term, climate models predict that summer rain will increase.

12. **Water Resources**. Surface water resources in the project area are dominated by the Kharaa river. The existing WWTP is approximately 1.5 km from the river. In between the river and the WWTP is a water body which is a flooded borrow pit, currently used for sand extraction, according to maps held by the *aimag* Land Administration.

13. The Kharaa River Basin is part of the larger Selenge river catchment, shown in Figure 22.

Figure 1: Selenge River Basin

Source: MoMo[7]

14. The Kharaa river is 362 km long and has a mean long-term annual discharge (1990-2008) of 12.1 $m^3 s^{-1}$, measured at the Buren Tolgoi, 23 km from Darkhan city. In the lower end of the drainage basin, in which the project is based, the river flows naturally and is channelized in only a limited number of locations and therefore the river meanders and the floodplain meadow still serves its natural function.

15. **Groundwater**. Groundwater resources are abstracted and monitored by Us Suvag. Groundwater is located primarily along the river channel and flood plain. The depth to groundwater fluctuates with the season and averages at 3 m. There are 18 groundwater abstraction boreholes in the *aimag* along the Kharaa river valley and about 5 km upstream of Darkhan city, of which currently around five are used for meeting the water use requirements[8]; the current total residential and industrial demand (of about 18,000 cum/day but up to 23,000 cum/day) can be provided from just 5 or 6 production wells. The remainder of the boreholes can

[6] Mongolia 2nd National Communication for UN Framework Convention on Climate Change
[7] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report
[8] Meeting Ms Sarangerel, Us Suvag Laboratory 26. 09. 2013

be bought into operation by Us Suvag if needed. The wells are located along the Kharaa river and are approximately 70 m deep

16. The Detailed EIA undertaken for the project presents water quality data for the Kharaa river. The data and a comparison with the Mongolian National Standard are presented in Table 2 The table shows that for the data given, the parameters of ammonia (NH4) and the Biological Oxygen Demand did not meet the standard.

Table 2: Kharaa River Water Quality

Parameter	Kharaa bridge (mg/l)	Kharaa- Darkhan Meteorological Office (mg/l)	Mongolian National Standard (mg/l)	Standard is Met
PH	8.12	8.14	**6.5-8.5**	✓
Solute O2	9.63	9.67	**6.00**	✓
NH4	0.2	1.02	**0.50**	×
NO2	0.009	0.019	**0.02**	✓
NO3	0.029	1.22	**9.00**	✓
P	0.043	0.061	**0.100**	✓
BOD5	2.39	3.02	**3.00**	×

Source: Environ LLC. Detailed EIA

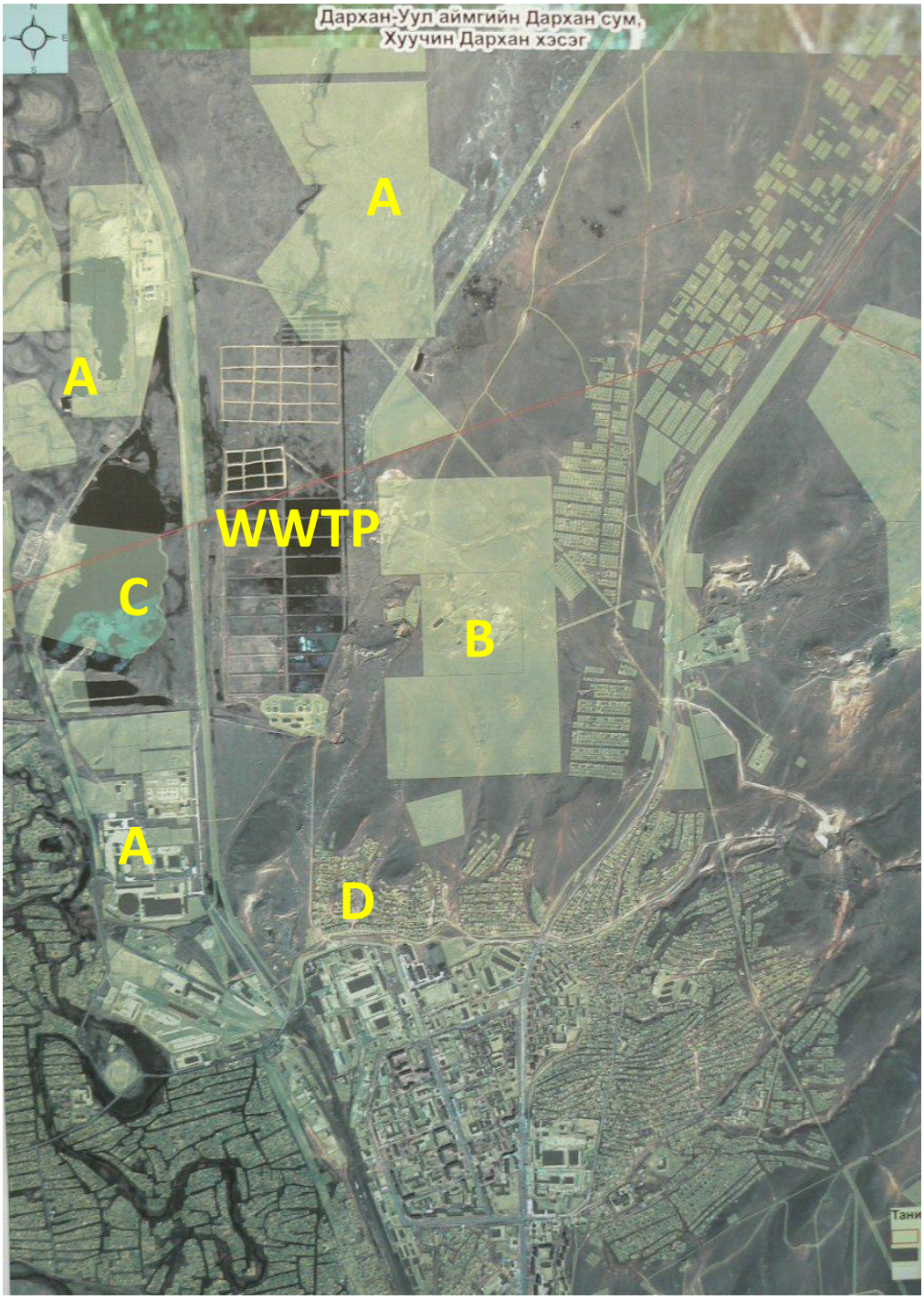
17. **Land use**. The WWTP is shown to be in a clear industrial area according to maps provided by the *aimag* Land Administration. The maps show that the nearest ger housing, or hashaa (plot of land) is approximately 650 m from the WWTP.

18. **Flooding**. The Kharaa river does not regularly flood. The most significant flood in recent years was in 1973 when flows of 722 m^3/second in Kharaa river. Also in January 2006 high rainfall led to the Kharaa river flooding and flowing at 65.9 m^3/sec[9]. However, during intense rainfall events, specific areas of the city are subject to temporary flooding, primarily caused by blocked stormwater channels. The channels are blocked with sediment and solid waste. Flooding is exacerbated by the lack of connections to the storm water drainage system; most areas of the city, apart from main roads, have no stormwater flow management[10]. Areas liable to this flooding include old Darkhan's market area, the micro-district in between old and new Darkhan and ger areas built on the flood plain of the Kharaa river, to the west of the railway. The flooding generally lasts for one to two days after a prolonged intense rainfall event.

19. **Air Quality**. An environmental assessment undertaken by the Meteorological Office for the National Committee on Reducing Air Pollution[11] concludes that the main cause of air pollution in Darkhan is the power station. This is leading to higher than expected outputs of pollutants such as NO_x and SO_x. The 2011 Human Development Report for Mongolia noted that air quality issues are significant in urban areas. The report made a policy recommendation specifically to reduced the vulnerability of urban residents to urban air pollution in a number of urban areas including Darkhan by improving energy use industries. Annual average SO_2 & NO_x data for Darkhan *soum* against the National Standard MNS 5919:2008 show that air quality parameters do not meet national standards on average.

[9] http://air.president.mn/en/
[10] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report
[11] http://air.president.mn/en/

Figure 2: *aimag* Land Administration Maps, Darkhan city



Key: A -Industrial areas. B - Brick Factory. C: Aggregate extraction. D: Hashaa area
Source: *aimag* Land Administration: Land Allocation

20. **Physical Cultural Resources**. The only observed cultural site in the project area is the Old Darkhan Buddhist temple. The temple is not a heritage site and has multiple entrances, the

closest being approximately 100 m from component A2, sewer pipeline replacement at Darkhan hospital.

21. **Flora and Fauna**. The Detailed EIA[12] for the project confirmed that although approximately 20 species of bird are indicated as using the area around the project site, none of the species are on the IUCN red list and those that are present, such as crows and sparrows, are familiar with habitats which have been degraded by human activities. The Detailed EIA also includes information on a number of rodents which are common in Mongolia, such as the house mouse (*Mus musculus*) and Mongolian gerbil (*Meriones unguiculatus*) however the study also concludes that the presence of these mammals cannot be confirmed but the habitat is already greatly disturbed by human activities therefore any species which are present are likely to be those which tolerate disturbance and do not need a habitat with a high ecological value.

22. **WWTP Technology Alternatives**. The treatment technologies proposed have been the subject of intensive analysis, based on both international and Mongolian experience of wastewater treatment under condition similar to those found in Darkhan. Wastewater treatment plants are complex systems which rely on a series of sensitive physical, biological and (sometimes) chemical processes to achieve optimal treatment results. Given the context of the Darkhan WWTP, the technology alternatives evaluated as part of the Technical Assistance are narrowed to:

- Option 1. rehabilitation of the existing WWTP as a modified activated sludge process;
- Option 2: construction of a step-feed activated sludge system;
- Option 3: construction of a sequencing batch reactor; and
- Option 4: construction of an Integrated Fixed-film Activated Sludge (IFAS) Plant

23. In terms of environmental risks, there is little between the options considered as all, if operated correctly, will offer adequate performance. In terms of costs, the step-feed activated sludge is slightly more expensive and has slightly higher operational cost than the other two systems. Following a series of discussions and workshops, the final technology choice is IFAS which where possible, will be housed within the existing structures.

D. Key Findings - Impacts and Mitigation

24. A screening process is undertaken which identifies the residual impact i.e. the impact on a receptor after mitigation. This is key to the assessment of impacts and demonstrates the importance of the implementation of EMP mitigation measures. Table 19 shows the matrix used during the screening process to anticipate the Potential and Residual Impact Significance.

[12] Environ LLC (2014) A Detailed Environmental Impact Assessment Report for Expansion Project of Central Treatment Plant in Darkhan-Uul Province [*sic*]

Table 3:Potential Impact Significance

		Magnitude of Impact		
		LOW	MEDIUM	HIGH
Receptor Sensitivity & Importance	LOW	Low	Low	Medium
	MEDIUM	Low	Medium	High
	HIGH	Medium	High	High

25. The screening process showed that following mitigation, related to project design (design phase), the most significant impacts are the temporary economic displacement of around 5 street vendors and the need for ensuring continuity of relocation sewage treatment. The majority of impacts will arise during the construction phase. The most significant impacts may arise from hazardous waste arisings and noise and dust arising from excavations which at one project site, is outside a school and a hospital. In the operation phase, with mitigation, including comprehensive training for the WWTP operators, it is anticipated that the environmental benefits of the project will be significant.

26. The project will have a number of positive environmental benefits:

- **Environmental Sustainability & Energy**. It is possible that at times of low flow and with an increase in housing and industry, the impacts on the river arising from the current WWTP would become more significant with time and the environmental sustainability will be compromised. This is increasingly likely as the outdated waste water treatment technology becomes progressively more unreliable with age. Therefore the project will seek to improve the environmental sustainability of the WWTP. Environmental sustainability will also be improved through the use of more energy efficient technologies. The current WWTP is inefficient, wasting valuable energy resources. The introduction of efficient modern technology, such as improved sewage pumps, will mean significant energy savings, associated with which are savings in carbon emissions and resource use.

- **Industrial Development**. Darkhan is considered an industrial city in Mongolia, and the potential attraction of additional industries to the city, will increase the likelihood that industrial wastewater volumes will increase. Current and future industries will benefit from the WWTP as their effluent will be able to be treated centrally in the WWTP, following pre-treatment if needed.

- **Community Health and Safety**. The project will help to ensure that the safety of the community is not impacted upon by the potential health impacts associated with leaking sewer pipes, particularly when they are above ground, such as the emergency sewer pipe near the Secondary Pumping Station (Component A2). Component A2 will also include the installation of a cover on the inspection chamber which is currently covered only partially and temporarily, yet is outside a school entrance.

27. **Mitigation Measures**. Before construction starts, the contractor is required to develop a number of documents which will guide the construction process in order to reduce the likelihood of adverse environmental impacts:

(i) Water Protection Management Plan
(ii) Soil Erosion Management Plan
(iii) Aggregate, Borrow Pits and Spoil Management Plan.
(iv) Spill Management Plan
(v) Hazardous and Non-Hazardous Waste Management Plan
(vi) Health and Safety Management Plan (HSMP).

28. **Mitigation of impacts on soil.** The impacts on soil will be mitigated through a number of measures which will control the impacts in relation to (a) soil erosion, through managing slopes, cut faces and revegetation; (b) soil contamination through managing use and storage of potentially polluting materials; (c) borrow pits through appropriate siting and restoration.

29. **Mitigation of impacts on Air Quality.** Humans are the receptor most sensitive to dust. The mitigation measures to protect sensitive receptors from air quality issues include (a) management of stockpiles to reduce dust (b) good construction site practices to suppress dust (c) covering materials during transport (d) siting plant for production of concrete or pavement surfaces away from receptors.

30. **Mitigation of impacts on surface and groundwater**. In general the project will improve the quality of the surface. Potential impacts may occur through accidental release of pollutants therefore mitigation measures include (a) Adequate WWTP capacity to be maintained at all times (b) controlled storage and management of all chemicals and wastes (c) spill management plan to be developed..

31. **Mitigation of impacts from solid and liquid waste and resource use.** The potential impacts arising from solid and liquid waste production and disposal will be mitigated through a number of activities including (a) application of the waste hierarchy at all times (b) appropriate storage and containment of wastes including potential PCB wastes and PCB containing equipment which may be present in old transformers in the pumping stations; this will require a specific PCB assessment and management plan.

32. **Mitigation of impacts from construction noise**. Although noise can never be entirely eliminated, the potential noise impacts will be mitigated through measures which include (a) Source control: Maintaining all equipment in good working order (b) siting noise generating activities such as concrete mixing away from receptors (c) operating within reasonable times and in consultation with affected people.

33. **Mitigation of impacts on Community Health and Safety.** Potential impacts may arise at any construction sites, therefore the focus will be on clear signage, using machinery only in day light and where possible keeping members of the public out of construction areas.

34. **Mitigation of impacts on Occupational Health and Safety.** The civil works contractors will implement adequate precautions to protect the health and safety of construction workers and will appoint an Environment Health and Safety Officer (EHSO) to develop, implement and supervise a Health and Safety Management Plan (HSMP), as well as ensure that the requirements of the EMP are implemented.

35. **Potential indirect impacts - Traffic during Construction.** When the WWTP and related infrastructure is constructed, indirect impacts will result in potential longer journey times around the important market area in Old Darkhan. This will be mitigated through consulting with relevant *aimag* officers on the timing of the road excavation, and signage to warn motorists of when the road closures may be needed.

36. **Consultations during Project Preparation**. Consultations with potentially affected people and key experts were undertaken during the project preparation. In general the public support the project as many of the residents, particularly in ger areas, recognize the need for improved sanitation including an effective WWTP.

37. Consultations with experts provided baseline data for the project as well as advice and opinions on specific aspects of the project including technology issues and the Grievance Redress Mechanism. As a result, the project proposes a robust Grievance Redress Mechanism which has been approved by the Darkhan Uul *aimag* authorities.

E. Conclusion

38. The findings of this IEE show that the project will not have any significant, long term or irreversible impacts on the physical, biological or socio-economic environment. The project will have short term impacts during construction which can be mitigated to an acceptable level through mitigation measures which seek to reduce the potential for harm to the environment and human health. These measures relate primarily to implementing good construction practice as well as meeting the particular needs of the project area through consultation with affected people. Good practice through comprehensive training and appropriate technological design will also contribute significantly to reducing the operational impacts of the project.

39. The project will have significant positive environmental benefits. It will lead to improved water quality in the Kharaa river as the effluent quality from the WWTP will be significantly improved over the long term. In addition the use of modern technology and replacement of the outdated and broken equipment will lead to better sludge management which will benefit the environment and the residents of the city.

II. INTRODUCTION

A. Background

40. This IEE refers to Additional Financing Technical Assistance (TA) for the Preparation of a Wastewater Management Project for Darkhan city under Loan 2301-MON, the Urban Sector Development Project. Loan 2301-MON was approved in December 2006 and consists of four components: (i) Improvement of basic urban services, (ii) Urban road improvement, (iii) Small loans for water connections and on-plot facility improvements, and (iv) Institutional development and training. The components have been implemented in Mongolian cities and their ger areas in five provinces.

41. The Government of Mongolia through its Ministry of Economic Development, and Ministry of Construction and Urban Development, requested from ADB additional financing to Loan 2301-MON of $20 million to support wastewater treatment and wastewater management improvement for Darkhan city.

B. Introduction and Purpose

42. This Initial Environmental Examination (IEE) has been prepared for the Wastewater Management Project for Darkhan city. This TA project aims to help the local Government consider wastewater treatment options, evaluate these options, determine the optimum solution, and prepare a feasibility study report for this wastewater treatment plant (WWTP) solution. The general objectives of this IEE are to:

(vi) Provide necessary baseline data for the project;
(vii) Provide understanding on potential impacts of the project;
(viii) Provide information on potential mitigation measures to minimize negative impacts and associated costs;
(ix) Provide information on the consultations undertaken and the project level Grievance Redress Mechanism (GRM) established; and
(x) Provide an Environmental Management Plan (EMP) including mitigation and monitoring measures, definition of institutional responsibilities, capacity building and training plans and associated budgets.

43. **Project components**. The project supports the rehabilitation and/or expansion of the existing Darkhan WWTP. If found appropriate during the TA project, the construction of a new WWTP and ancillary facilities in Darkhan city may be required. The project components are:

(iv) **Component A:** Environmental improvements through new and upgraded wastewater infrastructure and improved and more efficient treatment capacity in Darkhan as follows:

- (**A1): Wastewater Treatment Plant.** A new central wastewater treatment plant for Darkhan which will treat all wastewater from residential areas in New and Old Darkhan and (pre-treated) wastewater from Darkhan industrial estate. The new WWTP will follow the footprint of the existing WWTP.
- **(A2): Infrastructure Replacement/Rehabilitation**. Replacement or rehabilitation of existing sewer pipes, pumps and ancillary works which are currently broken or beyond their useful economic life, located at various points

within the city network. All works will follow existing pipeline alignments, or be located at existing facilities (e.g. pump stations).

(v) **Component B:** Institutional reform and capacity development of Darkhan Us Suvag (the water undertaking) to improve management efficiency, develop management skills and support a range of in-house and outsourced management arrangements to optimise the cost effectiveness of .

(vi) **Component C:** Project management support to the project executing and implementing agencies (Ministry of Construction and Urban Development (MCUD) and Darkan-Uul *aimag*) to ensure smooth and timely execution of project components.

44. This IEE is focused on those components of the project that are considered likely to interact with environmental receptors.

C. ADB and Domestic Environmental Due Diligence

45. **Environmental categorization.** Based on ADB's Rapid Environmental Assessment checklists the project is classified as environmental category "B", requiring an IEE. This IEE report is prepared in accordance with ADB's Safeguard Policy Statement (2009).

46. The Mongolian EIA process is set out in local law. The domestic EIA requirements will be met for this project. A request for a General EIA was issues to the Ministry of Environment and Green Development (MEGD) in September 2013. A detailed EIA was undertaken by a Mongolian company in March 2014 and approved by MEGD in August 2014.

D. Structure of This Report

47. This IEE report is structured as follows:

(i) Executive Summary – outlines important facts, major findings, and recommended actions of this IEE.

(ii) Policy, Legal, and Administrative Framework – presents the national and local legal and institutional framework within which the environmental assessment is carried out. It describes the environmental categorization by ADB and MEDG.

(iii) Description of the Project – provides a justification of the project based on a sector analysis; a detailed description of the project, including project location and components.

(iv) Description of the Environment (Baseline Data) – relevant physical, biological, and socioeconomic conditions within the project area. ADB SPS (2009) requires environmental assessments to address induced impacts and risks to (i) physical (ii) biological (iii) socioeconomic (iv) physical cultural resources in the context of the project's area of influence[13]; and (v) potential transboundary and global impacts, including climate change.

[13] Project's area of influence as defined in SPS 2009: (i) the primary project site(s) and related facilities that the borrower/client develops or controls; (ii) associated facilities that are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project; (iii) areas and communities potentially affected by cumulative impacts from further planned development of the project, other sources of similar impacts; and (iv) areas and communities potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that might occur without the project or independently of the project.

(v) Anticipated Environmental Impacts and Mitigation Measures – predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic, and physical cultural resources in the project's area of influence; identifies mitigation measures and any residual negative impacts that cannot be mitigated.

(vi) Analysis of Alternatives – examines alternatives to the proposed project site, technology, design, and operation, including the no project alternative.

(vii) Information Disclosure, Consultation, and Participation – the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders and addressing the comments raised in consultation.

(viii) Grievance Redress Mechanism (GRM) – presents the GRM established to handle grievances and complaints arising during project implementation. It defines GRM entry points, timeframe and institutional responsibilities within the GRM.

(ix) Environmental Management Plan (EMP) – defines the mitigation measures, performance indicators, environmental monitoring requirements, institutional responsibilities, training activities related to environmental management, reporting requirements, and a mechanism for feedback and adjustment.

(x) Conclusion and Recommendation – summarizes the major environmental impacts and mitigation measures and concludes on the environmental soundness of the project.

(xi) Appendices – includes results of consultations, detailed EMP and Terms of References for specialists.

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Mongolia's Environmental Policy

48. Mongolia has enacted a comprehensive policy and legal framework for environmental assessment and management. It has policies, legislation and strategies in place to manage the protected areas such as national parks, to satisfy its international obligations, and to protect the quality of the environment for the health and well-being of its citizens. The hierarchy of policies and legislative provisions for environmental management in Mongolia comprise the Constitution, international treaties and environment and resource protection laws[14].

49. The main policy documents are the National Environmental Action Plan of 1996, the State Environmental Policy of 1997, the National Plan of Action to Combat Desertification, the Biodiversity Conservation Action Plan, and the National Plan of Action for Protected Areas, all developed under the auspices of MEGD (MEGD was Ministry of Nature, Environment and Tourism known as MNET), as well as the Mongolian Action Program for the 21st Century. The National Environmental Action Plan was updated in 2000 and the National Action Plan for Climate Change was added in the same year. Several program documents (e.g. National Water Program, National Forestry Program, Program of Protection of Air, Environmental Education, Special Protected Areas, and Protection of Ozone Layer) were also completed in 2000/2001. State policy on Environmental Impact Assessment (EIA) was in place in 1998. In addition, other guidance documents with important environmental repercussions were developed under the auspices of other ministries and these include the Roads Master Plan, the Power Sector Master Plan, the Tourism Master Plan, and the Renewable Energy Master Plan. Other documents, such as the annual Human Development Reports have increasingly incorporated environmental aspects.

50. A fundamental principle of the Mongolian state environmental policy is that economic development must be in harmony with the extraction and utilization of natural resources and that air, water and soil pollution will be controlled. In April 1996, Mongolia's National Council for Sustainable Development was established to manage and organize activities related to sustainable development in the country. The country's strategy is designed for environmentally friendly, economically stable and socially wealthy development, which emphasizes people as the determining factor for long-term sustainable development.

51. Mongolia's natural ecosystems and populations of wild species are of both national and global importance. In recognition of its global responsibilities, Mongolia has acceded to a number of international environmental conventions, see Table 4 for the key conventions. Each of these conventions places obligations on signatory governments ranging from the provision of a legislative basis for implementation, to adherence to the requirements and conditions of each convention, to monitoring implementation performance on a regular basis, to reporting on a regular basis to the conference of parties.

Table 4: International Environmental Conventions Signed by Mongolia

Convention	Year of Accession
Convention on Biological Diversity (CBD)	1993
UN Framework Convention on Climate Change (UNFCCC)	1994
Kyoto Protocol	1999
UN Convention on Combating Desertification (UNCCD)	1996
Convention on the Protection of Wetlands of International Importance (Ramsar)	1998

[14] UNDP. 2008. Institutional Structures for Environmental Management in Mongolia. Ulaanbaatar and Wellington.

Convention	Year of Accession
Vienna Convention for the Protection of the Ozone Layer	1996
Montreal Protocol (regulating substances that deplete the ozone layer)	1996
Convention on International Trade in Endangered Species of Fauna and Flora (CITES)	1996
Convention on the Transboundary Movement of Hazardous Waste (Basel)	1997
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	2000
Stockholm Convention on Persistent Organic Pollutants (POPs)	2004
World Heritage Convention	1990

52. The Government of Mongolia undertook a major environmental law reform in 1990 including the law of land, protected areas, water, forest, wildlife, and native flora resources. The legislation base is extensive as evidenced by the following table of key environmental legislation, see Table 5.

Table 5: National Environmental Laws

Name of the Law	Year Adopted
The Constitution of Mongolia	1992
Law on Environmental Protection	1995, 2006, 2008
Law of Land	2002
Law on Land Cadastre and Mapping	1999
Law on Land Fees	1997
Law on Land Possession	2002
Law on Special Protected Areas	1994
Law on Buffer Zones	1997
Law on Water	2004
Law on Water and Mineral Water Resource Fee	1995
Law on Forests	1995
Law on Prevention of Steppe and Forest Fires	1996
Law on Reinvestment of Natural Resource Use Fees for Conservation	2000
Law on Natural Plants	1995
Law on Protection of Plants	1996
Law on Fauna	2000
Law on regulation of export and import of endan*ger*ed species (flora, fauna)	2002
Law on Underground Resources	1994
Law on Mineral Resources	1997, 2006
Law on Petroleum	1991
Law on Air	1995
Law on Hydrometeorology	1997
Law on Protection from Toxic Chemicals	1995
Law on Environmental Impact Assessment	1998, 2002
Law on Tourism	1998
Law on Solid Waste	2003
Law on prohibiting export and transportation of Hazardous Waste	2000

B. Environmental Impact Assessment Requirements

53. The project is subject to the environmental requirements of both Mongolia and ADB. These requirements are defined in the next two sections.

1. Environmental Assessment Requirements of ADB

54. Safeguard requirements for all projects funded by ADB are defined in ADB SPS (2009). SPS 2009 establishes an environmental review process to ensure that projects undertaken as

part of programs funded through ADB loans are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and are not likely to cause significant environmental, health, or safety hazards. SPS 2009 is underpinned by the ADB Operations Manual, Bank Policy (OM F1, 2010). The policy promotes international good practice as reflected in internationally recognized standards such as the *World Bank Group's Environmental, Health and Safety Guidelines*[15].

55. SPS 2009 environmental assessment requirements specify that:

(i) At an early stage of project preparation, the borrower/client will identify potential direct, indirect, cumulative and induced environmental impacts on and risks to physical, biological, socioeconomic, and cultural resources and determine their significance and scope, in consultation with stakeholders, including affected people and concerned NGOs. If potentially adverse environmental impacts and risks are identified, the borrower/client will undertake an environmental assessment as early as possible in the project cycle. For projects with potentially significant adverse impacts that are diverse, irreversible, or unprecedented, the borrower/client will examine alternatives to the project's location, design, technology, and components that would avoid, and, if avoidance is not possible, minimize adverse environmental impacts and risks;
(ii) The assessment process will be based on current information, including an accurate project description, and appropriate environmental and social baseline data;
(iii) Impacts and risks will be analyzed in the context of the project's area of influence;
(iv) Environmental impacts and risks will be analyzed for all relevant stages of the project cycle, including preconstruction, construction, operations, decommissioning, and post-closure activities such as rehabilitation or restoration;
(v) The assessment will identify potential trans-boundary effects as well as global impacts; and
(vi) Depending on the significance of project impacts and risks, the assessment may comprise a full-scale environmental impact assessment (EIA) for category A projects, an initial environmental examination (IEE) or equivalent process for category B projects, or a desk review.

56. Other key requirements of SPS 2009 include:

(i) *Environmental Management Plan.* The borrower/client will prepare an environmental management plan (EMP) that addresses the potential impacts and risks identified by the environmental assessment.
(ii) *Consultation and Participation.* The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation.
(iii) *Information disclosure.* The borrower/client will submit to ADB the following documents for disclosure on ADB's website: (i) a draft full EIA/IEE (including the draft EMP) at least 120 days prior to ADB Board consideration; (ii) the final EIA/IEE; (iii) a new or updated EIA/IEE and corrective action plan prepared during project implementation, if any; and (iv) semi-annual environmental monitoring reports.

[15] New Version of the "World Bank Group Environmental, Health, and Safety Guidelines", April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

(iv) *Grievance Redress Mechanism.* The borrower/client will establish a mechanism to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the project's environmental performance.

(v) *Monitoring.* The borrower/client will monitor and measure the progress of implementation of the EMP.

57. This IEE is intended to meet SPS 2009 requirements.

2. Environmental Assessment Requirements of Mongolia

58. The EIA requirements of Mongolia are regulated by the Law on EIA (1998, amended 2002[16] and amended 2012). The terms of the law apply to all new projects, as well as rehabilitation and expansion of existing industrial, service or construction activities and projects that use natural resources.

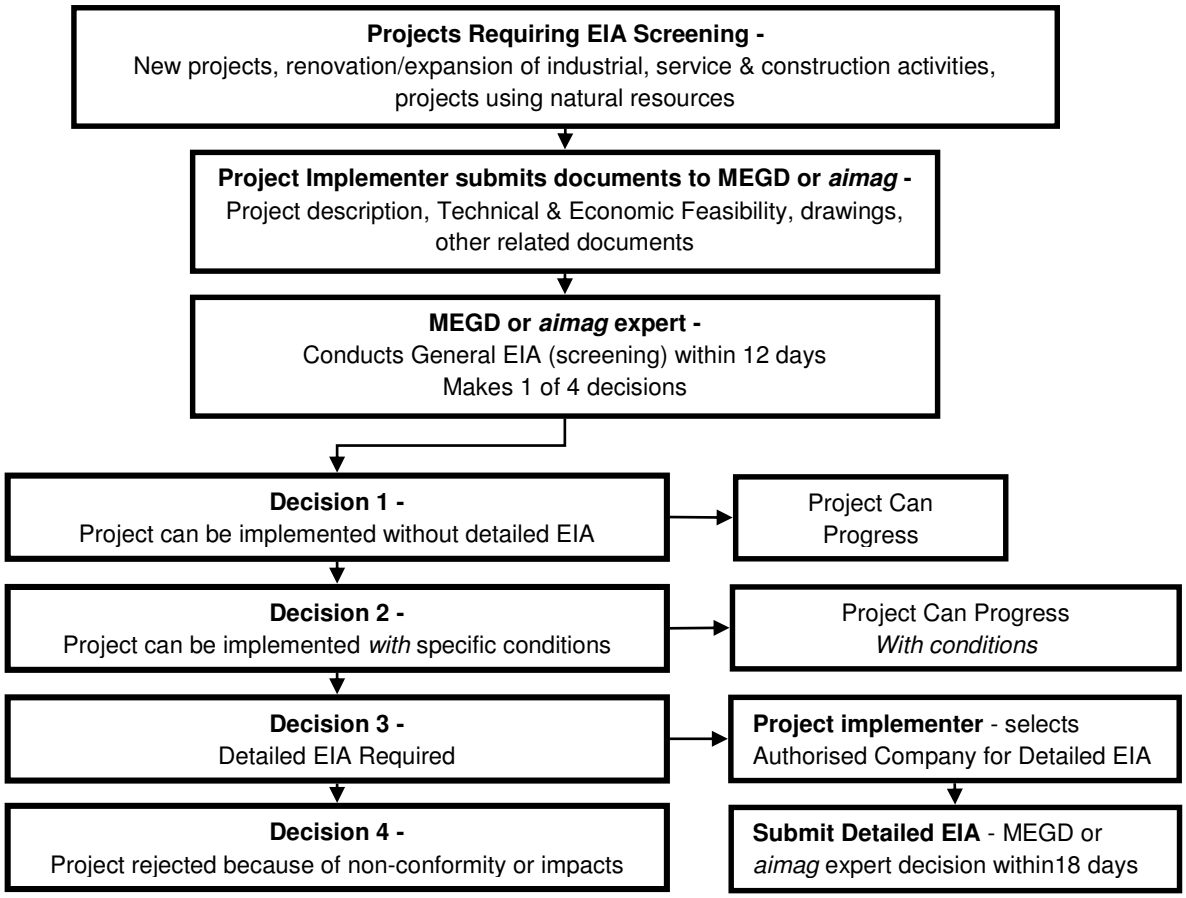
59. The most recent amendment to the law was adopted in 2012 and will be brought into force in 2013, implemented through a new Environmental Impact Assessment Regulation[17]. The 2012 amendment introduces a requirement for Strategic Environmental Assessment for policy documents, and increases emphasis on public participation during a general EIA.

60. The purpose of the EIA law is environmental protection, the prevention of ecological imbalance, the regulation of natural resource use, the assessment of environmental impacts of projects and procedures for decision-making regarding the implementation of projects. The EIA process in Mongolia is summarized in Figure 3.

[16] Law of Mongolia on Environmental Impact Assessments (1998, amended in 2002). Unofficial translation available from http://cdm-mongolia.com.

[17] The new EIA Regulation revokes 2 Regulations and 1 Guideline document which do not meet the requirements of the EIA Law. The revoked legislation is: Regulation on the Environmental Impact Assessment Committee (2006); Guidelines on Formulating EPPs and EMPs (2000); and Regulation on Detailed EIA Appraisal (2006). These regulations are superseded by the EIA Law.

Figure 3: EIA Process in Mongolia



Source: Adapted from Vol. 1 (2001) Compendium of Laws: A Mongolian Citizens Reference Book

61. The type and size of the planned activity define responsibility as either MEGD or *aimag* (provincial) government. There are two types of EIA defined in the Law:

(i) **General EIA (screening)** - to initiate a General EIA, the project implementer submits to MEDG (or *aimag* government) a brief description of the project including feasibility study, technical details, drawings, and other information. The General EIA may lead to one of four conclusions: (i) no detailed EIA is necessary, (ii) the project may be completed pursuant to specific conditions, (iii) a Detailed EIA is necessary, or (iv) project cancellation. The General EIA is free and usually takes up to 12 days.

(ii) **Detailed EIA** – the scope is defined by the General EIA. The Detailed EIA report must be produced by a Mongolian company which is authorized by MEDG by means of a special procedure. The developer of the Detailed EIA should submit it to MEDG (or *aimag* government). An expert of the organization who was involved in conducting General EIA should make a review of the Detailed EIA within 18 days and present it to MEDG (or *aimag* government). Based on the conclusion of the expert, the MEDG (or *aimag* government) takes a decision about approval or disapproval of the project.

(iii) The Detailed EIA must contain the following chapters: (i) Environmental baseline data; (ii) Project alternatives; (iii) Recommendations for minimizing, mitigation and elimination of impacts; (iv) Analysis of extent and distribution of adverse impacts

and their consequences; (v) Risk assessment; (vi) Environmental Protection Plan; (vii) Environmental Monitoring Program; and (viii) Opinions of residents on whether the project should be implemented.

C. Environmental Standards

62. **Ambient Water Quality**. Mongolia has national standards for a range of environmental parameters including water quality, noise and air quality. **Table 6** shows the Mongolian standard for ambient water quality.

Table 6: Mongolian Standard for Ambient Water Quality

pH	SS [mg/l]	DO [mg/l]	BOD [mg/l]	NH_4^+ [mg/l]	PO_4^{-3} [mg/l]	SO_4^{-2} [mg/l]
6.5-8.5	-	6.4	3.0	0.5	0.1	100

Source: Mongolian National Standard. MNS 4586:98

63. **Potable Water**. The National Center of Standardization and Metrology has a number of standards relating to potable water. Potable water characteristics are assessed qualitatively for taste, smell and color and against Mg/l for turbidity. Table 7 provides standards on characteristics and chemical composition of potable water according to Mongolian National Standard MNS 900:2005.

Table 7: National Standard for Chemical Composition of Potable Water MNS 900:2005

	Composition	Unit	Acceptable Concentration
1	Molybdenum (Mo)	mg/l	0.07
2	Barium (Ba)	mg/l	0.7
3	Boron (B)	mg/l	0.5
4	Copper (Cu)	mg/l	1.0
5	Calcium ion (Ca^{2+})	mg/l	100.0
6	Magnesium ion (Mg^{2+})	mg/l	30.0
7	Manganese (Mn)	mg/l	0.1
8	Sodium (Na)	mg/l	200.0
9	Phosphate ion (PO_4^{2+})	mg/l	3.5
10	Flourine (F)	mg/l	0.7-1.5
11	pH	-	6.5-8.5
12	Selenium (Se)	mg/l	0.01
13	Strontium (Sr)	mg/l	2.0
14	Sulphate oxide ion SO_4^{2+}	mg/l	500.0
15	Hardness	mg.eq/l	7.0
16	Chlorine ion (Cl^-)	mg/l	350.0
17	Arsenic (As)	mg/l	0.01
18	Hydrogen Sulfide (H_2S)	mg/l	0.1
19	Chromium (Cr)	mg/l	0.05
20	Dehydrated remaining	mg/l	1000.0
21	Uranium (U)	mg/l	0.015

Source: National Center of Standardization and Metrology.

64. Mongolia has a network of air quality monitoring stations which analyze air quality data for comparison with national and international standards. The standards for Mongolia and WHO are in **Table 8**.

65.

Table 8: Mongolian Standard (24 hr mean) for Air Quality

	SO_2 [µg/m^3]	NO_2 [µg/m^3]	CO [mg/m^3]	PM_{10} [µg/m^3]
Mongolian Standard (24 hr mean)	**20**	**40**	**3**	**100**
WHO	**20**	**40 (annual mean)**	**10 (8 hrs)**	**50**

Source: Mongolian Air Quality Standard MNS 4585:2007 and WHO[18]

66. Mongolian National Standard for Ambient Noise MNS 4585:2007 sets an allowable limit for noise in daytime at 60 dB, and night at 45 dB, with night being 10pm-6am according to the Act on Labor. These standards can be compared to the more detailed WHO guidelines which recommend that indoor noise levels should not exceed 30 dB (average equivalent over 8 hours LA_{eq}) and 45 dB (maximum for an individual noise event), and outdoor sound levels should not exceed 50 dB LA_{eq}. Comparison is made with IFC standards in **Table 9**.

Table 9: Mongolian and International Standard for Permissible Ambient Noise Levels

	Maximum allowable noise limit (hourly measurement), 1hr LA_{eq} in dB(A)	
Standard	**Day** (07:00-22:00)	**Night** (22:00-07:00)
IFC Guideline: Industrial/ Commercial	70	70
IFC Guideline: Residential/ Institutional/ Educational	55	45
MNS 4585:2007	60	45

Source: Oyu Tolgoi ESIA 2012

67. Table 9 shows that IFC guidelines are slightly more stringent that the national standard for residential day time permissible levels.

D. Climate Change Policy

68. Mongolia has joined 14 environment-related UN Conventions and Treaties, including the UN Framework Convention on Climate Change (UNFCCC). Nationally, the Mongolian Action Program for the 21st Century (MAP 21) includes considerations and recommendations related to climate change adaptation and the mitigation of Greenhouse gas (GHG) emissions.

69. In order to comply with the obligations and commitments under the UNFCCC as well as to address challenges relevant to climate change, Mongolia has developed its National Action Program on Climate Change, which received Government approval in 2000 and was updated in 2010. The action program includes the national policy and strategy to tackle impacts of climate change and to mitigate GHG emissions. It also sets priorities for action and to integrate climate change concerns into other national and sectoral development plans. In order to fulfill the requirements of the National Program on Climate Change, an inter-disciplinary and inter-sectoral National Climate Committee has been established by the government and is led by MEGD. The

[18] WHO air quality guidelines, for all parameters except carbon monoxide, available at http://www.who.int/mediacentre/factsheets/fs313/en/index.html; WHO, UNEP and ILO, Environmental Health Criteria 213 carbon monoxide (second edition) for carbon monoxide, available at http://whqlibdoc.who.int/ehc/WHO_EHC_213.pdf

Committee coordinates and guides national activities and measures aimed at adapting to climate change and mitigating GHG emissions.

70. Regarding climate change mitigation, the government has undertaken to mitigate GHG emissions through a range of strategies for sustainable development covering different sectors including energy, waste, transportation and agriculture. Of specific relevance to the Project is the strategy for ' Improvement of energy efficiency in Industry'. Policy measures which will implement this strategy relate to (i) Equipment efficiency improvements and good housekeeping; and (ii) Technology changes[19]. Therefore the implementation of a project to improve the energy efficiency in the WWTP would support the energy efficiency in industry strategy.

71. Regarding climate change adaptation, the government has outlined strategies relating to the following sectors: animal husbandry, arable farming, water resource, human health, and forestry. Each sector has a number of strategies and policies and measures relating to the strategy. In the water resource sector, one of the strategies is 'improved water resource management' and the measure to implement it is 'developing and implementing integrated river basin management policy and plans in the river basins and at national level, coping with desertification'. Another target area is the strategy for 'Improved water quality' to be implemented through 'Advancing the level of water purification and sewage water treatment plants in urban areas'. The project fully supports this policy measure.

72. ADB Guidelines for Climate Proofing Investment do not extend to the urban development sector. However existing guidelines for the energy and transport sectors both confirm the need to adapt to changing levels and intensity of precipitation. Such changes may impact on the WWTP in Darkhan, which although is a separate system from stormwater flow, the system is not totally sealed hence heavy rain increases the flow into the WWTP.

E. Specially Protected Areas

73. **Specially Protected Areas.** In 1994, the protected area system was consolidated and formalized through the Law on Special Protected Areas. Under this law, Mongolia has a national system of protected areas, called Special Protected Areas, covering 22 million hectares, equivalent to almost 14% of the country. The Law on Special Protected Areas provides for four categories of protected areas: Strictly Protected Areas; National Parks; Nature Reserves; and National Monuments.

74. Nature Reserves are further classified into four sub-categories: Ecological Reserves; Biological Reserves; Paleontological Reserves; and Geological Reserves. In addition, the Law on Buffer Zones requires the establishment of Buffer Zones outside Strictly Protected Areas. In addition, local *soum* authorities may establish Buffer Zones around Nature Reserves and Natural Monuments[20].

F. Mongolia's Occupational Health and Safety Standards

75. Article 16 of the National Constitution of Mongolia states that every employee has the right to 'suitable conditions of work'. The government adopted a National Program for Occupational Safety and Health Improvement in 2001 and national standards are also adopted such as the National Standard on Occupational Health and Safety MNS 5002:2000 which support the

[19] Mongolia's Second National Communication on Climate Change
[20] UNDP Project Document: Strengthening of the Protected Area Network in Mongolia (SPAN) (2010).

Occupational Safety and Health Law 2008 which sets out policies, rules and regulations on occupational safety and health, and the most common requirements for workplace safety.

G. Integrated Water Resource Management Planning

76. The Government of Mongolia has given a priority to water issues and legalized a basin wide water management approach by revising Mongolian Law on Water. This law states that a “Basin Council consisting of representatives of water users and consumers, government, non-governmental, and specialized or professional organizations will be established for the implementation of the approach”.

77. Darkhan is on the Kharaa River within the Kharaa River Basin, in which an extensive three year project was undertaken "Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo)". The MoMo project, 2006-2009, identified important management related issues in the river basin such as impact of climate change, ground water depletion and pollution, land management, material fluxes in receiving surface waters, ecology, drinking water supply and waste water disposal in the river catchment. The project proposed solutions to these identified problems. However the recommendations of MoMo are not yet translated into a plan or policy to be implemented in the Kharaa river basin although MEDG has announced that the Kharaa River Basin Authority will be the next to be formed in Mongolia. After this, plans and policies for basin management can be implemented.

IV. DESCRIPTION OF THE PROJECT

A. Justification and Rationale

1. Needs Addressed by the Project

78. **Current Wastewater Treatment Infrastructure.** The current WWTP in Darkhan is functioning below the optimal level. Two out of three sedimentation tanks are no longer functioning leading to the primary sedimentation treatment being overloaded. Rusted bar screens allow the flow of debris into the system, and creates a risk to pipes and pumps. Currently the city's wastewater is collected through 97 km of sewerage pipes, and treated in the WWTP, which started operation in 1965 with a design capacity of 50,000 cubic meters/day, treating both, industrial and domestic wastewater. Current wastewater inflow and treatment is approximately 21,200 cubic meters/day, with the WWTP operating inefficiently and below capacity[21]. In summer and autumn 2012 regular aeration blackouts were observed which lasted in excess of a week[22]. This led to a loss of activated sludge and negatively influenced the treatment efficiency.

79. Us Suvag maintains that some 40% of the sewer network is in need of rehabilitation or replacement, and there is evidence of significant infiltration (and thus also exfiltration) from the sewer network. It is reported[23] that there is a significant increase in inflows to the WWTP during periods of intense rainfall, indicating significant ingress of storm water into the system. This suggests there is also significant ex-filtration which has the potential to pollute groundwater resources. Based on the differential between water consumption and sewage flows, there are estimates that infiltration of ground water and surface water into the sewer system is of the order of 25%[24].

80. Inefficiencies in the treatment plant mean that energy is being wasted unnecessarily. The cost of energy for the WWTP is currently approximately 60% of Darkhan Us Suvag's annual budget. The current energy use[25] equates to approximately 1.3 KWh/m^3 which is considered inefficient by WWTP design experts. Although Mongolia is currently largely meeting its energy needs domestically, primarily through seven coal fired power plants, thirteen hydro power plants and small size solar and diesel generators, about 13% of electricity, mostly during peak demand, is imported from Russia Federation. With the high increase of the final energy consumption in the recent years and the projections for further increase, there are expectations that the future electricity demand will not be met with the existing generation capacity[26]. Therefore taking opportunities to reduce domestic energy consumption will be beneficial to Darkhan city's local energy demands.

81. **Industrial Development.** Darkhan city currently has a number of industries which produce wastewater requiring treatment. The level of industrial activity is projected to increase in Darkhan, meaning additional and effective wastewater treatment will be required. Discussions with the *aimag* Land Administration Department[27] confirmed that within the last five years,

[21] ADB. Application To Access Water Financing Partnership Facility (WFPF) Resources For Direct Charges, 2013.
[22] P2Mberlin. Terms of Reference: Main Trunk Sewer and Central Wastewater Treatment Plant for Darkhan, Mongolia, 2013
[23] Us Suvag flow records at the Central WWTP
[24] Source: Milojevic, Nikola, Klaus-Jochen Sympher, Matthias Schütz, and Martin Wolf, MoMo Technical Report No 6 Integrated Wastewater Management in Central Asia – MoMo Model Region, 2011
[25] Based on data for August 2013 from Darkhan Us Suvag
[26] Energy Charter Secretariat, 2011 In-Depth Review of Energy Efficiency Policies and Programmes: Mongolia
[27] Mr Munkh-Erdene J, Head of Land Administration; Mr Olonbayar KH, Senior Land Officer, meeting 19/09/13

applications and approvals for both commercial and housing developments have rapidly increased.

82. Although industrial wastewater is pre-treated by the key producer (tannery) before it enters the WWTP, it still requires further treatment in the WWTP before it can be discharged. Darkhan Nekhii is a well known sheepskin tannery making products for domestic and export markets. In 2010 with funding from the Czech government a pre-treatment plant opened for use by the tannery. However additional industries in Darkhan which have potential to produce wastewater include Darkhan Metallurgical Plant which produces steel products from reprocessing metal and steel scraps and has a production capacity of 100,000 tons per year. In addition, a new ore processing plant and wool processing factory were built in the industrial area in 2013, although are not yet operational. Additional industries sited in the industrial area include meat processors, a flour mill, cement and brick factories, and a timber processing plant in Old Darkhan. An oil refining industry is also planned for the industrial area although the current status of this plan is unknown. This demonstrates that there is a likelihood that industrial wastewater volumes will increase in the future.

83. **Environmental Sustainability**. The main water body in the project area, the Kharaa river has elevated nitrogen and phosphorous levels as the removal of these contaminants from the WWTP is inefficient. Due to the dilution capacity and turnover processes in the river, the nutrient levels are moderate. This has led to limited detectable impact on the ecology of the river[28]. However it is possible that at times of low flow and with an increase in housing and industry, the impacts on the river arising from the current WWTP would become more significant and the environmental sustainability will be compromised. This is increasingly likely as the outdated waste water treatment technology becomes progressively more unreliable with age.

84. **Impacts on Social Development and Liveability**. The development of an efficient and effective WWTP will ensure that in the future, those relying on the Kharaa river as a raw drinking water source are not affected by poor water quality. This includes nomadic herders who graze their livestock on the Kharaa river flood plain, and residents of ger areas in the flood plain[29]. The nomadic herders are generally the poorer members of the population, and as such, are less able to withstand health shocks which may be associated with health impacts from poor drinking water. Within the city, development of a WWTP which is able to manage the potential increases in sewage will further the liveability of the city in the future. The existing WWTP and equipment is nearing the end of its useful life, therefore through replacing the existing WWTP before it is no longer useable, the quality of life for residents in the city and those in the Kharaa basin will be maintained in the future.

85. **Fit With Government Policy**. The work is aligned with the Government's 2012–2016 Action Program, which includes objective of: (i) improving public utility services and networks in provincial centres; and (ii) supporting the significant expansion of industrial development in Darkhan city. The activity will further support the Ministry of Economic Development's strategy for the development of Darkhan as both an industrial centre and as a "model city for urban liveability" for Mongolia.

86. **Fit With ADB Country Partnership Strategy**. The proposed intervention aligns with the ADB country partnership strategy, 2011–2015 for Mongolia, and is consistent with ADB's Water

[28] MoMo. 2009. Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo). Kharaa River Case Study Main Findings Summary Report.

[29] Sigel K. (2010) Environmental sanitation in peri-urban ger areas in the city of Darkhan (Mongolia): A description of current status, practices, and perceptions.

Operational Plan in Mongolia through its objectives of: (i) supporting innovative approaches to wastewater treatment technologies under Mongolian conditions; and (ii) supporting urban utilities sector reform and capacity development. It is in alignment with the impacts, outcomes and outputs supported by the country partnership strategy, and will contribute to the achievement of millennium development goal targets in providing improved access to satisfactory sanitation.

87. Urban development was first included as a distinct sector in 1992 in the ADB Mongolia Country Strategy. However, the link between the urban sector and the overall country strategy was not strong. In an attempt to strengthen this strategic linkage, the 2004 country strategy and program sought to reorient the urban strategy toward the provision of those services fundamental to achieving MDG targets. The 2012-2016 Country Strategy continues on this trajectory with a strong emphasis on infrastructure and access to basic services. The Components which contribute to this goal and are included under this project are: (i) improved infrastructure planning; (ii) provision of physical infrastructure (including wastewater treatment): and (iii) institutional and service delivery reform and capacity development.

2. Impact and Outcome

88. As stated in the Application to Access Water Financing Partnership Facility (WFPF) resources, the expected project impact and outcome will be as follows:

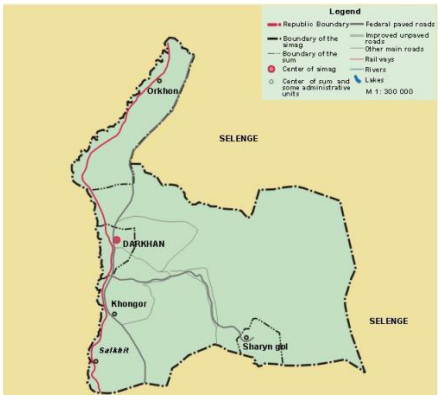
(i) **Impact**: sustainable urban environment in Dharkan city and the Kharaa River Basin.
(ii) **Outcome**: improved wastewater treatment and management for domestic and industrial users in Darkhan city.

89. In addition, the project outputs will be (i) a modernized, efficient and expanded, or newly-constructed WWTP, and (ii) institutional capacity strengthened for the effective management of wastewater. The total number of the project's beneficiaries is expected to exceed 130,000 people, as well as industries and businesses in Darkhan.

B. Project Components and Subcomponents

90. The project is located in Darkhan city, Darkhan Uul *aimag*, approximately 230 km by road, north of Ulaanbaatar. Figure 4**:** shows the location of Darkhan city within the *aimag*.

Figure 4: Location of Darkhan city, Darkhan Uul *aimag*



Source: www.infomongolia.com

91. The project is operating in the context of an existing sewerage network, WWTP and Industrial wastewater pre-treatment plant. The existing WWTP is described in 'Current Wastewater Treatment Infrastructure', paragraph 78. The sludge from the WWTP is left to dry in the extensive pond area which forms the majority of the WWTP footprint. Us Suvag does not undertake any testing or analysis of the residual sludge and the sludge drying ponds are not managed as they have never known to be full. The sludge ponds are not located close to residential areas or industrial buildings.

92. The sewer network has of total length of 223.5 km made up of about 97 km of trunk main, 2 km of rising main, and the remainder in secondary sewers and connectors. The condition of the network is variable, as many of the pipes are almost 50 years old. The age of the network by length is: installed in 1965: 65%; in 1990: 30%; and in 2005: 5%. There is no detailed information on the retention period within the sewer system, although there are no reports of septicity problems. The generally sloping topography of the core urban areas of Darkhan help in generating self-cleansing velocities in the sewer network

93. **Industrial wastewater pre-treatment plant.** The plant has been in operation in the industrial area in Old Darkhan since 2010. The main user of the treatment plant is the tannery; the plant precipitates chromium from tannery effluent which is then discharged to the sewerage system for further treatment and the central WWTP. At the point of discharge to the WWTP, the water quality meets relevant Mongolian standards. This is confirmed through discussions with the *aimag* Environment Protection Agency and Us Suvag. The Environment Protection officer confirmed that since the new industrial wastewater pre-treatment plant was constructed, funded by a Czech organisation, there are no current concerns with effluent from the industrial area.

94. **Component A**: Environmental improvements through new and upgraded wastewater infrastructure and improved and more efficient treatment capacity in Darkhan as follows:

95. **Component (A1): Wastewater Treatment Plant.** A new central wastewater treatment plant for Darkhan which will treat all wastewater from residential areas in New and Old Darkhan and (pre-treated) wastewater from Darkhan industrial area. The new WWTP will follow the footprint of the existing WWTP, and will use the existing structures at the WWTP and will have the following characteristics:

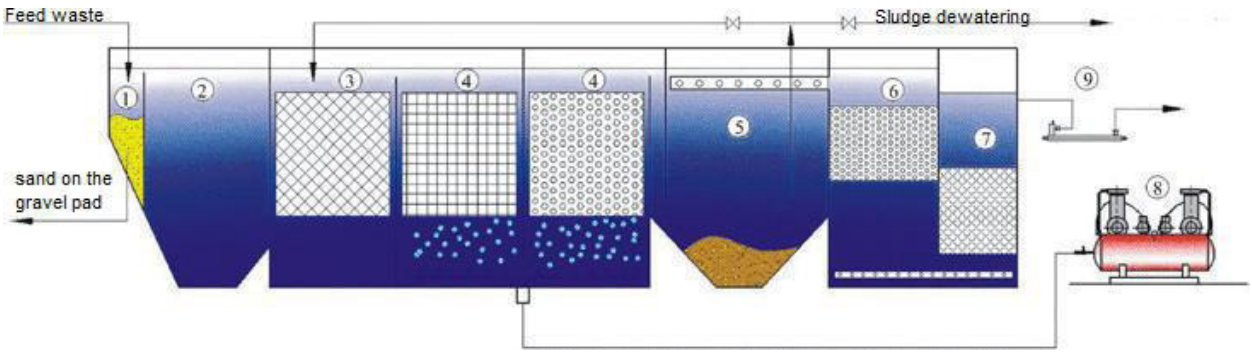
- Integrated Fixed-film Activated Sludge (IFAS) Plant
- The System: wastewater is pumped and discharged into a full biological treatment tank. The biological treatment tank includes a denitrification tank, a nitrification tank, a thin-layer sedimentation tank, a full purification bioreactor and a fine filter
- The system will produce well mineralized sludge in lower volumes than a conventional activated sludge process. The sludge can be dewatered and used as organic fertilizer if deemed appropriate by Darkhan Uul *aimag*.
- The effluent produced will exceed the Mongolian standard for discharge to waterways.

96. The key steps in the IFAS plant are shown in

10

97. Figure **5**.

Figure 5: IFAS Plant Technology



Notes:
1. Vertical sand and grit removal channel
2. Equalization tank
3. Denitrification tank
4. Nitrification tank
5. Sludge settlement (thin layer module) secondary settlement
6. Primary bio reactor
7. Full treatment bio reactor
8. Aeration equipment
9. Disinfection through ultra-violet lamp

Source: ADB. Wastewater Management for Darkhan – Project Preparation, L2301-MON Interim Final Report

98. The technology shown in

99. Figure **5** will, where possible, be housed in the existing WWTP structures.

The location of Component A1 is given in Figure 6. The WWTP is located in *bagh* 3 (sub-district). A photograph of the WWTP site is given in

100. **Figure 7**.

Figure 6: Component A1 WWTP Location

Source: ADB Study Team

Figure 7: Component A1 Site- WWTP

WWTP buildings, pumping house, area towards Kharaa river
Source: ADB Study Team

101. Component A1 will follow the footprint of the existing WWTP area. The current site is approximately 2.1 km x 0.64 km, with an area of approximately 136 ha. This is an adequate land area for Component A1.

102. **Component (A2): Infrastructure Replacement/Rehabilitation**. Replacement or rehabilitation of existing sewer pipes, pumps and ancillary works which are currently broken or beyond their useful economic life, located at various points within the city network. All works will follow existing pipeline alignments, or be located at existing facilities (e.g. pump stations). Priority sub-projects will include:

- Secondary Pumping Station: (i) Pumping station infrastructure and pipes 100m x 0.8 m dia 1.4 km concrete pipe (ii) 6Kw power distribution networks
- New South Pumping Station: (i) Tertiary sewers 800m x 1 m dia and (ii) pumping station infrastructure
- Old Darkhan Hospital : Tertiary sewers 600m x 1 m dia 0.25 km plastic pipe

103. **Secondary Pumping Station**. The basic structure of the pump house is sound, so the project will carry out the following:

- Full rehabilitation of the existing building – adding surface treatments
- Full replacement of pumping facilities (duty and standby units)
- Replacement of ventilation system (including both inlet and outlet piping)
- Replacement of power supply system
- Provision of automated remote control facilities to connect with the overall remote control system panel
- Replacement of facilities including screens and manual lifting equipment.

104. **New South Pumping Station (Industrial Area).** Based on the Government's policy to establish an industrial park in the southern part of Darkhan in the late 1980s, the new south pumping station was constructed using Russian technology and equipment in 1989. Although the pump station was fully equipped for operation, it has never been used. In addition a section of 1,400 m of gravity flow pipeline is not installed at the pumping station. This needs to be installed to enable the pump station to operate. There is a need to rehabilitate the pumping station since the existing station is (i) running at its full capacity; and (ii) old and dilapidated. Operation of any further industries in the industrial park which generate wastewater will cause the existing pump station to overload.

105. The basic structure of the pump house is sound, so the project will support the following activities:

- Full rehabilitation of the existing building – adding surface treatments
- Full replacement of pumping facilities (duty and standby units)
- Replacement of ventilation system (including both inlet and outlet piping)
- Replacement of power supply system
- Provision of automated remote control facilities to connect with the overall remote control system panel
- Replacement of facilities including screens and manual lifting equipment.

106. The location and context of Component A2 project sites are shown in Figure 8 to Figure 13.

Figure 8: Component A2 Location - New South Pumping Station Tertiary Sewers

Source: ADB Study Team

Figure 9: Component A2 Site- New South Pumping Station

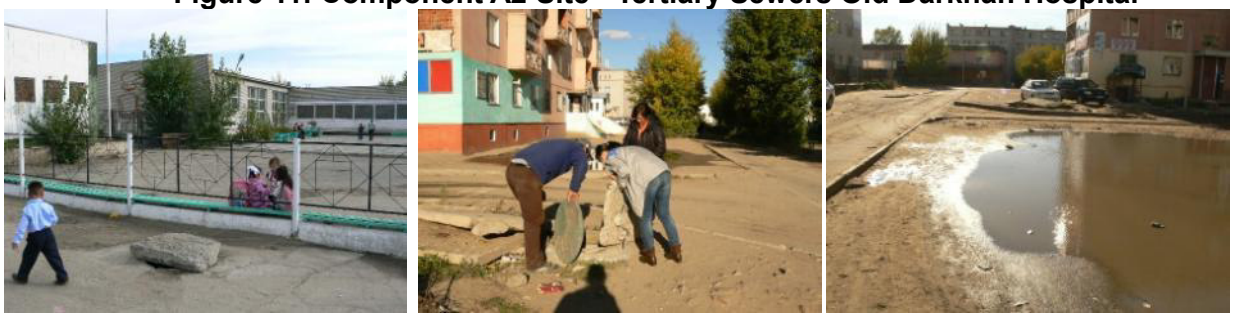
General area | Pumping station | Access road and ger

Source: ADB Study Team

Figure 10: Component A2 Location - Tertiary Sewers Old Darkhan Hospital

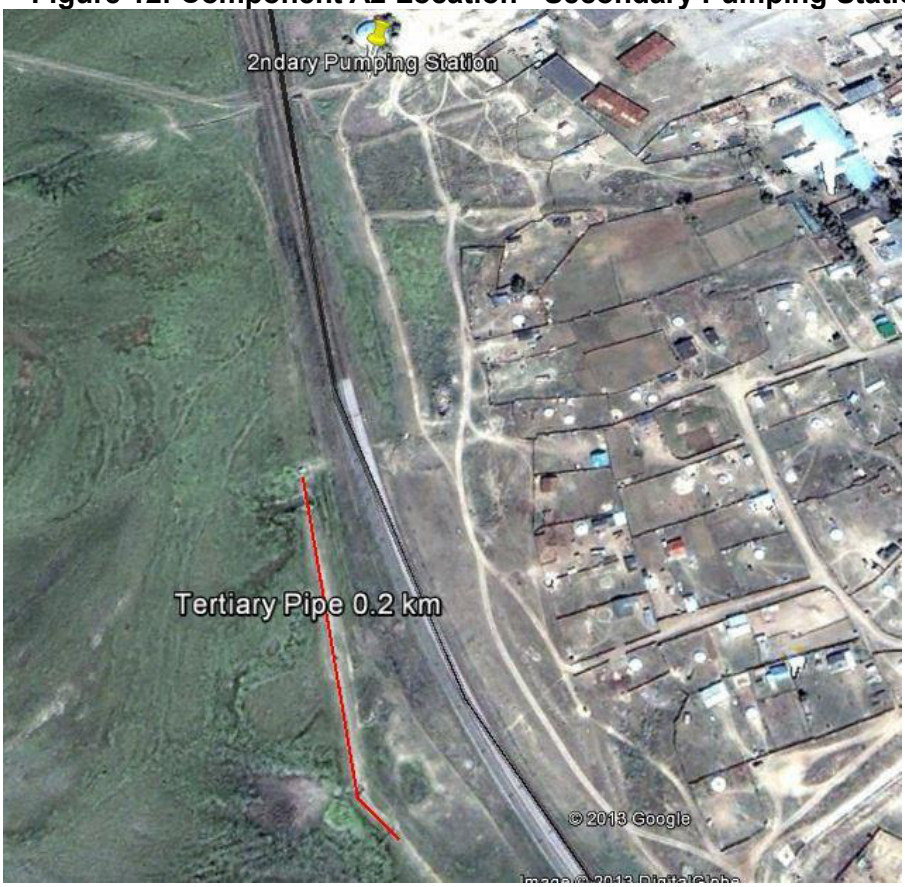
Source: ADB Study Team

Figure 11: Component A2 Site - Tertiary Sewers Old Darkhan Hospital



Route of Pipeline: School (exposed inspection chamber, Inspection chamber, Apartment area
Source: ADB Study Team

Figure 12: Component A2 Location - Secondary Pumping Station



Source: ADB Study Team

Figure 13: Component A2 Site- Secondary Pumping Station

Unused Tertiary pipe

Tertiary pipeline

Secondary Pumping Station

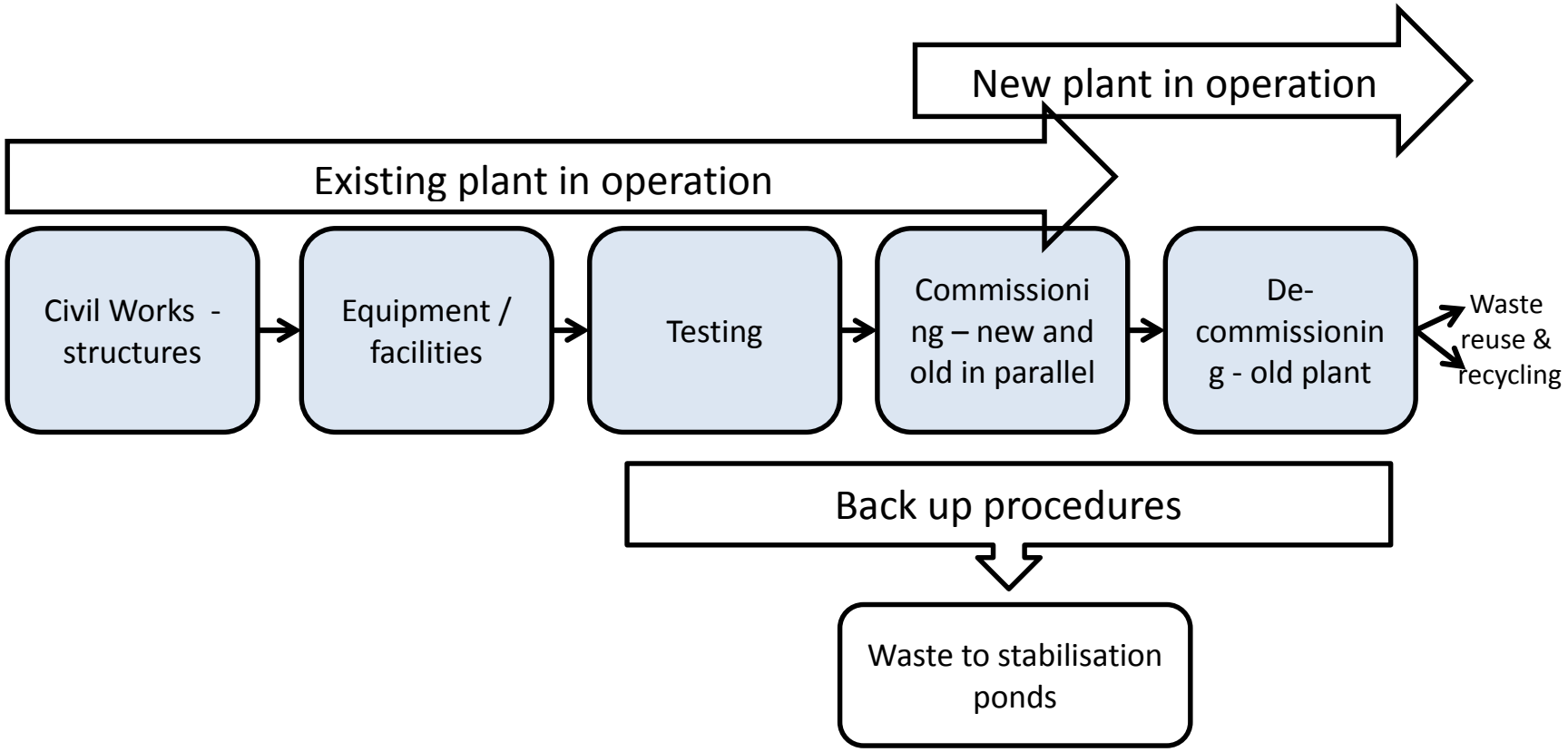
Source: ADB Study Team

107. **Component B: Institutional reform and capacity development** of Darkhan Us Suvag (the water undertaking). This component will contribute to environmental protection through the provision of relevant training. Training requirements for environmental management are shown in **Error! Reference source not found.**.

108. **Component C: Project management support** to the project executing and implementing agencies (MCUD and Darkan-Uul *aimag*).

109. **Project Commissioning Sequence**. The approach to commissioning a new WWTP is presented in Figure 14. The figure shows that environmental protection should be maintained throughout the commissioning process, by the new and old plant operating in parallel until the new plant is ready to be operational alone.

Figure 14: WWTP Commissioning Sequence, Darkhan



Source: ADB Study Team

110. The area of the existing WWTP includes an area of approximately 1.9 km by 600 m dedicated to waste stabilisation ponds. This area will be used as back up storage for waste during the commissioning of the new plant if required. This adds a further level of environmental control; the wastewater will be directed either through the existing or new plant, however if an emergency occurs, the waste can be stored in the ponds until needed. The capacity of the ponds is adequate for approximately 90 days of wastewater storage, given current in flow rates. This is further explored in Section VII, Anticipated Impacts and Mitigation.

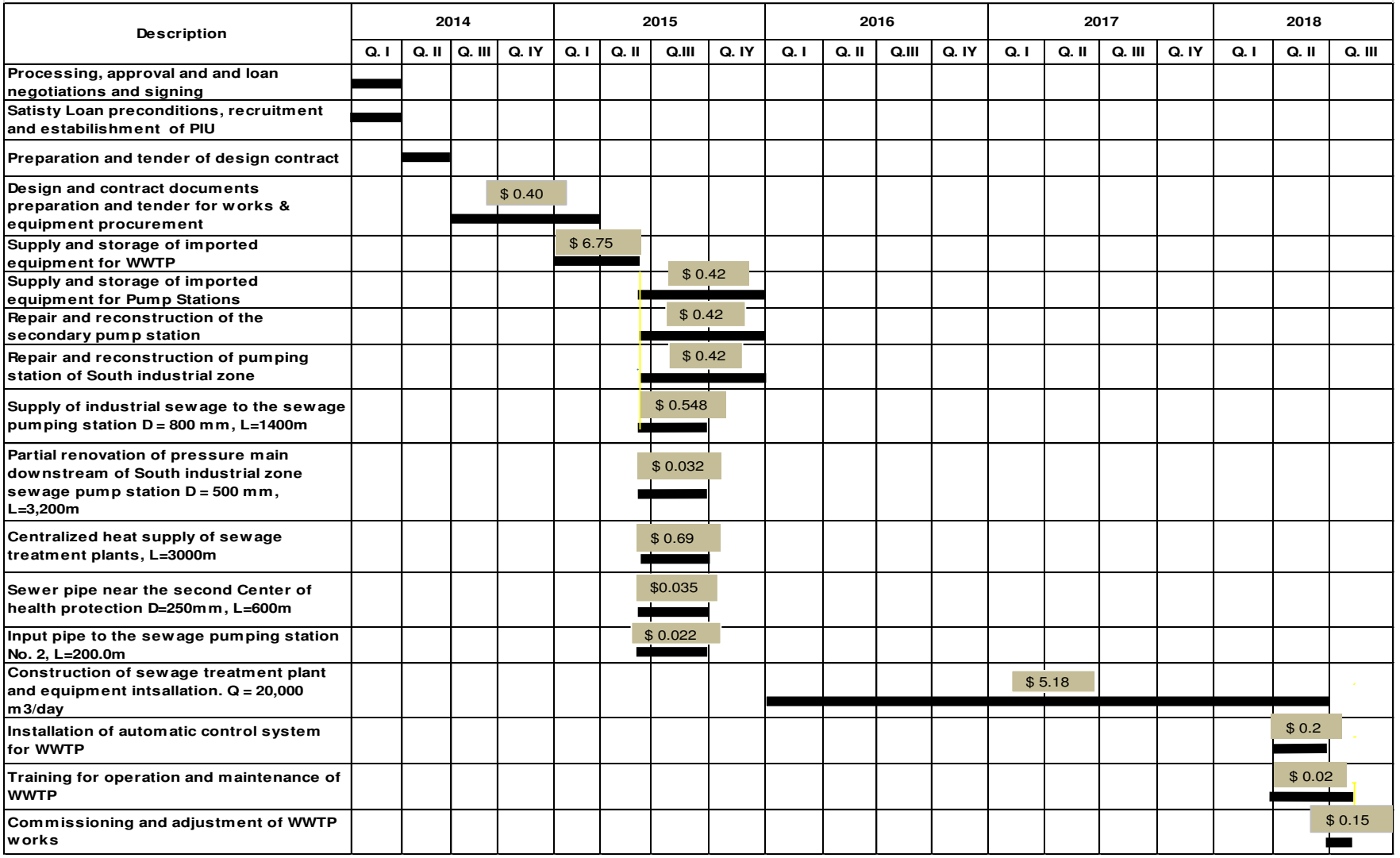
111. **Labour**. Provision will be made for the workers required during construction / rehabilitation of the project components. ADB TA Team estimates for labour requirements are as follows:

- Construction Phase: 50 workers
- Equipment Installation Phase: 20 workers.

112. Therefore it is estimated that at one time a maximum of 50 workers will be needed as the construction and installation phases will not happen concurrently.

113. **Project Implementation Schedule**. The proposed timescales for the project are set out in the schedule shown in Figure 15:

Figure 15: Implementation Schedule with Base Costs $ USD



Source: ADB Study Team

V. DESCRIPTION OF THE ENVIRONMENT

A. Project Area of Influence

114. The project sites were visited in September 2013 for the preparation of this IEE with particular attention paid to:

- Sensitive natural environmental receptors such as water bodies and wildlife habitats;
- Sensitive human receptors; and
- Cultural and heritage sites.

115. According to SPS 2009 the project area of influence is defined as follows:

(i) **Primary project site(s) and related facilities**. This is the WWTP site in Darkhan, and includes three sections of sewer pipe which are to be rehabilitated along a government right of way near Darkhan hospital and the secondary and industrial area pumping stations owned by Darkhan *aimag*.

(ii) **Associated facilities that are not funded as part of the project**. Under ADB's Environment Safeguards Sourcebook , Associated Facilities are those which are "not funded as part of a project but whose viability and existence depend exclusively on the project". The sewerage network is an existing facility which is not reliant on the project (improvements to the WWTP, 1.1 km of tertiary sewer rehabilitation and pumping stations upgrades). The sewerage network is currently functioning adequately and issues with the existing sewerage network have been identified by Us Suvag and will be addressed as part of their regular and planned maintenance. Therefore it is concluded that because existing facilities do not depend exclusively on the project, there are no associated facilities for this project.

(iii) **Areas and communities potentially affected by cumulative impacts from further planned development of the project**. The communities around the project area are principally those industries and houses closest to the WWTP and residents and businesses close to the area which may be affected by noise, during replacement of sewer pipes. Regarding further planned development of the project and its potential impacts, the project, when completed, will not require further development however in the future, the WWTP and sewerage network will require maintenance which will be carried out by the Us Suvag.

(iv) **Areas and communities potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location**. It is not anticipated the WWTP and related improvements will cause any planned or unplanned developments. It is a site specific project that is not likely to cause additional developments in the city, rather additional developments (housing and industry) will benefit from the project.

116. On the ground, the area which may potentially be affected by the project can be considered as: (i) “main project areas of influence”, covering component sites (footprints) and areas within 200 m from their edges. 200 m is the potential reach of noise and dust which is likely to have an impact on human receptors which are the most sensitive receptors in the project area; and (ii) ”extended areas of influence” which includes borrow areas/quarry sites, waste disposal sites, access routes to and from component sites and the resources in close proximity to them, sources of water for construction use, resource use and sources of labor. Table 10 shows the

potential receptors and resources which may be influenced by impacts from the project at each component site.

Table 10: Potentially Affected Receptors and Resources in Component Sites

Component Site	Affected Resources and Distance (meters)
Component A1 - Central WWTP	Soil / Ground - contamination and erosion Water - Kharaa River from effluent WWTP operators/staff - noise and dust Air - dust Waste disposal site Resource use - materials and energy
Component (A2): Infrastructure Replacement/Rehabilitation	**Sewer Replacement at old Darkhan hospital** Socio-Economic- Street sellers outside hospital / market and two businesses in apartment blocks (3 m and 20 m) Residents - apartment blocks (20 m) Social services - School (5 m), Hospital (15 m) Cultural Resources - Temple (100 m Soil / Ground - contamination and erosion Health and Safety - community Waste disposal site Resource use - materials and energy
	Sewer Replacement & Power Distribution at Secondary Pumping Station Soil / Ground - contamination and erosion Water - Kharaa River from effluent Air - dust Residents - gers (130 m from pipe, 30 m from pumping station) Socio-Economic - pastureland Health and Safety - community Waste disposal site Resource use - materials and energy
	New south pumping station Soil / Ground - contamination and erosion Socio-Economic - pastureland Air - dust Residents - ger (50 m) Health and Safety - pumping station caretaker Waste disposal site Resource use - materials and energy

Source: ADB Study Team

B. Geography, Topography and Geology

117. **Geography and Administration.** Darkhan is situated at 49°28'08"N; 105°57'27"E approximately 230 km from Ulaanbaatar. It is a city which was founded as an industrial city in the 1960s and is still known as one of the most significant centres for industry outside Ulaanbaatar. The city is situated in the Kharaa river basin, which drains into the arctic ocean drainage basin. This is one of the three drainage basins in Mongolia. Through Lake Baikal 230 km to the North of Darkhan, in the Russian Federation, the basin eventually drains into the arctic ocean.

118. Administratively, Mongolia is divided into 21 *aimags* (provinces) and the capital city Ulaanbaatar. *Aimags* are divided into *soums* which are further divided into *baghs*. The proposed project is in Darkhan-Uul *aimag*, which is divided into 4 *soum*s. The project components are all in Darkhan *soum* which is the most populated of the four *soum*s in Darkhan-Uul. The wastewater

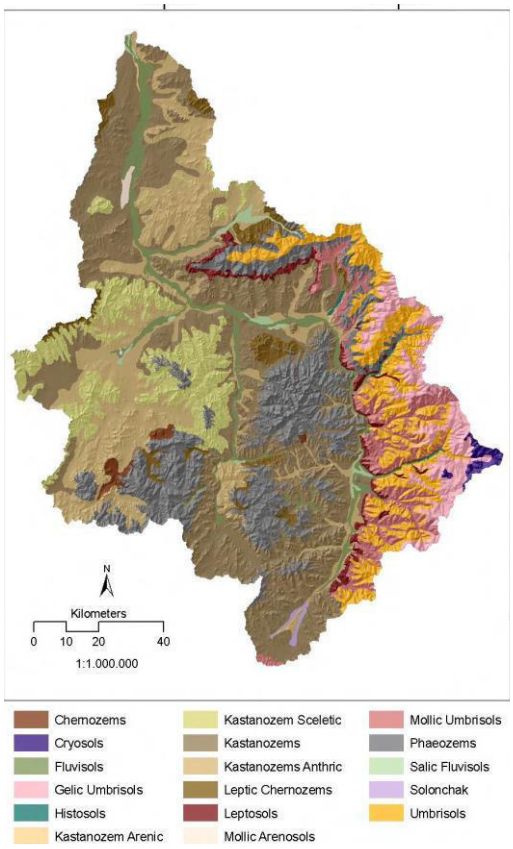
treatment plant is owned by Darkhan-Uul *aimag* government but is operated and maintained under an agreement by Darkhan Us Suvag, which is a private company.

119. **Topography and Geology**. Darkhan is at an elevation of around 700m above sea level. The east of the city is characterized by rolling hills which are used as pasture land for herders. The west is clearly defined by the Kharaa river and its floodplain which at Darkhan city is approximately 2-3 km wide. The river basin lies in an area where intrusive rocks of leucocratic granite and granodiorite have intruded into sediments. In places where this intrusion has occurred, gold deposits can be found in the Kharaa river basin.

120. Hummocky terrain in the floodplain around Darkhan indicates thermokarst, which is the thawing of permafrost. Permafrost is characterized by negative temperatures of soils/rocks and occurrence or possible of occurrence of underground ice. An active layer is subject to seasonal thawing/freezing, beneath which is a permanently frozen ground. Global warming and anthropogenic impacts intensify permafrost warming and thawing. Permafrost degradation can cause substantial change in water hydrology, damage infrastructure and affect ecosystems. Continuous permafrost lies predominantly in mountain areas with altitude of more than 3,000 m above sea level. Therefore given the altitude of Darkhan (700 m) any permafrost in the floodplain is likely to be sporadic permafrost which occurs in the muddy soil of springs/water bodies.

121. **Soil**. Soil characteristics within the Kharaa basin are identified on a digital soil map which, shown in Figure 16.

Figure 16: Kharaa Basin Digital Soil Map



122. The map shows the project area to be dominated by (i) fluvisols - typically found on flat land associated with flood plains, (ii) Kastanozems - are humus-rich soils that were originally covered with early-maturing native grassland vegetation, which produces a characteristic brown surface layer, found in relatively dry climatic zones[30]. Around the city, where the ground is not covered with vegetation or paved such as in unpaved ger areas, dry friable soils are visible, with gulleying caused by stormwater flow on slopes

123. A Detailed EIA undertaken for the project included soil sampling at six locations in the project area. The analysis confirmed that Samples 1 and 2 are on alluvial soil, samples 3-5 are sandy dark brown soil and sample 5 is a dark brown soil. The results are presented in Table 11 and Table 12.

Table 11: Chemical Characteristics of Soil Samples

Sample Number	Coordinate	pH	$CaCO_3$ %	Humus %	EC dS/m	Mobility, mg/100gr	
						P_2O_5	K_2O
WWTP-1 River bank	49°30'31.3 105°54'11.5	8.73	0.00	2.073	0.628	1.85	16.2
WWTP-2. River sediment	49°30'31.2 105°54'11.2	8.60	0.00	0.310	0.230	0.14	7.2
WWTP-3. Project area	49°30'24.3 105°55'28	8.40	0.00	6.537	2.512	2.38	31.4
WWTP-4. WWTP area	49°30'28.3 105°55'31.3	8.36	0.00	2.488	0.195	1.954	16.2
WWTP-5. Sludge pond	49°30'33.1 105°55'36.9	7.59	0.00	6.688	0.399	4.26	42.7
WWTP-6. Mountain slope	49°30'22.9 105°56'02	7.95	12.72	2.270	0.840	1.86	30.8
CaCO3 - Calcium Carbonate, EC- Electroconductivity, P_2O_5 - Phosphate (oxide), K_20 - Potassium (oxide)							

Source: Environ LLC. Detailed EIA.

Table 12: Heavy Metal Content of Soil Samples

Sample number	Heavy metal content mg\kg				
	Chromium	Lead	Cadmium	Nickel	Zinc
WWTP-1. River bank	15.5	20.1	0.23	7.1	187.8
WWTP-2. River sediment	7.9	5.5	0.04	4.7	23.5
WWTP-3. Project area	21.7	18.7	0.08	21.5	200.6
WWTP-4. WWTP area	73.9	12.3	0.05	12.9	94.8
WWTP-5. Sludge pond	60.3	63.8	0.11	8.1	192.7
WWTP-6. Mountain slope	16.9	15.2	0.07	10.6	68.5
Standard (MNS 5850 : 2008)	**150**	**100**	**3**	**150**	**300**

Source: Environ LLC. Detailed EIA.

124. The Detailed EIA concludes that all the samples tested meet the required Mongolian National Standard relating to soil contamination.

[30] United Nations Food and Agriculture Organization

C. Meteorology and Climate

125. **Climate Change**. Based on appropriate climate models for Mongolia (HadCM3 model of the HADLEY center) results show that the annual precipitation will generally increase. However, there will be a small decline in the summer season between 2011-2030 according to specific[31] emission scenarios. Precipitation in the summer season will increase by less than 10 percent, which is smaller than the rise in winter precipitation compared to the normal climate. Because of climate change, it is anticipated that winter is becoming milder and more snowy, while summer is becoming hotter and drier even though there will be a slight increase of precipitation based on overall climate change assessment. A recent trend of increasing frequency of extreme precipitation events is likely to continue.

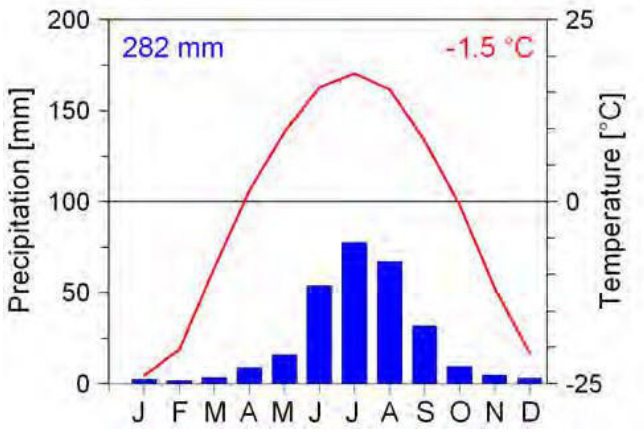
126. Specific climate predictions made for the Arctic Ocean drainage basin (in which Darkhan is based) shows that river runoff in the Arctic Ocean basin is predicted to increase by 2-9 mm. However, the projected increase in evaporation from open surface water will exceed the increase in runoff. This will lead to dryer conditions and to an imbalance between inflow and outflow of water bodies[32].

127. **Climate**. The Kharaa river basin climate is characterised as a dry winter continental climate. Mean annual temperatures are around 0 °C with long cold winters; mean monthly temperatures in January range from -20 to -25 °C with minimum temperatures reaching - 40 °C). The summer season is short and warm, with average temperatures for July exceeding 15 °C[33]. The Kharaa river is continuously covered with ice between November and March.

128. **Precipitation.** Precipitation data for Baruunkharaa, 80 km from Darkhan city show that the majority falls between June and August in the Kharaa river basin. The relatively low levels of precipitation from November to March means that snow cover is sparse in the Kharaa basin in winter. Potential evapotranspiration is high during summer; between 85 and 95 % of precipitation is lost through evapotranspiration[34]. Figure 17 shows the variation in precipitation in the Kharaa river basing catchment.

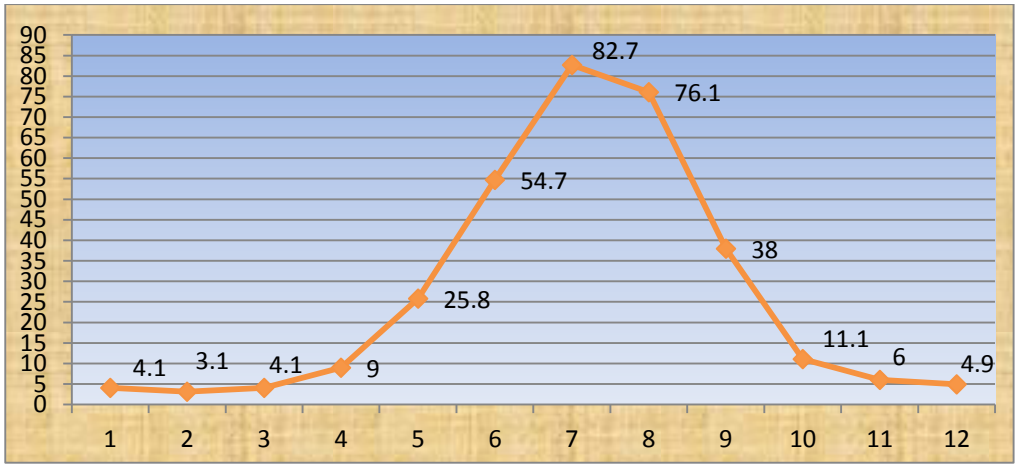
[31] In global climate change projections, three GHG scenarios (A2, A1B and B1) have been used, based on 24 climate models developed by 17 World Centers as cited in the Fourth Assessment Report of IPCC.
[32] Mongolia 2nd National Communication for UN Framework Convention on Climate Change
[33] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report
[34] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report

Figure 17: Average monthly precipitation and temperature, Baruunkharaa



129. Specific rainfall data are available for Darkhan Uul, showing that the project area receives about 320 mm of precipitation annually, of which over 90% occurs in summer months[35].

Figure 18: Average Annual Precipitation in Darkhan Uul



Source: Environ LLC. Detailed EIA.

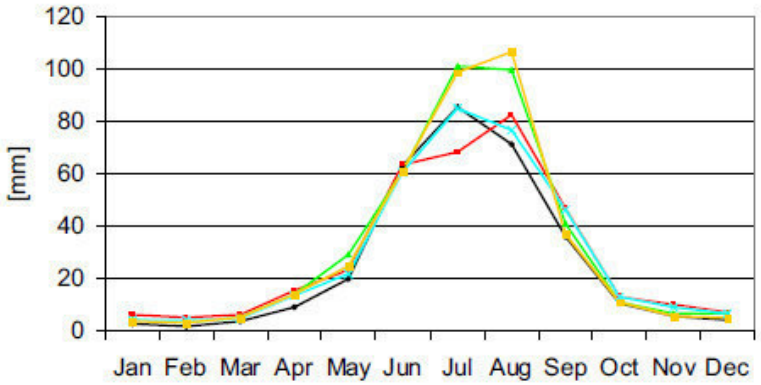
130. The relative humidity in the project area is an annual average of 66% which is one of the most humid areas in Mongolia. Maximum relative humidity in Darkhan is 70-80% during winter, 35-45 % during spring, 55-65% during summer and 40-49% during autumn.

131. Precipitation patterns in Mongolia are showing evidence of change. Between 1940 and 2008, evidence shows an increasing trend of winter precipitation and a decreasing incidence of summer rainfall.[36]. However for Mongolia, over the longer term, climate models predict that summer rain will increase.

[35] Environ LLC (2014) A Detailed Environmental Impact Assessment Report for Expansion Project of Central Treatment Plant in Darkhan-Uul Province [*sic*].
[36] Mongolia 2nd National Communication for UN Framework Convention on Climate Change

132. Figure **21** shows the predicted changes to precipitation under a number of climate models.

Figure 19: Kharaa River Basin Climate Change Scenarios for Precipitation



Key: 1971-2000: data averaged for the Kharaa catchment

Note: A1B and B1 are greenhouse gas scenarios used for climate change predictions. Based on statistical interpretation of the global climate models outputs, the HadCM3 model of the HADLEY center was the most suitable for the specific conditions of Mongolia.

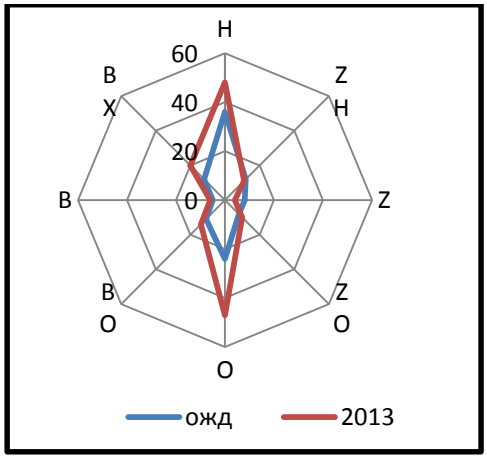
Source: Mongolia Second National Communication on Climate Change and MoMo[37]

133. **Wind Direction**. Using 30 years of data for Darkhan, it is confirmed that the predominant direction of wind in Darkhan is north and the average wind speed is 3.4 m/sec^{-1}.

[37] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report

134. Figure **20** shows the wind direction over 30 years and updated data for 2013.

Figure 20: Wind Direction, Darkhan



Source: Environ LLC. Detailed EIA.

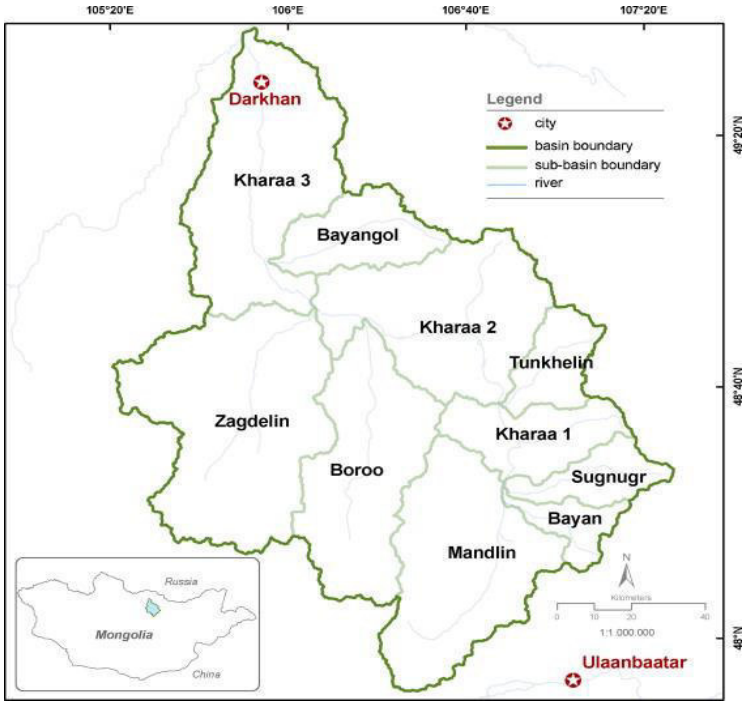
D. Hydrology, Surface Water Quality

135. Surface water resources in the project area are dominated by the Kharaa river. The existing WWTP is approximately 1.5 km from the river. In between the river and the WWTP is a water body which is a flooded borrow pit, currently used for sand extraction, according to maps held by the *aimag* Land Administration.

136. The Kharaa River Basin is shown in

137. Figure **21** and Kharaa river basin is in turn part of the larger Selenge river catchment, shown in Figure 22.

Figure 21: Kharaa River Basin Map



Source: Priess, J. et al[38].

Figure 22: Selenge River Basin

Source: MoMo[39]

[38] Priess, J. et al. The consequences of land-use change and water demands in Central Mongolia. Land Use Policy Volume 28, Issue 1, January 2011, Pages 4–10

[39] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report

138. The Kharaa River is 362 km long and has a mean long-term annual discharge (1990-2008) of 12.1 $m^3 s^{-1}$, measured at the Buren Tolgoi, 23 km from Darkhan city. In the lower end of the drainage basin, in which the project is based, the river flows naturally and is channelized in only a limited number of locations and therefore the river meanders and the floodplain meadow still serves its natural function.

139. The runoff regimes into the Kharaa River are dictated primarily by rainfall distribution; higher river flows occur in summer. However a secondary discharge peak occurs in May melt waters from the Khentii area temporarily raise the water levels.

140. **Groundwater and Monitoring**. Groundwater resources are abstracted and monitored by Us Suvag. Groundwater is located primarily along the river channel and flood plain. The depth to groundwater fluctuates with the season and averages at 3 m.

141. There are 18 groundwater abstraction boreholes in the *aimag* along the Kharaa river valley and about 5 km upstream of Darkhan city, of which currently around five are used for meeting the water use requirements[40]; the current total residential and industrial demand (of about 18,000 cum/day but up to 23,000 cum/day) can be provided from just 5 or 6 production wells. The remainder of the boreholes can be bought into operation by Us Suvag if needed. The wells are located along the Kharaa River and are approximately 70 m deep. The unconfined aquifer is characterized by alluvial sand and gravel with interlaced sandy loam. The main aquifer extends with a width of 10 to 20 km along the Kharaa River, and up to a thickness of 70 m. The ground water recharge from precipitation is very low in the Darkhan area. The recharge depends on the inflow of ground water from aquifers of the upper catchment area where the precipitation and ground water infiltration are higher.

142. Us Suvag tests the groundwater weekly for between 6 to 18 parameters. Us Suvag confirm that the groundwater meets the MNS 900:2005 (Mongolian National Standard for potable water)[41];.

143. **Surface Water Quality and Monitoring**. The water quality of all the Kharaa River is monitored weekly by the *aimag* Meteorological Office and the results of the monitoring in comparison with MNS 4586:1998 Water Quality Standards Mongolia (ambient water quality) are published on their website. Date collected between 21st - 22nd August 2013 by *aimag* Meteorological Office are shown in Table 13.

Table 13: Kharaa Basin Water Quality 21-22 August, 2013

Parameter	O2	BOD	COD	NH4	NO2	P
MNS 4586	6.0	3.0	10	0.50	0.02	0.10
Location: Sharingol Bridge, Darkhan	6.70	1.08	6.5	0.45	0.006	0.103

Source: *Aimag* Meteorological Office[42]

144. Longer term water quality monitoring data are presented by MoMo[43] for the Kharaa river basin. Darkhan falls in the Kharaa III sub-basin, for which water quality data are presented in Table 14.

[40] Meeting Ms Sarangerel, Us Suvag Laboratory 26. 09. 2013
[41] Meeting Ms Sarangerel, Us Suvag Laboratory 26. 09. 2013
[42] Data available on http://www.icc.mn/*aimag*/Darkhan/
[43] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report

Table 14: Kharaa Basin Water Quality

	NH4-N (mg/L)	TN (mg/L)	PO4-P (mg/L)	TP (mg/L)	Cl- (mg/L)	B (mg/l)
Kharaa III sub-basin	0.109	1.08	0.113	0.094	8.98	0.04

Source: MoMo

145. The Detailed EIA undertaken for the project also presents water quality data for the Kharaa river. The data and a comparison with the Mongolian National Standard are presented in Table 15. The table shows that for the data given, the parameters of ammonia (NH4) and the Biological Oxygen Demand did not meet the standard.

Table 15: Kharaa River Water Quality

Parameter	Kharaa bridge (mg/l)	Kharaa- Darkhan Meteorological Office (mg/l)	Mongolian National Standard (mg/l)	Standard is Met
PH	8.12	8.14	**6.5-8.5**	✓
Solute O2	9.63	9.67	**6.00**	✓
NH4	0.2	1.02	**0.50**	×
NO2	0.009	0.019	**0.02**	✓
NO3	0.029	1.22	**9.00**	✓
P	0.043	0.061	**0.100**	✓
BOD5	2.39	3.02	**3.00**	×

Source: Environ LLC. Detailed EIA

146. The *aimag* Meteorological Office also monitor the effluent from four WWTPs in the Kharaa basin. Date collected in August 2013 shows that 80% of the effluent from Darkhan WWTP in August met the relevant national standard, Table 16. This is supported by evidence from MoMo which states that "the impact of the waste water input is detectable although the nutrient levels are on a moderate level".

Table 16: Kharaa Basin WWTP Effluent Quality 21-22 August, 2013

Wastewater Treatment Plant Location	Approximate Distance from Darkhan city (km)	% of effluent samples meeting MNS4586:1998 (ambient water quality standard)
Darkhan WWTP	-	80.0
Khongor *Soum* WWTP	25 km	36.9
Salkhit WWTP	35 km	42.9
Sharin Gol WWTP	47 km	70.4

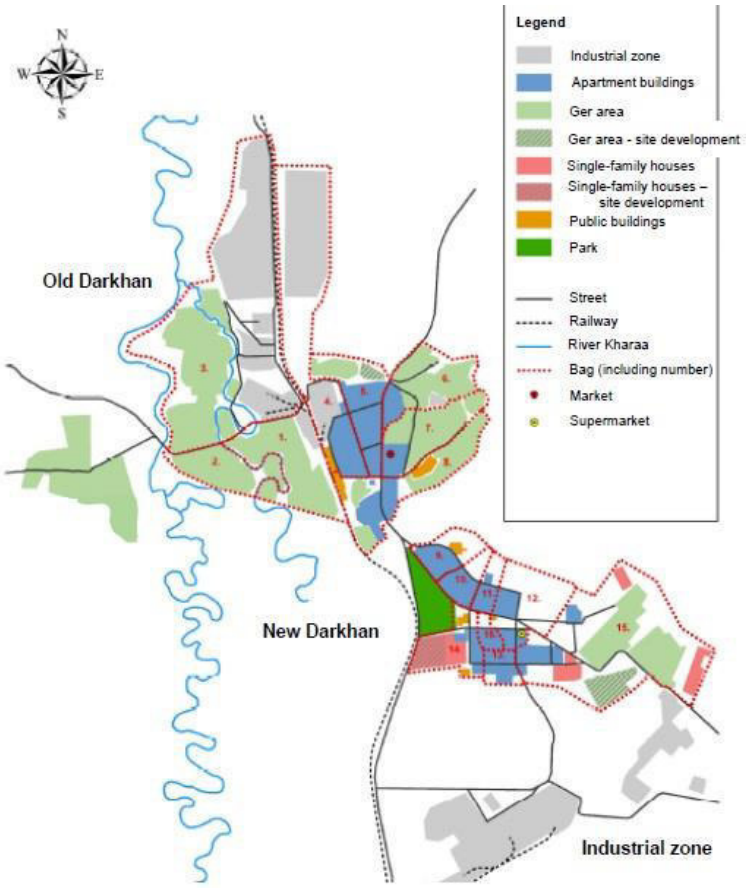
Source: *Aimag* Meteorological Office[44]

E. Land Use

147. The current land use for the city is shown in Figure 23. The figure also shows the *bagh* boundaries; the WWTP is in *bagh* 3 to the north of the city, Old Darkhan.

[44] Data available on http://www.icc.mn/*aimag*/Darkhan/

Figure 23: Land use, Darkhan city

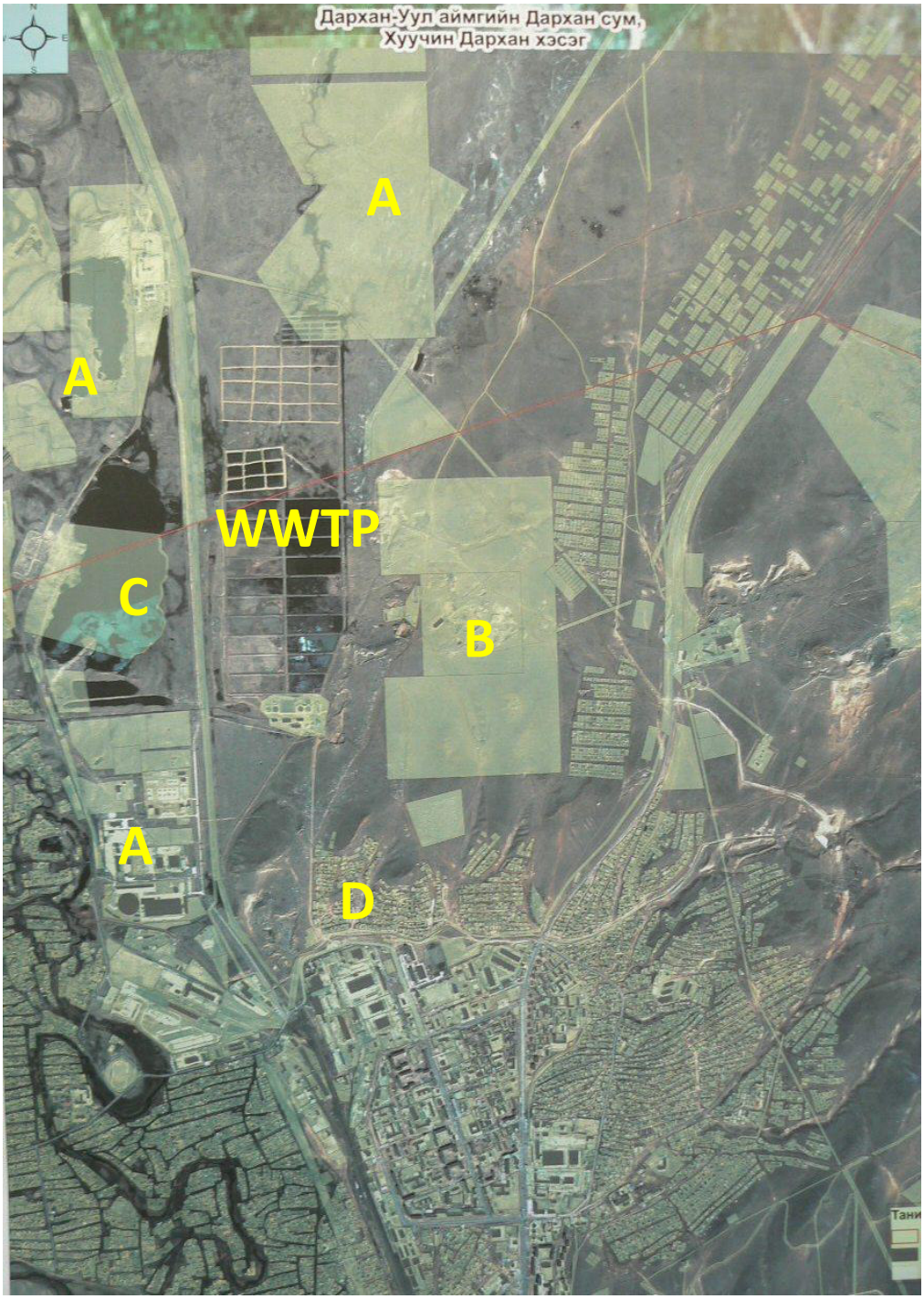


Source: K. Sigel (2010)[45]

148. The WWTP is shown to be in a clear industrial area according to maps provided by the *aimag* Land Administration. The maps show that the nearest ger housing, or hashaa (plot of land) is approximately 650 m from the WWTP.

[45] Sigel, K. (2010) Environmental sanitation in peri-urban ger areas in the city of Darkhan (Mongolia): A description of current status, practices, and perceptions. Helmholtz-Zentrum für Umweltforschung – UFZ Department Ökonom.

Figure 24: *aimag* Land Administration Maps, Darkhan city

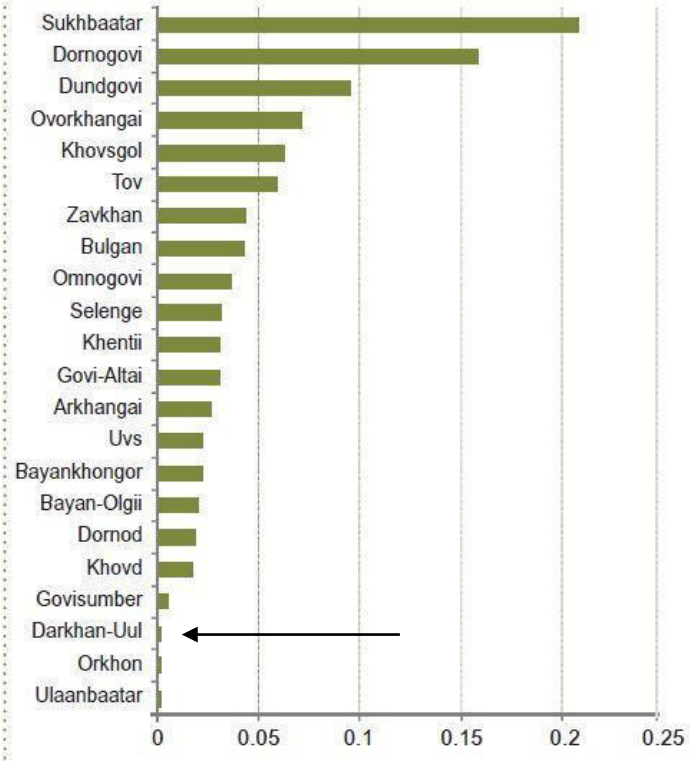


Key: A -Industrial areas. B - Brick Factory. C: Aggregate extraction. D: Hashaa area
Source: *aimag* Land Administration: Land Allocation

149. **Land Degradation**. In Mongolia, land is degraded in a number of ways including forest clearance, pasture degradation, damage through mining and chemical pollution. Between 2006 - 2009 annually approximately 110,000 km^2 (approximately 7% of Mongolia's territory) is

considered degraded. The majority of this land degradation has occurred in pasture land. However, Darkhan-Uul is shown to have one of the lowest rates of land degradation of all *aimag*s in Mongolia however the main form of degradation is damage to farmland in Darkhan-Uul, see Figure 25.

Figure 25: Share of *aimag*s in Land Degradation (average 2005-2009)



Source: UNDP (2011) Mongolia Human Development Report 2011. From Vulnerability to Sustainability: Environment and Human Development

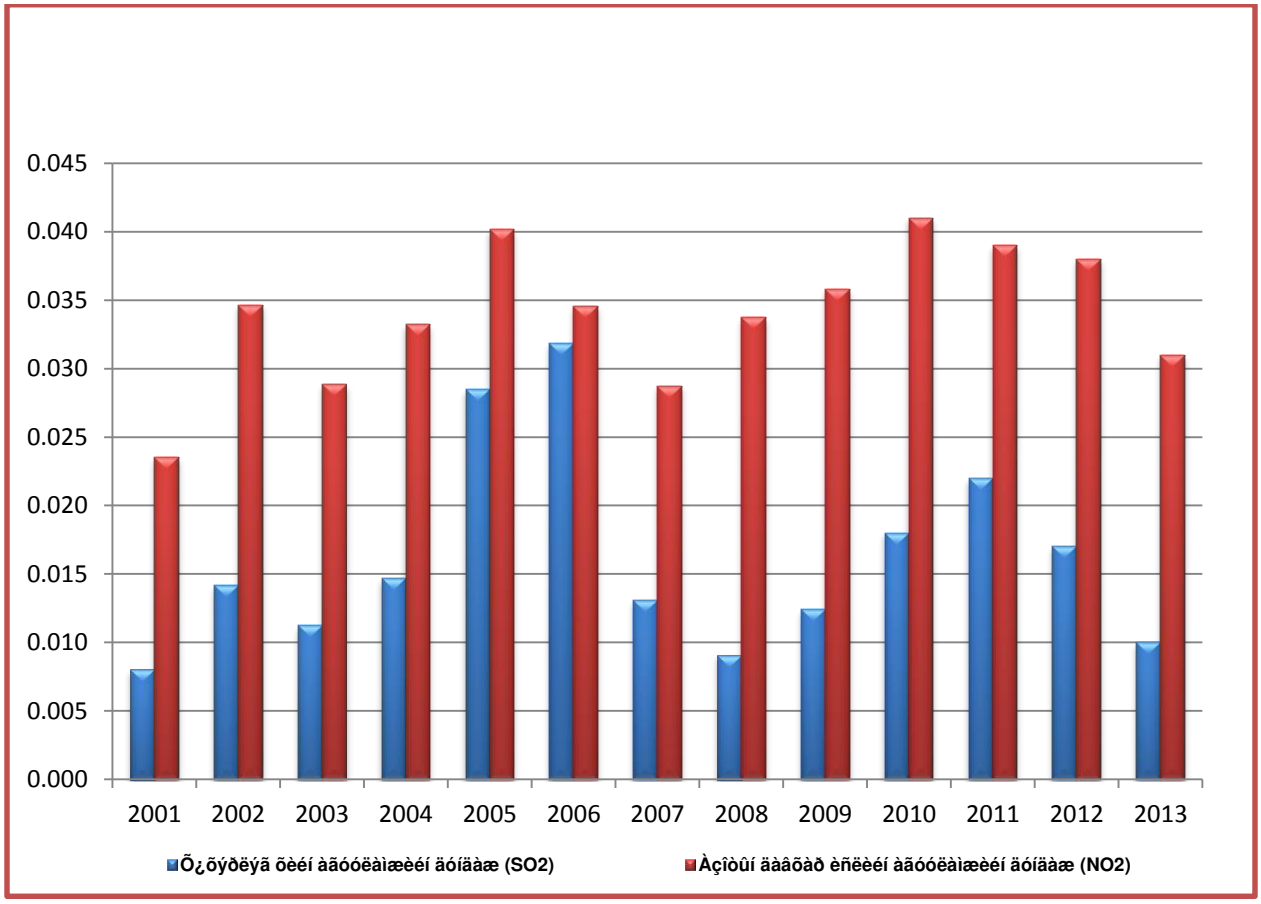
150. In Darkhan-Uul *aimag*, as demonstrated by discussions with the *aimag* Environment Protection Agency officer, deforestation is an issue. This is further supported by the 2011 Human Development Report for Mongolia which states that in some *aimags*, including Darkhan-Uul, if the present rate of deforestation continues, there will be no forests left in three years' time (2014). Currently forests are found in more rural parts of the *aimag*, and are not found near Darkhan *soum.*

F. Air Quality

151. Air quality is monitored by the Meteorological Institute of Darkhan at an air quality station in Darkhan.

152. Figure **26** shows the last 13 years of measurements for sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) in Darkhan.

Figure 26: Air Quality Data Annual Average, Darkhan, mg/m^3



Source: Environ LLC. Detailed EIA

153. Additional recently available data (Table 17) indicates[46] that air quality met the national air quality standards and meets the WHO standards for 24 hour mean of SO_2 (0.02 mg/m^3) and NO_2 (0.04 mg/m^3).

Table 17: SO_2, NO_2, and Dust, Darkhan 12/09/2013

	Sulfur dioxide SO_2	Nitrogen dioxide NO_2	Dust
Average	0.003	0.024	0.053
Mongolian Standard 24 hr Mean	0.020	0.040	0.15
Units	mg/m^3	mg/m^3	mg/m^3

Source: Meteorological Institute of Darkhan

154. The data in Table 17 are for air quality in late summer, which is known to be higher quality than in winter, when the thermal power plant and ger areas of Darkhan emit higher levels of emissions. Therefore the average figures given in

[46] The text emphasizes that the data ''indicate'' that standards are met, rather than 'it does' meet the standards as the data available are not 24 hour means, therefore are not directly comparable with the standard.

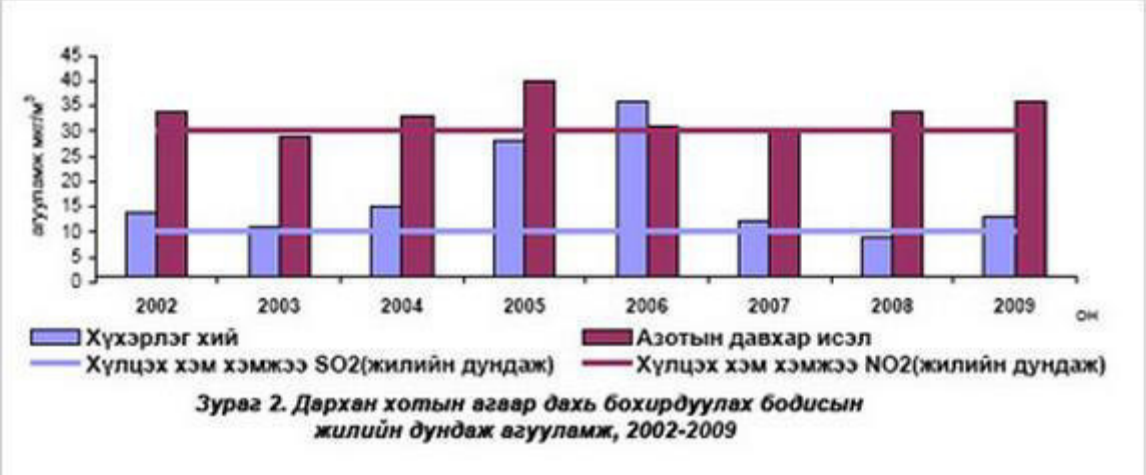
155. Figure **26** are higher, particularly for SO_2, as this includes both winter and summer data; the comparison of these two data sets demonstrates how differences may occur between summer and winter air quality.

156. The environmental assessment undertaken by the Meteorological Office for the National Committee on Reducing Air Pollution[47] concludes that the main cause of air pollution in Darkhan is the power station in addition, some of the boilers in the thermal power plant are not meeting air quality emissions requirements. This is leading to higher than expected outputs of pollutants such as NOx and SOx which exceeds standards MNS 5919:2008 (emissions from industrial boilers and thermal power plants) by a factor of 1.2 to 1.5 for NOx, leading to air pollution in Darkhan.

157. The 2011 Human Development Report for Mongolia noted that air quality issues are significant in urban areas. The report made a policy recommendation specifically to reduce the vulnerability of urban residents to urban air pollution in a number of urban areas including Darkhan by improving energy use industries.

158. Figure 27 shows annual average SO2 & NOx data for Darkhan *soum* against the National Standard MNS 5919:2008. The data are in line with the Human Development Report recommendations as they show that air quality parameters do not meet national standards on average.

Figure 27: Darkhan *soum* Air Pollution Emission 2002-2009 Annual Average



Key:

Source: National Committee on Reducing Air Pollution[48]

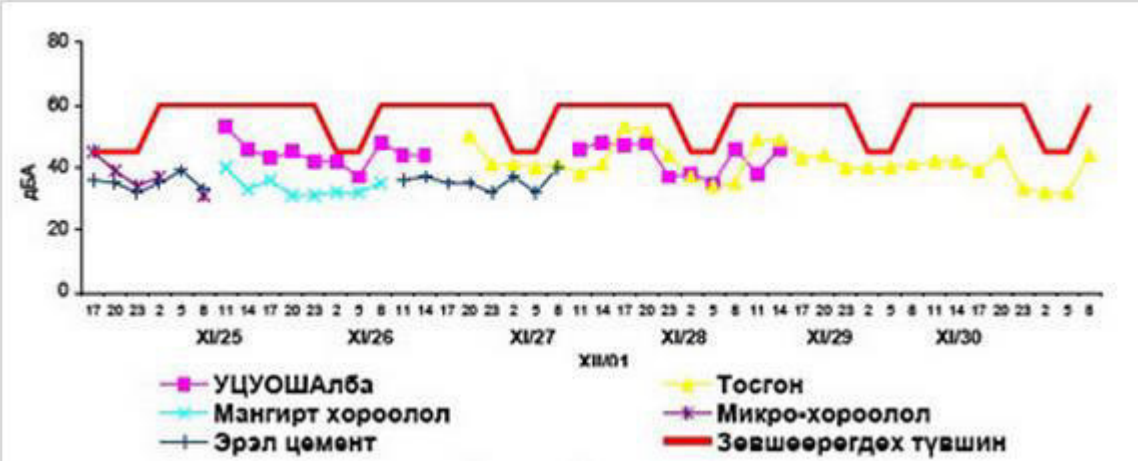
G. Noise

[47] http://air.president.mn/en/
[48] http://air.president.mn/en/

159. Noise can affect sensitive receptors such as humans. Mongolian standards on noise are discussed in Chapter III, C. Environmental Standards. No regular noise monitoring data were available to inform this study relevant to WWTP site. However noise data are available for a specific study undertaken in November 2012 for an assessment of the environmental condition of Darkhan, undertaken by the *aimag* Meteorological Institute. The data were recorded in five locations, and showed that the daytime average was 30-45 dB (Mongolian National Standard is 60 dB) and night time average is 31-43 dB (Mongolian National Standard 45 dB).

160. Figure 28 gives noise monitoring data for five locations in Darkhan.

Figure 28: Darkhan *soum* Noise Monitoring Data



Key to Locations
Pink - Meteorological Institute, Blue - Mangirt ger district, Black - Erel Cement Factory
Yellow - Tosgon ger district, Purple - Micro district - between Old/New Darkhan
Red line = National Standard
Source: National Committee on Reducing Air Pollution[49]

H. Climate Change

161. In 2007, Mongolia was ranked 96th in the list of CO_2 emitting countries, contributing around 0.04% to global emissions[50]. UNEP[51] states that in Mongolia, the energy sector (including stationary energy, transportation and fugitive emissions) was the largest source of greenhouse gas (GHG) emissions comprising 65.4% of total emissions. The second largest source of GHG emissions was the agricultural sector (41.4%). The report also states that total CO_2 removal was more than total CO_2 emissions in 2006 because of an increase in the area of abandoned lands and a reduction in newly cultivated land. However, by 2020, it is predicted that Mongolia's GHG emissions will be more than five times levels in 2006.

162. Climate modelling for Mongolia is projecting changes which include increased air temperatures, increased precipitation in some areas and a reduction of water resources in other areas[52]. Potential evapotranspiration increase would be higher than precipitation increase. This

[49] http://air.president.mn/en/
[50] United Nations Statistics Division, Millennium Development Goals Indicators. Available at http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=749&crid=
[51] United Nations Environment Program (2009) Mongolia: Assessment Report on Climate Change 2009.
[52] United Nations Environment Program (2009) Mongolia: Assessment Report on Climate Change 2009.

is supported by Mongolia's Second National Communication on Climate Change[53]. The climate analyses in the National Communication shows where Mongolia is vulnerable to climate change and what the changes may be, as shown in Table 18.

Table 18: Climate Change Vulnerabilities

Vulnerability	Impact
Ecosystem	In 2080, forest-steppe and steppe areas will decrease, as a result of a decrease in rainfall and an increase in temperature in the growing season
Rangeland	The pasture biomass will decrease in almost all areas
Desertification	Future temperature increases during the growing season, the increase of potential evapotranspiration, a precipitation decrease in most areas
Water Resources	The projected increase in evaporation from open surface water will exceed the increase in runoff by much higher rates in different basins, leading to dryer conditions; and Increased tendency to flooding
Cryosphere	The area of stable snow cover will be decreased in future periods; and Permafrost will retreat in mountainous areas, and eventually the higher geographical classes of permafrost will be replaced with lower ones

Source: Mongolia's Second National Communication on Climate Change

163. The report notes that the reasons for hydrological changes are complex and include climate factors such as the effects of melting glaciers and permafrost as well as anthropogenic influences such as watershed management. The most vulnerable areas for the country are in the agricultural, livestock, land use, water resources, energy, tourism and residential sectors. This indicates that future climate changes are expected to negatively impact Mongolia meaning that climate change adaptation is a significant issue for the country.

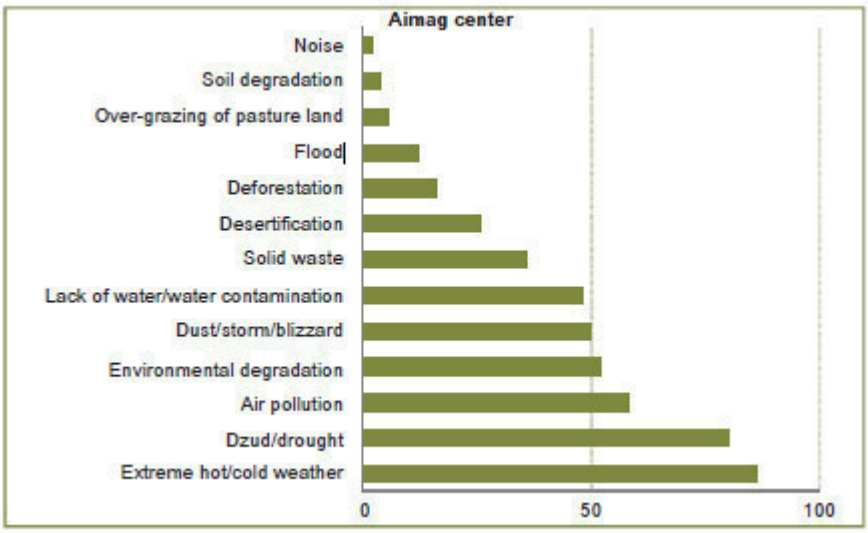
I. Natural Disasters

164. Mongolia is susceptible to a number of natural disasters.

[53] MNET (2010) Mongolia's Second National Communication on Climate Change; Under the United Nations Framework Convention on Climate Change (UNFCCC)

165. Figure **29** gives results from a household survey undertaken for the 2011 Human Development Report for Mongolia. The figure shows that the two most significant issues are related to natural disasters and in particular to climate change.

Figure 29: Environmental Issues Affecting Daily Life



Source: Human Development Report Mongolia 2011

166. In particular the second highest environmental condition for Mongolia is dz*ud* conditions. This means an extremely cold winter when livestock cannot graze and reach fodder. This condition can be caused by a variety of factors including: i) a layer of ice formed after a warm thaw in winter; ii) a lack of snow in the waterless regions; iii) too much snow; or iv) the trampling of pasture in areas where stock density is too high.

167. **Flooding**. Reduced forest areas in Darkhan-Uul *aimag* may alter water discharge pattern and contribute to increased risks of flooding in the Kharaa River and its tributaries. The Kharaa river does not regularly flood. The most significant flood in recent years was in 1973 when flows of 722 m^3/second in Kharaa river. Also in January 2006 high rainfall led to the Kharaa river flooding and flowing at 65.9 m^3/sec[54].

168. During intense rainfall events, specific areas of the city are subject to temporary flooding, primarily caused by blocked stormwater channels. The channels are blocked with sediment and solid waste. Flooding is exacerbated by the lack of connections to the storm water drainage system; most areas of the city, apart from main roads, have no stormwater flow management[55]. Areas liable to this flooding include old Darkhan's market area, the micro-district in between old and new Darkhan and ger areas built on the flood plain of the Kharaa river, to the west of the railway. The flooding generally lasts for one to two days after a prolonged intense rainfall event.

169. **Earthquakes**. The Research Center of Astronomy and Geophysics of the Mongolian Academy of Sciences (RCAG) has partnered with the French organization 'Département Analyse, Surveillance, Environnement' (DASE) in order to assess the seismic hazard in Mongolia and Ulaanbaatar (on-going). The results of the RCAG and DASE assessment[56] were derived through

[54] http://air.president.mn/en/
[55] MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report
[56] http://www-dase.cea.fr/public/dossiers_thematiques/evaluation_de_l_alea_sismique/description_en.html

a full review of Mongolia's seismic activity, and attenuation laws were redefined. The results so far show previously unknown active faults around Ulaanbaatar.

170.

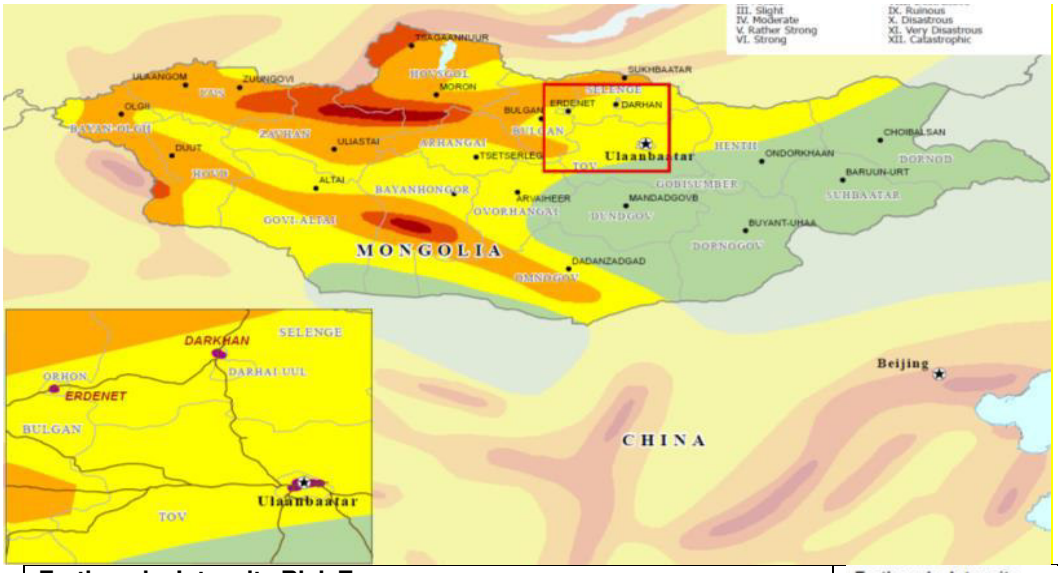
171. Figure **30** illustrates seismic hazard in terms of macro-seismic intensity[57], using the Modified Mercalli Scale which is an alternative hazard metric to the older peak ground acceleration measure. Intensity is a generic bounded damage scale used to relate observed (or expected/forecasted) damage to the earth and built environment directly to earthquake magnitude. Macro-seismic intensity is a subjective scale requiring a personal interpretation of damage experienced by buildings after an earthquake, and is largely based on post-earthquake field surveys of building and site damage.

[57] Intensity may be related directly to peak ground acceleration and peak ground velocity through empirical relationships. The former measure is an international standard hazard metric currently adopted by many countries for presenting national seismic hazard assessments; ground velocity however is often considered a more representative measure of a location's ground motion hazard than ground acceleration. Peak ground velocity is closely related to the energy flux between ground and building. Seismic hazard may be forecast using ground velocity as an alternative measure to intensity, such that intensity may be determined as a function of peak ground velocity. Earthquake damage statistics often give a much closer correlation with peak ground velocity than with peak ground acceleration, particularly at higher intensity values. Both however are more meaningful than using magnitude in isolation when specifying engineering seismic loading design criteria. *Source: Dr J Bayliss, Independent Advisor, UK. Pers. Comm. December 2012*

172. Figure **30** shows the project components to be in a zone of intensity VI hazard[58].

[58] Hazard Intensity VI. Felt by everyone, outside or inside; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books fall off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight to moderate to poorly designed buildings, all others receive none to slight damage

Figure 30: Earthquake Risk: Modified Mercalli Scale (Mongolia) Created 17 August 2010



Earthquake Intensity Risk Zones

This map shows earthquake intensity zones in accordance with the 1956 version of the Modified Mercalli Scale (MM), describing the effects of an earthquake on the surface of the earth and integrating numerous parameters such as ground acceleration, duration of an earthquake, and subsoil effects. It also includes historical earthquake reports. The Zones indicate where there is a probability of 20 percent that degrees of intensity shown on the map will be exceeded in 50 years. This probability figure varies with time; i.e., it is lower for shorter periods and higher for longer periods.

I. Instrumental	VII. Very Strong
II. Feeble	VIII. Destructive
III. Slight	IX. Ruinous
IV. Moderate	X. Disastrous
V. Rather Strong	XI. Very Disastrous
VI. Strong	XII. Catastrophic

OCHA Regional Office for Asia-Pacific

Earthquake Intensity
Modified Mercalli Scale

- Degree I-V
- Degree VI
- Degree VII
- Degree VIII
- Degree IX-XII
- Town
- Province
- Urban Area
- Primary Road

Map Doc Name: MNG_Earthquake Risk_v1_100816
Creation Date: 17 August 2010
Projection/Datum: GCS MONREF 1997
Web Resources: http://ochaonline.un.org/roap

0 250 500 Kilometers

Map data source(s): Pacific Disaster Center (PDC), Natural Hazard Assessment Network (NATHAN) by the Munich Reinsurance Company, UNEP/GRID, UN Cartographic Section, FAO-GAUL

Disclaimers: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Source: http://www.preventionweb.net/files/15692_mngearthquakeriskv1100816.pdf

J. Physical Cultural Resources

173. The only observed cultural site in the project area is the Old Darkhan Buddhist approximately 200 m from Old Darkhan hospital (Component A2, sewer pipe replacement near Old Darkhan hospital).

174. Figure **31** shows the temple which can be accessed from several locations, the photograph shows an entrance to the east, 100m from the sewer pipeline (Component A2) to the side of Old Darkhan Hospital. The temple is not a heritage site.

Figure 31: Old Darkhan Temple, Getsogdarjaalin Monastery

Source: ADB Study Team

K. Ecological Resources

175. **Context.** The location of Component A1 (WWTP) is in an ecologically disturbed environment which been used as an industrial type site for at least 48 years, since the WWTP was established. Component A2 (pumping, pipes and ancillary works) are in (i) an urban environment, largely devoid of vegetation and other ecological resources and also (ii) in the industrial area of the city, in which heavy industry such as the thermal power plant and tannery are based. In these circumstances, coupled with heavy grazing on the grasslands around the city, available data suggests that flora and fauna in the area to limited and of low ecological value.

176. **Flora and Fauna**. The project area is located in the Mongolian steppe or Mongolian-Manchurian grassland[59]. 59% of the Kharaa river basin area is characterized by grasslands. These grasslands are mainly in the lower reaches of the river, in which Darkhan is located. As the altitude of the basin increases, the vegetation changes to mountain forest steppe zone in the middle reaches and boreal coniferous in the mountainous upper reaches.

177. The grasslands are currently being threatened by grazing. Sheep-grazing is dominant, although the number of goats raised on the Mongolian-Manchurian grasslands has increased due to the high prices for cashmere wool. Goats eat a wider range of plant species than sheep, forage more aggressively and consume the whole plant; this has contributed to degradation of the

[59] World Wildlife Fund. Temperate grasslands, savannas and shrublands; Ecoregions. - http://worldwildlife.org/ecoregions/pa0813

grasslands over a widespread area. The flora is dominated by feathergrass (*Stipa baicalensis, S. capillata, and S. grandis*), Sheep Fescue (*Festuca ovina*), *Aneurolepidium chinense*, *Filifolium sibiricuman*, and *Cleistogenes sqarrosa*[60].

178. World Wildlife Fund (WWF) confirms that the only endemic bird to use the grassland type habitat is the brown eared pheasant and one of the most significant mammals in the grassland is the Mongolian Gazelle (*Procapra gutturosa*)[61]. However the IUCN Red List[62] confirms that the pheasant is only present in the grasslands of China and the range of *Procapra gutturosa* does not extend as far north as the grasslands around Darkhan.

179. The Detailed EIA[63] for the project confirmed that although approximately 20 species of bird are indicated as using the area around the project site for roosting or transiting, none of the species are on the IUCN red list and those that are present, such as crows and sparrows, are familiar with habitats which have been degraded by human activities. The Detailed EIA also includes information on a number of rodents which are common in Mongolia, such as the house mouse (*Mus musculus*) and Mongolian gerbil (*Meriones unguiculatus*) however the study also concludes that the presence of these mammals cannot be confirmed but the habitat is already greatly disturbed by human activities therefore any species which are present are likely to be those which tolerate disturbance and do not need a habitat with a high ecological value.

Ecological assessments of flora and fauna in the Kharaa river basin are presented by MoMo. MoMo. The report states that the analysis of the macroinvertebrate communities along the Kharaa catchment indicated good ecological conditions at most of the sites and an assessment of the fish communities showed a good or very good ecological status at most of the sites sampled. Further information is provided in

[60] World Wildlife Fund. Temperate grasslands, savannas and shrublands; Ecoregions. - http://worldwildlife.org/ecoregions/pa0813

[61] World Wildlife Fund. Temperate grasslands, savannas and shrublands; Ecoregions. - http://worldwildlife.org/ecoregions/pa0813

[62] A global list of endangered species. http://www.iucnredlist.org

[63] Environ LLC (2014) A Detailed Environmental Impact Assessment Report for Expansion Project of Central Treatment Plant in Darkhan-Uul Province [*sic*]

180. **Figure 32**.

181. **Specially Protected Areas and Endangered Species.** Darkhan is one of three provinces in Mongolia which does not have any Specially Protected Areas (Strictly Protected Area, National Conservation Parks, Nature Reserves and Monuments). Locally however Darkhan-Uul *aimag* authorities have a local nature reserve status for two local areas of the Kharaa River. (i) Khongor *soum*, the east side of the river bank bagh 1,3; and (ii) Darkhan *soum* the east side of the river bank in *bagh* 2 and 3, 500 m from Ukhaa hoshuu river. These areas were defined by local decisions (i) the 61st decree of People's Representatives' Meeting in *Aimag*, 2007; and the 4th decree of People's Representatives' Meeting in *Soum*, 2006 respectively**.** This nature reserve status is not set out in national law, but rather it supports the *aimag* with protecting the natural beauty of an area and therefore is focused on the landscape and visual appeal of the area. Discussions with *aimag* Environmental Protection Agency staff confirmed that there are no concerns with rare wildlife species in the area; the main issues dealt with by staff is regarding the illegal collection of fire wood, forest fires and artisanal gold mining. None of these issues will be exacerbated by the project.

Figure 32: Ecological Assessment and Priority Substances

site	Macro-invertebrates average of 5 to 6 metrics	Fish fauna FIBS	Water Quality General parameters		Ecological Status average of MZB, fish and Water Quality	Priority Substances Heavy Metals
Kharaa River Main Channel						
Sug_2	2,0	2,0	2,0		2,0	2,0
Sug_1	2,0	2,0	1,0		1,7	2,0
Kh_8.5	2,0	2,0	2,0		2,0	2,0
Kh_8	1,0	2,0	2,0		1,7	2,0
Kh_7	2,0	2,0	2,0		2,0	2,0
Kh_6	3,0	2,0	2,0		2,3	2,0
Kh_5	3,0	2,0	2,0		2,3	2,0
Kh_4	3,0	2,0	2,0		2,3	2,0
Kh_3	3,0	3,0	2,0		2,7	2,0
Kh_2	2,0	2,0	2,0		2,0	5,0
Kh_1	2,0	2,0	2,0		2,0	2,0

Note: For quality classes: "very good" = blue, "good" = green, "moderate" = yellow, "poor" = orange, "bad" = red; no data =grey. FIBS= German assessment tool
Source: MoMo (2009). Integrated Water Resources Management for Central Asia: Model Region Mongolia (MoMo) Case Study in the Kharaa River Basin Final Project Report

L. Socio-Economic Conditions

182. **Demographics**. Darkhan is Mongolia's third largest city, with a population of 88,875 in 2012. Darkhan-Uul *aimag* has 4 *soum*s; Darkhan, Orkhon, Khongor and Sharyn gol. Darkhan *soum* is also known as Darkhan city or the *aimag* center. The city is the main population centre in the *aimag*; it contains 85% of the population of the *aimag*.

183. **Economic Conditions**. Darkhan was established as an industrial city in the 1960s and it continues to be an industrial town. In 2009, manufacturing and mining employed approximately 19,000 people, which is approximately 16% of the *aimag* population[64]. Heavy industries are located close to residential areas of Darkhan. The industrial area, approximately 2 km from Old Darkhan, includes a sheepskin tannery making products for domestic and export markets, a metallurgical plant which produces steel products, a meat processor, a flour mill, cement and brick factories and in old Darkhan there is a timber processing operation. Additional industry is planned, which will afford more employment opportunities. This includes a new ore processing factory which has been built but is not operational, and a new wool processing operation, also not yet operational.

184. **Infrastructure - water supply**. For information on potable water abstraction, see Section V, Paragraph 141, Groundwater. Us Suvag supplies residential water needs and a total of 18-23,000 m^3 water is abstracted for city wide consumption[65].. Water distribution fee is 3.79 MNT (Mongolian Tughrik) per liter for the city and 1.0 MNT per liter for ger areas, which is supplied by local kiosks which are serviced by water trucks. The majority of the population (72.7%) has

[64] Sigel K. (2010) Environmental sanitation in peri-urban ger areas in the city of Darkhan (Mongolia): A description of current status, practices, and perceptions
[65] TA Interim Report- Draft. ADB. October 2013

access to the central water supply network; the rest uses water kiosks and surface water for drinking.

185. The raw groundwater extracted by Us Suvag is generally of drinking quality at the point of extraction, and as such is not normally subject to treatment. However, chlorination facilities exist at storage tanks and it is reported by Us Suvag that chlorination is occasionally carried out during the summer period when quality declines. Despite this, water quality problems are experienced at the point of delivery as a result of the poor condition of many sections of the 40 year-old pipe network, which suffers an overall leakage rate currently estimated at about 40%.

186. **Infrastructure - solid waste management**. The solid waste management services in the city are provided by the *aimag* Environment Protection Agency. The *aimag* provides a waste collection services to households and businesses, with a government owned undertaking being responsible for the collection and disposal of waste. Informal recycling occurs with waste collectors in the city picking recyclables such as plastics and metals, also a limited number of apartment blocks source segregate recyclables. The metallurgy plant accepts ferrous waste for recycling and a small plastics factory in the city makes manhole covers from plastic waste.

187. The waste disposal facilities are limited. An uncontrolled dumpsite is used, sited 3 km outside the built up city area, and it has one or two vehicles which are used for moving the waste. There is no provision made for separation or treatment of solid or liquid hazardous wastes.

188. **Poverty**. In April 2012, revised poverty numbers were released for Mongolia according to the World Bank methodology based on the 2011 Household Social Economic Survey conducted by the Mongolian National Statistics Office. According to the joint estimation, poverty headcount index in Mongolia stands at 29.8 percent which is 9.4 percentage points less than in 2010, poverty depth amounts to 7.6 percent which represents a drop of 3.7 percentage points, poverty severity is at 2.8 percent which is 1.8 percentage points less than in 2010. By regions, the poverty headcount index shows that the headcount index in the Central region (in which Darkhan-Uul *aimag* is located) is 27.2 percent, compared to Ulaanbaatar city at 23.5 percent. The data show that for the country as a whole, there is more poverty in rural areas than urban.

189. **Economic Displacement and Land Acquisition**. Economic displacement and land acquisition will be covered by a Resettlement Plan in accordance with ADB's SPS 2009.

190. **Occupational Health and Safety**. Occupational safety considerations are currently a low priority in Mongolia, given observations on construction sites. Construction workers and maintenance staff can be observed operating without Personal Protective Equipment (PPE). Article 16 of the National Constitution of Mongolia states that every employee has the right to 'suitable conditions of work'. The government adopted a National Program for Occupational Safety and Health Improvement in 2001 and national standards are also adopted such as the National Standard on Occupational Health and Safety MNS 5002:2000.

191. **Community Safety Related to Construction**. The location of the WWTP means that members of the community are unlikely to enter or pass through the WWTP site; it is not close to housing areas or industrial/commercial buildings and does not appear to be used for access. The works required for Component A2 (rehabilitation of pumps and ancillary equipment) may occur in more populated areas, particularly the replacement of sewer pipes at around the hospital in Old Darkhan (Figure 11). However all construction areas in the project should be prepared for managing community health and safety, even if community residents do not appear to be living or working near the construction sites.

VI. ALTERNATIVE ANALYSIS

192. Under ADB's SPS 2009 there is a requirement to examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and consider the no project alternative.

A. No Action Alternative

193. **The "No Action Alternative**" addresses the likely consequences of not undertaking the proposed action. For this project, the failure to develop and improve the existing sewerage infrastructure may be an impediment to development of the Darkhan as a liveable city and may give rise to pollution of the Kharaa river basin as a result of failing WWTP equipment and a predicted increase in wastewater.

194. The improvement of the WWTP will ensure that the urban environment is 'future proofed' and that new developments both in terms of industry and expansion of the town, do not affect negatively on the environment as a result of increased volumes of wastewater. Therefore, it can be determined that the "No Action Alternative" is not a reasonable option if the future environmental quality in Darkhan and the Kharaa River Basin is to be maintained and improved.

B. Location Alternatives

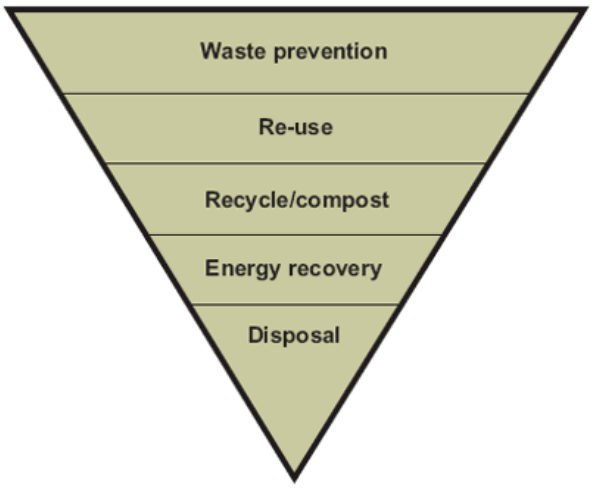
195. The project seeks to improve the efficiency and performance of the existing sewerage network. The central WWTP is currently in a suitable location; it is on the edge of the town, not close to any residential areas and is well served by the sewerage network of pumping stations and pipes in the city. The current WWTP has a large footprint with enough land to store the drying sludge, as currently happens as well as approximately 90 days of wastewater if required. Therefore given the existing location for the WWTP and the current pipe network that services it, location alternatives are not considered further.

C. Design and Technology Alternatives

196. **Design for Reuse**. A key consideration regarding the design of the WWTP is the condition of the existing buildings, in particular the pump houses. The pump houses are in a reasonable condition and the fabric of the buildings is sound. In order to consider the most environmentally and socially sound option for WWTP design, the Waste Hierarchy can be applied (

197. Figure **33**). The Waste Hierarchy is a classification of waste management options, ranging from most preferable (waste prevention) to least preferable (disposal).

Figure 33: Waste Hierarchy



Source: Department for Environment and Rural Affairs (UK)

198. The design of the WWTP takes into account the current structures at the project sites. The chosen option is to rehabilitate the central, secondary and industrial pumping stations. The alternatives include constructing new buildings, and either leaving the existing pumping stations or demolishing them. However the chosen option, of reusing the existing buildings where possible, is the most environmentally and socially acceptable option as falls under the 'waste prevention' category of the Waste Hierarchy. It is anticipated to be the least resource intensive option as constructing new buildings requires considerable resources, in terms of energy, raw materials and associated embodied carbon[66].

199. **WWTP Technology Alternatives**. The treatment technologies proposed have been the subject of intensive analysis, based on both international and Mongolian experience of wastewater treatment under condition similar to those found in Darkhan. Wastewater treatment plants are complex systems which rely on a series of sensitive physical, biological and (sometimes) chemical processes to achieve optimal treatment results. While the evaluation of alternative options has narrowed the technology choices to those which are most appropriate for Darkhan, the specific design of the treatment plant, and the way in which it is operated, will need to respond precisely to local conditions and the current and changing nature of the wastewater it will receive, as new generators connect to the wastewater network.

200. Given the context of the Darkhan WWTP, the technology alternatives evaluated as part of the Technical Assistance are narrowed to:

- Option 1. rehabilitation of the existing WWTP as a modified activated sludge process;
- Option 2: construction of a step-feed activated sludge system;
- Option 3: construction of a sequencing batch reactor; and
- Option 4: construction of an Integrated Fixed-film Activated Sludge (IFAS) Plant

[66] Embodied Carbon is the greenhouse gas emissions (usually expressed as carbon dioxide equivalents – CO2e) associated with a product lifecycle; for construction this is the manufacture and transport of the construction materials and components, includes the construction process itself and end of life aspects of the building

201. In terms of environmental risks, there is little between the options considered as all, if operated correctly, will offer adequate performance. In terms of costs, the step-feed activated sludge is slightly more expensive and has slightly higher operational cost than the other two systems.

202. The performance of the treatment options is the key environmental and social concern. This includes the adequate mineralisation of sludge and the likelihood of accidents or errors in the WWTP operation which may result in the emission of untreated effluent. It is considered that all three options are technically feasible in Mongolia and will be able to meet the necessary effluent standards and sludge mineralisation requirements. Therefore the Interim Report[67] proposed that further evaluation of these options is necessary, and a workshop held, attended by the client group and Mongolian technical experts and academics in the field in order to define the final technological solution.

203. **Decision Process**. The client group has reviewed the evaluation prepared by the consultants. In addition Darkhan Uul *aimag* Government and Us Suvag have been given presentations by the consultants on the treatment system evaluation and the options under consideration. The conclusions and recommendation of this group have been as set out below:

- In its meeting held in December of 2013, the MCUD Project Steering Committee concluded that a separate meeting involving MCUD, academia, technical experts and specialists, and Us Suvag should be convened on 27th January 2014 to select the preferred technology for the WWTP.
- The expert group met and a presentation was made by the consultant team. However, the group recommended that the MCUD Technical Committee on Water and Wastewater Infrastructure should consider the options and make a recommendation.
- On 20th February 2014 a meeting of the MCUD Technical Committee on Water and Wastewater Infrastructure recommended: (i) that the consultants look again at moving bed bioreactor and modified bioreactor options for treatment; (ii) that the existing structures of the WWTP should be rehabilitated if proved to be feasible; and (iii) that a modified activated sludge process technology – such as the IFAS system - should be adopted which is proven suitable for Mongolian conditions.
- At the MCUD Steering Committee meeting held on Wednesday April 2nd 2014 it was concluded that: (i) the proposed design capacity of 20,000 cum/day should be reviewed and confirmed by the consultants based on projections of future wastewater generation rates; (ii) that the most appropriate and up-to-date technology should be used for the plant; (iii) that the committee supported the adoption of the modified activated sludge process (the three sludge or Integrated Fixed-film Activated Sludge (IFAS) process) for the Darkhan WWTP, and that the existing structures should be used where feasible, and where consistent with the treatment plant adopting the most modern treatment approaches.

204. The chosen solution of Option 4 (IFAS), with the reuse of existing buildings is considered to be environmentally sound; in particular it will produce approximately 1/3 of the sludge as produced by SBR technology and therefore will require smaller volumes of sludge to be treated and disposed of. The effluent quality of IFAS is anticipated to be sufficient to adequately meet Mongolian National Standards.

[67] Draft Interim Report. ADB. October 2013.

VII. ANTICIPATED IMPACTS AND MITIGATION MEASURES

A. Environmental Impact Screening

205. The following discussion on environmental impacts screens the potential impacts according to the following factors and recommends mitigating activities on this basis:

- **"Receptor"**: the resource (human/natural environment/economic/social) which is potentially going to receive and have to cope with an impact.
- **"Sensitivity"**: ability to cope with an impact and/or its importance to the country of Mongolia. It is generally accepted that human health is always a high sensitivity receptor, however in terms of environmental/natural resources, the sensitivity varies according to the receptor e.g. scrubland with no significant biodiversity is considered less sensitive than a mature forest which supports ecosystems and livelihoods.
- **"Magnitude"**: the size of the potential impact. Impacts may be short term and considered low magnitude (e.g. noise or temporary reduction of income during a short construction project) or high magnitude (e.g. the disposal of large quantities of hazardous waste into a water course).

206. **Source-Pathway-Receptor**. Where an impact may occur, if there is no receptor which is potentially going to receive the impact, then mitigating actions will not be required. This follows the source-pathway-receptor model, whereby in order for there to be an impact, the pollutant or issue (source) needs to be present, the pathway to a receptor is needed (such as fissures in rocks, or water for human consumption) and a receptor must be present to receive the impact, such as humans, flora or fauna.

207. The impact on the receptor after mitigation is the 'residual impact'. This is key to the assessment of impacts and demonstrates the importance of the implementation of EMP mitigation measures. Table 19 shows the matrix used during the screening process to anticipate the Potential Impact Significance. This assists with identifying the most significant likely impacts to be addressed in the Environmental Management Plan:

Table 19: Impact Significance

Receptor Sensitivity & Importance	Magnitude of Impact: LOW	MEDIUM	HIGH
LOW	Low	Low	Medium
MEDIUM	Low	Medium	High
HIGH	Medium	High	High

208. The Potential Impact Significance and Residual Impact Significance are presented in Table 20 to Table 22. Residual Impact Significance is the significance of the impact remaining after mitigation has taken place. This more accurately describes the impacts of the project as it

is anticipated that the requirements of the EMP will be followed and impacts satisfactorily mitigated. In addition, Table 20 to Table 22 are in line with the Detailed EIA[68] undertaken in accordance with the laws of Mongolia.

Table 20: Impact Screening - Project Design

	Category	Impact Yes/No	Receptor Sensitivity	Magnitude	Potential Impact Significance	Residual Impact Significance
DIRECT IMPACTS						
Physical	Water	Yes	Kharaa River - has ecological value and water source. Design must ensure uninterrupted sewage treatment. Medium	Short term during construction until new plant on line Medium	Medium	Low
	Soil	No	-	-	-	-
	Air	No	-	-	-	-
	Noise	No	-	-	-	-
	Resource Use	Yes	Design will affect energy recovery and re-use of existing buildings. Medium	Long term operational implications for energy recovery. Medium	Medium	Low
Biological	Fauna	No	-	-	-	-
	Flora	No	-	-	-	-
Socio-Economic	Land Acquisition	No	-	-	-	-
	Cultural Heritage	No	-	-	-	-
	Economic Displacement	Yes	Some local livelihoods may be temporarily affected. Low	Short term. Low	Low	Low
INDIRECT, INDUCED AND CUMULATIVE IMPACTS						
No impacts anticipated resulting from project design/location						

[68] Environ LLC (2014) A Detailed Environmental Impact Assessment Report for Expansion Project of Central Treatment Plant in Darkhan-Uul Province [*sic*].

Table 21: Impact Screening – Construction Impacts

	Category	Impact Yes/No	Receptor Sensitivity	Magnitude	Potential Impact Significance	Residual Impact Significance
	DIRECT IMPACTS					
Physical	Soil	Yes	Poor quality soil, not fertile lands. Already likely contamination from existing WWTP. Low	Worst case is medium term if contamination is from chemical spillage. High	Medium	Low
	Flooding	No	-	-	-	-
	Air	Yes	Airborne dust will arise and could affect nearby human receptors. High	Short term, most construction sites will not be close to receptors. Medium	Medium	Medium
	Water	Yes	Kharaa river flood plain - emergency sewer pipe comp.A2 . Medium	Short term with contamination from construction waste. Low	Low	Low
	Waste	Yes	Poor waste controls could affect soil / water, and public health. High	Hazardous waste may be produced if asbestos pipes and PCBs are encountered however quantity is small. Medium	High	Medium
	Resource Use	Yes	Construction resources include fuel and materials such as concrete which may need to be imported. Medium	Relatively small quantities but project will lead to more efficient WWTP. Medium	Low	Low
Biological	Fauna	Yes	Higher fish species in Kharaa river. Medium	Potential contamination from spillages at WWTP but would be diluted by river as construction will not take place near water body. Low	Low	Low
	Flora	No	-	-	-	-
Socio-economic	Cultural Heritage	Yes	Getsogdarjaalin Monastery monks and visitors. High	Temporary noise and dust impacts may affect people attending the site. Low	Medium	Low
	Noise	Yes	Noise will impact on the community, particularly hospital residents. High	Temporary during construction and construction period near hospital will be brief. Medium	High	Medium
	Community Health &Safety	Yes	Public health and impacts on people from noise, dust and construction sites e.g. open trenches. High	Temporary during construction as construction area will be near a school and housing areas. Medium	Medium	Low

	Category	Impact Yes/No	Receptor Sensitivity	Magnitude	Potential Impact Significance	Residual Impact Significance
	Economic Displacement and / or Land Acquisition	Yes	These issues are covered in the Land Acquisition and Resettlement Plan which is developed for the project according to SPS 2009.			
	Occupational Health & Safety	Yes	Occupational health. High	Throughout construction, risks may arise. Medium	High	Low
	Utilities Provision	Yes	Limited impact assuming accidental damage only to other services buried near sewer pipes. No district heating pipes are near project sites. Low	Assume short term and unlikely impact. Low	Low	Low
	Employment	Yes	Anticipated positive impact as the labor supply (around 50 workers) is likely to be met by the local population			
	Interruption to pasture land	Yes	Animals out to pasture may be affected by disturbance from project sites in pasture areas (Comp. A2). Low	Short term during construction. Low	Low	Low
INDIRECT IMPACTS						
Physic -al	Physical resources	No	-	-	-	-
Biolog -ical	Biological resources	No	-	-	-	-
Socio-Economic	Traffic & Journey Times	Yes	Minor journey delays for road users. Low	Short term during single pipe excavation. Low	Low	Low
CUMULATIVE and INDUCED IMPACTS						
Physi cal	Physical Resources	No	-	-	-	-
Biolog -ical	Biological Resources	No	-	-	-	-
Socio-Economic	Noise	Yes	Can affect health for example in hospital patients, Old Darkhan Hospital. High	Hospital near a main road therefore constant level of background noise, but elevated noise short term during pipe excavation. Medium	Medium	Medium

Table 22: Impact Screening – Operational Impacts

	Category	Impact Yes/No	Receptor Sensitivity	Magnitude	Potential Impact Significance	Residual Impact Significance
Physical	DIRECT IMPACTS					
	Water	Yes	Kharaa river flood plain - emergency sewer pipe above ground,Comp.A2 . Medium	Pipe is rarely used but needs to be well maintained. Medium	Medium	Low
	Water and Soil	Yes	Inappropriate sludge disposal and poorly mineralized sludge may impact on immediate soil quality, but soil in existing industrial brownfield site Low	Contamination would be low but over a long period. Medium	Medium	Low
	Water, Soil, Waste & Resource Use, Air Quality	No	Positive impacts anticipated given the increased efficiency of the WWTP and sewerage infrastructure			
Biological	Flora	Yes	Positive impacts for flora and fauna in Kharaa river are anticipated given the increased efficiency of the WWTP and sewerage infrastructure			
	Fauna	Yes				
Socio-Economic	Community Health and Safety	Yes	Positive impacts anticipated given the increased replacement of a cover on current exposed inspection chamber near school (Component A2)			
INDIRECT, INDUCED AND CUMULATIVE IMPACTS						
No impacts anticipated resulting from project design/location						

209. The screening process showed that following mitigation, related to project design (design phase), the most significant impacts are the temporary economic displacement of around 5 street vendors and the need for ensuring continuity of relocation sewage treatment. The majority of impacts will arise during the construction phase. The most significant impacts may arise from hazardous waste arisings and noise and dust arising from excavations which at one project site, is outside a school and a hospital. In the operation phase, with mitigation, including comprehensive training for the WWTP operators, it is anticipated that the environmental benefits of the project will be significant.

B. Positive Impact and Environmental Benefits

210. **Beneficiaries**. The Project will directly benefit the residents of the Darkhan, a population of 88,875 (2012). Further beneficiaries are those downstream of Darkhan in the Kharaa river basin, which eventually drains into Lake Baikal. The river basin's population and ecology will benefit from any measure which will minimise the pollution entering the water bodies in the basin.

211. **Environmental Sustainability & Energy**. It is possible that at times of low flow and with an increase in housing and industry, the impacts on the river arising from the current WWTP would become more significant with time and the environmental sustainability will be compromised. This is increasingly likely as the outdated waste water treatment technology becomes progressively more unreliable with age. Therefore the project will seek to improve the environmental sustainability of the WWTP. Environmental sustainability will also be improved through the use of more energy efficient technologies. The current WWTP is inefficient, wasting valuable energy resources. The introduction of efficient modern technology, such as improved sewage pumps, will mean significant energy savings, associated with which are savings in carbon emissions and resource use.

212. **Industrial Development**. Darkhan is considered an industrial city in Mongolia, and the potential attraction of additional industries to the city, will increase the likelihood that industrial wastewater volumes will increase. Current and future industries will benefit from the WWTP as their effluent will be able to be treated centrally in the WWTP, following pre-treatment if needed.

213. **Community Health and Safety.** The project will help to ensure that the safety of the community is not impacted upon by the potential health impacts associated with leaking sewer pipes, particularly when they are above ground, such as the emergency sewer pipe near the Secondary Pumping Station (Component A2). Component A2 will also include the installation of a cover on the inspection chamber which is currently covered only partially and temporarily, yet is outside a school entrance.

C. Impacts Associated with Project Location, Planning and Design

214. Impacts associated with the project location and design focus on the following key areas:

(i) Planning to ensure the current WWTP will remain operational until the new WWTP / technology is on line; and
(ii) Resource use. Ensuring that the existing plant and machinery, where possible are reused in accordance with the Waste Hierarchy.

215. **Mitigation Measures and Actions during Pre-construction**. The mitigation of impacts from these design issues are as follows:

(i) Implementation of one of the alternative technological options as opposed to rehabilitating the existing WWTP thus ensuring that a WWTP is always on line.
(ii) Design with the waste management hierarchy in mind, meaning where possible existing buildings and machinery will be reused thus preventing waste at source.

216. Further actions will be implemented in the pre-construction phase to ensure the project's environment management readiness. These include:

(iii) Appointment of one Environmental and Social Specialist (PIU-ESS) within the PIU in order to ensure implementation of the project EMP;
(iv) Contracting a specialist environmental monitoring institutions for project specific sludge, surface water and effluent quality;
(v) Updating the EMP mitigation measures defined in this based on final technical design; and
(vi) Tender and contract documents to include EMP requirements.

217. Before the construction starts, the Contractor will prepare a number of mitigation plans and method statements consistent with the EMP for review and approval by MCUD and/or MEGD as appropriate. Approval will be required one month prior to construction commencing. Contract documents shall explicitly indicate the requirement of these plans that construction cannot start until all documents are approved and also state that all environmental protection measures should be included in the bid price. These management plans are needed in order to address the following issues:

(vii) **Water Protection Management Plan** will include measures to be taken during construction to avoid/mitigate pollution of the Kharaa River arising from construction site drainage (silt), use of chemicals, construction around existing wastewater containing equipment and other potential pollution sources.
(viii) **Soil Erosion Management Plan** will identify likely areas of soil erosion and the mitigation measures which the contractor will employ to minimize potential erosion around any excavations and construction areas.
(ix) **Aggregate, Borrow Pits and Spoil Management Plan** will describe work activities; technology, potential environmental impacts, and mitigation measures for aggregate/borrow pits. It should specify that borrow pits and quarries should not be in a protected area. Contractors will ensure that (i) borrow areas will be located away from residential areas, water bodies and will avoid valuable pasture/grazing land, (ii) After use borrow pit areas will be graded to ensure drainage and visual uniformity, (iii) borrow pit restoration will follow the completion of works in full compliance with all applicable standards and specifications, and (vi) topsoil from borrow pits will be saved and used during restoration.
(i) **Spill Management Plan** will document the specific requirements, protocols, responsibilities, and materials necessary to implement an emergency spill response following an incident.
(ii) **Hazardous and Non-Hazardous Waste Management Plan** for operation of construction sites will provide procedures for management of household type waste, hazardous waste, and sewage (if appropriate). It will evaluate the type and quantities of waste matter, as well as detail arrangements for storage and transportation of the waste to its disposal point. It will include agreements with the *aimag* authorities for waste disposal and consideration of the Waste Hierarchy. Include Polychlorinated Biphenyl (PCB) assessment and management plan for all pumping station sites. It will include a schedule for disinfection of all waste collection and storage areas.
(iii) **Health and Safety Management Plan (HSMP).** For management of Occupational Health and Safety, the contractor will prepare a HSMP for the construction workers based on the EMP. It will be submitted to the Darkhan *aimag* for review. The detailed HSMP will include the following provisions:

a) *Clean water.* Provide a clean and sufficient supply of fresh water, for construction and for all houses, camps, offices, laboratories and workshops.
b) *Sewage and wastewater.* Provide adequate sanitation facilities at all work sites.
c) *Solid waste.* Provide garbage receptacles at construction sites, which will be periodically cleared and disinfected.
d) *Liquid chemical waste.* Provide receptacles in suitably bunded areas for the storage of liquid chemical waste prior to disposal. Include clear warnings with health risks.
e) *Personal protection.* Provide personal protection equipment (PPE), such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection, in accordance with relevant health and safety regulations, for workers.
f) *Emergency Preparedness and Response.* An emergency response plan to take actions on accidents and emergencies, including public health emergencies associated with hazardous material spills and similar events will be prepared. Emergency phone contacts with hospitals in Darkhan will be established.
g) *Records Management.* A Records Management System that will store and maintain easily retrievable records protected against loss or damage should be established. It will include documenting and reporting occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits.
h) *Safety communication.* Ensure that safety, rescue and health matters are given a high degree of publicity to all persons regularly or occasionally at active construction sites. Posters in Mongolian and any other language appropriate for the contractors drawing attention to relevant health regulations will be made or obtained from the appropriate sources and will be displayed prominently at construction sites.

218. **Utilities Provision**. It is not anticipated that the project will disrupt utilities or any municipal services during construction however excavations associated with sewer pipe replacement at Old Darkhan Hospital (Component A2) may result in accidental interruption to cables or pipes which may be buried near the sewer. Mitigation measures will include:

(i) Contractor will consult with relevant *aimag* departments to check location of utilities in advance of construction at all sites.

D. Environmental Impact and Mitigation Measures during Construction

1. Impact on Physical Resources

219. **Impacts on Soil Resources.** Three types of potential impacts on soil are anticipated, including: (i) soil erosion; (ii) soil contamination; and (iii) inappropriate management of borrow pits.

(i) **Soil erosion.** May be caused by excavation of borrow pits, stockpiles and spoils from earthworks during pipe excavation and groundworks for the central WWTP. The factors that are expected to contribute to accelerated erosion in the project

area are any exposed soil during periods of high rainfall during June, July and August.

(ii) **Soil contamination.** Localized contamination of soil in the construction phase may result from the inappropriate transfer, storage, and disposal of petroleum products, lubricants, chemicals, hazardous materials, liquids and solid waste. These impacts are particularly associated with construction site chemical storage, and during refueling of plant and equipment.

(iii) **Borrow pits and spoil disposal.** Borrow pits will be needed to provide fill for groundworks, particularly associated with adequate coverage of the Secondary Pumping Station tertiary pipes (Component A2) which are above ground and will need adequate protection from cold weather. Spoil will be generated through the excavation of trenches for pipes.

220. **Mitigation of impacts on soil.** The impacts on soil will be mitigated through a number of measures which are defined in the EMP, and which will be incorporated in the bid documents and construction contracts. A summary of the mitigation activities recommended in the EMP is as follows:

(i) **Soil erosion:** (a) Soil erosion management plan to be prepared by the contractor and to be approved by MCUD before construction starts; (b) Minimizing the area of soil clearance; (c) Maintaining slope stability at cut faces by implementing erosion protection measures; (d) Construction in the flood plain (tertiary pipe at Secondary Pumping Station) should be mainly restricted to the dry season where possible; (e) Control silt runoff particularly around tertiary pipe at Secondary Pumping Station; (f) Cover soil stockpiles; (g) Properly stabilize slopes and re-vegetate disturbed surfaces; and (h) use of temporary berms or other appropriate temporary drainage provisions at construction sites to prevent water eroding cut faces, stockpiles and other exposed areas of soil.

(ii) **Soil contamination**: (a) Store chemicals/hazardous products and waste on impermeable surfaces in secure, covered areas with clear labeling of containers and with a tray or bund to contain leaks; (b) Regularly remove all construction wastes from the site to approved waste disposal sites; (c) Establish emergency preparedness and response plan (Spill Management Plan); (d) Provide spill cleanup measures and equipment at each construction site; (e) Conduct training in emergency spill response procedures (f) ensure fuel is stored in a bunded tank and vehicle refueling takes place on hard standing away from sensitive receptors, such as surface water.

(iii) **Borrow pits**: (a) Site borrow pits far from residential areas; (b) Develop borrow pits and restoration plans, to be approved by MCUD and MEGD prior to the start of construction; (c) Pit restoration will follow the completion of works in full compliance with the Borrow Pit and Spoil Management Plan and will be required before final acceptance and payment under the terms of contracts.

221. **Air Quality.** Moderate temporary air quality impacts during the construction stage of the project could be anticipated because of fugitive dust generation at construction sites for the sections of replaced pipe and at the central WWTP. Minor increases in the level of nitrogen oxides (NO_x) and sulphur oxides (SO_x) from construction plant and machinery are expected. Air quality impacts during construction are likely to result from the following sources:

(i) Emissions from construction machinery and equipment, movement of haulage trucks to all construction sites;

(ii) Fugitive dust from stripping of pavement during pipe replacement near Old Darkhan Hospital (Component A2);
(iii) Fugitive dust and odor from concrete batching plants required for construction or other plant for manufacture of pavement surfaces when making good after pipe excavation;
(iv) Fugitive dust from earthworks such as establishment and use of borrow pits, and back-filling activities;
(v) Fugitive dust from loading, unloading and haulage of spoil for disposal following pipe excavation particularly in areas where human receptors are present such as near Old Darkhan Hospital (Component A2); and
(vi) Dust created by wind acting on unprotected surfaces.

222. The key receptor for air quality impacts is people, who would need to be near the construction works before an impact will occur as the impacts will be localized. Air quality issues could affect nearby residential areas at the site of Old Darkhan hospital which also includes a school.

223. **Mitigation Measures**. The mitigation measures to protect sensitive receptors from air quality issues are:

(i) **Stockpiles** must be managed to reduce dust emissions. The location of the stockpile must be downwind of sensitive receptors. The stockpile must be sprayed with water before material is moved. If the stockpile is within 300m of dwellings additional precautions must be taken including using a reusable stockpile cover and fencing to form a high barrier and prevent wind lifting and dispersing.
(ii) **Construction site management.** Water will be sprayed on construction sites and material handling routes where fugitive dust is generated.
(iii) **Transport of materials.** Trucks carrying earth, sand or stone will be covered with tarpaulins or other suitable cover. Construction vehicles and machinery will be maintained to a high standard to minimize emissions (note that local standards do not exist for vehicle emissions)
(iv) **Manufacturing plants**. Site any plants for the production of concrete or pavement covering such as asphalt at least 500 m from the nearest dwelling and locate downwind.

224. **Water Quality**. Overall the project will improve water quality, however it may impact on surface water quality during construction through primarily accidental contamination particularly on the Kharaa river flood plain (Component A2, tertiary pipe at Secondary Pumping Station) during periods of heavy rainfall (June - August). Also leaving the city without any WWTP during construction may have detrimental impacts on water quality although the current sludge ponds have the capacity for storing 90 days of wastewater.

225. Construction projects have potential to contaminate groundwater if accidental spills occur in areas of high water table and there are wells or ground water drinking sources in the area. The groundwater (depth of 3 m) may be impacted upon should a large spill occur however impacts on the drinking water quality are unlikely as the groundwater extraction boreholes are around 5 km from Darkhan city and residents do not use their own boreholes or wells.

226. **Mitigation of impacts on surface and groundwater**. The impacts on surface and groundwater will be mitigated through a number of activities defined in the EMP, and which will be incorporated in the bid documents and construction contracts:

(i) Adequate WWTP capacity will be maintained at all times.
(ii) Temporary drainage provision will be provided during construction at the Secondary pumping Station tertiary pipes site to ensure that any storm water running off construction areas will be controlled. This will ensure that potentially contaminated sediment laden water does not impact on the flood plain. Contaminated water will be removed off-site for disposal in the facilities identified in the Construction Site Management Plan
(iii) Enclosed drainage around chemical storage areas on construction sites and storage will be on hard standing.
(iv) Develop and implement contingency plans for control of spills of oil and other hazardous substances (Spill Management Plan);
(v) Fuel storage, maintenance shop and vehicle cleaning areas must be stationed at least 300 m away from the nearest water body and will include enclosed drainage to ensure contaminated water does not cause pollution and storage, maintenance and cleaning activities will be on hard standing;
(vi) Construction wastes and materials (e.g. fuel) will be properly contained during construction on hard standing and fuel tanks will be located in a bunded area which has a capacity of 110% of the fuel tank. Wastes will be stored in a hard standing area which is protected from rain and wind and waste removed from site and taken to approved disposal facilities.

227. **Solid and liquid waste management and Resource Use.** Minimizing waste conserves valuable natural resources. Disposal of construction wastes could have adverse impacts on the soil, water and health of contractors and the community. Waste streams will include inert construction wastes (e.g. soil, spoil, debris, concrete) and municipal type wastes (construction workers' food and packaging wastes from construction consumables) and hazardous wastes from construction (e.g.

228. Hazardous waste arisings may include fuel containers, oil filters, oily rags, but potentially will include Polychlorinated Biphenyls (PCBs) from the transformers which remain in the New South Pumping Station (Component A2) and asbestos pipes arising though pipe replacement. PCBs were widely used as dielectic and coolant fluids and may be found in older transformers. This would require disposal of PCB contaminated equipment as well as liquids.

229. **Mitigation of impacts from solid and liquid waste and resource use.** The potential impacts arising from solid and liquid waste production and disposal will be mitigated through a number of activities defined in the EMP, and which will be incorporated in the bid documents and construction contracts.

(i) **Waste Hierarchy.** Construction will be subject to the waste hierarchy to ensure efficient use and management of resources. The preference is for prevention of waste at source. This means the effective management of materials on site through good house-keeping and work planning, in order to generate less waste. Procurement options will play a role in waste prevention as the procurement of materials which have less packaging for example, would be preferable. Waste minimization is the second preferred option. Reuse or recycling options should be considered prior to disposal, separate containers for recyclables shall be used if there is a market for the materials. Disposal of waste which cannot be reused or recycled shall take place at sites authorized by the *aimag* authorities.
(ii) **Storage and containment**: Provide appropriate waste storage containers for worker's construction and hazardous liquid wastes; Install confined storage points

of solid and liquid wastes away from sensitive receptors, regularly haul to an approved disposal facility; Include scope for long term storage of hazardous liquid waste (PCB) which requires high temperature incineration;

(iii) **Use of contractors**: Use a contractor approved by the *aimag* authorities to remove all wastes from construction sites;

(iv) **Spoil management**. Spoil will be disposed only in sites which are approved by MCUD in accordance with the Borrow Pit and Spoil Management Plan; spoil will not be disposed of on slopes or near pasture land where it may impact on vegetation; Rehabilitate and restore spoil disposal sites in accordance with the agreed plan.

(v) **Asbestos.** Carefully handle asbestos containing material (ACM) if found during any demolition activities following emergency preparedness and response protocols on which the workers will be briefed; and

(vi) **PCB Assessment:** Assessment of likelihood of PCBs being present at pumping-stations prior to works commencing; Disposal Strategy for PCB arisings which is likely to include incineration for total PCB destruction**.** Incineration is the only waste management option which destroys PCBs. If this is not viable, PCB contaminated equipment and PCB containing liquid must be stored safely until its destruction can be arranged outside Mongolia.

(vii) **General Management:** Prohibit burning of waste at all times.

2. Impact on Biological Resources

230. **Fauna and Flora.** The potential impact of construction activities on biological resources is anticipated to be minimal as the environmental baseline showed a lack of flora and fauna in the project area. Overall the project will improve water quality, however it may impact on surface water quality during construction through primarily accidental contamination particularly on the Kharaa river flood plain (Component A2, tertiary pipe at Secondary Pumping Station) during periods of heavy rainfall (June - August). This in turn may impact on higher fish species in the Kharaa River, which are sensitive to changes in water quality. Also leaving the city without any WWTP during construction may have detrimental impacts on water quality although the current sludge ponds have the capacity for storing 90 days of wastewater.

231. **Mitigation of impacts on surface water for fauna**. The impacts on surface and groundwater will be mitigated through a number of activities defined in the EMP, and which will be incorporated in the bid documents and construction contracts:

(i) Adequate WWTP capacity will be maintained at all times.

(ii) Temporary drainage provision will be provided during construction at the Secondary pumping Station tertiary pipes site to ensure that any storm water running off construction areas will be controlled. This will ensure that potentially contaminated sediment laden water does not impact on the flood plain. Contaminated water will be removed off-site for disposal in the facilities identified in the Construction Site Management Plan

(iii) Enclosed drainage around chemical storage areas on construction sites and storage will be on hard standing.

(iv) Develop and implement contingency plans for control of spills of oil and other hazardous substances (Spill Management Plan);

(v) Fuel storage, maintenance shop and vehicle cleaning areas must be stationed at least 300 m away from the nearest water body and will include enclosed drainage

to ensure contaminated water does not cause pollution and storage, maintenance and cleaning activities will be on hard standing;

(vi) Construction wastes and materials (e.g. fuel) will be properly contained during construction on hard standing and fuel tanks will be located in a bunded area which has a capacity of 110% of the fuel tank. Wastes will be stored in a hard standing area which is protected from rain and wind and waste removed from site and taken to approved disposal facilities;

3. Impact on Socio-economic Resources

232. **Cultural Resources**. Component A2 (Old Darkhan Hospital site) is 100 m from a Buddhist temple (Getsogdarjaalin Monastery). The temple is not a heritage site but is regularly attended by worshippers which will primarily be affected by noise during construction, particularly any excavation works. There may be a limited impact on accessibility however the temple has several entrances, only one of which is likely to be impacted upon by the construction work. In order to mitigate the impacts arising from construction the following mitigation measures are proposed:

(i) **Consultation with monks in advance of construction.** In consultation with the temple monks, the plan for construction will be developed which will not coincide with any culturally significant dates or festivals in order to ensure that temple attendees are not affected. Dialogue to be maintained during construction.

233. **Noise**. The major sources of noise pollution near in the project area are removal and replacement of existing surface materials for pipe excavation, which is close to human receptors and may affect community members. Other noise will include the general movement of construction vehicles, rollers during resurfacing, the haulage of construction materials to the construction sites and the use of generators.

234. Construction activities are expected to produce noise levels up to 90 dB(A) within 5m of the machinery as shown in Table 23 which indicates noise levels for construction machinery. For the project, no receptors other than construction workers will be this close to the machinery, and construction workers will use appropriate Personal Protective Equipment. Component A2 (Secondary pumping station and Old Darkhan Hospital) have receptors (residential areas, hospital, school and businesses) within 20-50m of the construction sites. Therefore these are the key locations for noise and may be expected to be subject to noise outside in the region of 80 db(A).

Table 23: Construction Machinery Noise

Machine Type	Distance to Machinery									
	5 m	10 m	20 m	40 m	60 m	80 m	100 m	150 m	200 m	300 m
Loader	90	84	78	72	68.5	66	64	60.5	58	54.5
Vibratory Road Roller	86	80	74	68	64.5	62	60	56.5	54	50.5
Bulldozer	86	80	74	68	64.5	62	60	56.5	54	50.5
Land Scraper	90	84	78	72	68.5	66	64	60.5	58	54.5
Excavator	84	78	72	66	62.5	60	58	54.5	52	48.8
Roller	87	81	75	69	65.5	63	61	57.5	55	51.5
Mixing Equipment	87	81	75	69	65.5	63	61	57.5	55	51.5

Source: Government of Mongolia. 2011. Initial Environmental Examination (IEE) of the proposed Regional Logistics Development Project.

235. The major works will be carried out during the daytime. The noise produced during construction will have an impact on the existing ambient noise levels. However the elevated noise levels will be temporary and localized.

236. **Construction noise mitigation**. The potential noise impacts will be mitigated through a number of activities defined in the EMP, which will be incorporated in the bid documents and construction contracts:

(i) Source control: Maintain all exhaust systems in good working order; undertake regular equipment maintenance;
(ii) Locate sites for concrete-mixing and similar activities at least 500 m away from sensitive areas;
(iii) Operate between 8am-6pm only and reach an agreement with nearby residents regarding the timing of heavy machinery work, to avoid any unnecessary disturbances;
(iv) Provide advance warning to the community, including residents, school and hospital on timing of noisy activities. Seek suggestions from community members to reduce noise annoyance. Public notification of construction operations will incorporate noise considerations; information procedure of handling complaints through the Grievance Redress Mechanism will be disseminated.
(v) Ensure noise monitoring is undertaken near sensitive receptors, particularly dwellings and hospital.
(vi) All construction workers to use appropriate Personal Protective Equipment.

237. **Community Health and Safety.** Potential impacts may arise from noise, dust and health and safety of the public around construction activities. Noise impacts are considered in Paragraph 233 and dust is considered in Paragraph 221, Air Quality. Issues relating to construction site safety can be mitigated as follows:

(i) **Road Safety Awareness**. During any works which involve crossing roads and affecting traffic movements (Component A2, Old Darkhan Hospital sewer), road users and pedestrians will be made aware of changes to traffic flows through clear signage in advance of construction and during construction at the site.
(ii) **Construction Site Safety**. Clear signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials and excavation and raising awareness on safety issues. Heavy machinery will not be used after day light and all such equipment will be returned to its overnight storage area/position before night. All sites will be made secure, discouraging access by members of the public through fencing or security personnel, whenever appropriate. Specific notices will be issued to the School Number 16, opposite Old Darkhan Hospital (Component A2) in order to inform children about construction site safety.

238. **Occupational Health and Safety.** The civil works contractors will implement adequate precautions to protect the health and safety of construction workers. The occupational health and safety risks will be managed by applying measures in the following order of preference: avoiding, controlling, minimizing hazards, and providing adequate protective equipment. The contractors will undertake the following activities:

(i) **Environment Health and Safety Officer.** An Environment Health and Safety Officer (EHSO) will be nominated to develop, implement and supervise a Health and Safety Management Plan (HSMP), as well as ensure that the requirements of the EMP are implemented.
(ii) **Implementation of HSMP**. The EHSO will ensure that the HSMP, submitted to Darkhan *aimag* prior to construction, is approved and implemented. This includes recording and reporting any occupational health and safety incidents, and reviewing the distribution and use of appropriate Personal Protective Equipment.

239. **Interruption to Pasture**. During the excavation of pipes (Component A2 at secondary and industrial pumping stations), there will be disturbance to pasture land along the length of the excavated sections. These sites are in areas where a number of livestock were seen grazing during IEE preparation. However, given the area of land, the project will affect a minimal proportion of pasture and there is enough land for the animals to graze away from any noise disturbance which may be generated. Mitigation measures include:

(i) A robust GRM which will be signposted at each of the sites in order for those with grazing animals to contact the project if they have a concern with the construction works.
(ii) Notices in advance of construction work will be put up to warn residents, including owners of animals, that the work will commence including start/end dates and details of work.

E. Cumulative, Induced and Indirect Impacts - Construction

240. **Potential indirect impacts - Construction: Traffic.** When the WWTP and related infrastructure is constructed, indirect impacts will result in potential longer journey times for traffic passing by the Old Darkhan Hospital as traffic will be interrupted when the sewer pipe under the road is excavated. The impacts are anticipated to be short term as the excavation is for a single pipe. The mitigation associated with this impact is:

(i) Contractor to consult with relevant *aimag* authority on the timing of the road excavation, including departments responsible for transport and traffic police.
(ii) Signage to warn motorists of when the road closure will be operational; and
(iii) Use of appropriate traffic signals if alternate line traffic is required to maintain access along the road.

241. **Potential negative cumulative impacts - Construction: Noise.** Pipe excavation will cause noise outside Old Darkhan Hospital when the sewer pipe is replaced. Although this noise is a necessary part of the project implementation, it can be mitigated through:

(i) Consultation with hospital managers regarding advising on timing during the day when excavation may be least disruptive and the overall timing of construction.
(ii) Maintaining dialogue with hospital managers and ensuring they are aware of the GRM process throughout the construction process.

F. Environmental Impact and Mitigation Measures during Operation

1. Impact on Physical Resources

242. The impacts during operation, as compared with the baseline, will be positive in relation to physical, biological and socio-economic resources. The key to obtaining a positive impact during operation is effective operation of the WWTP technology. Therefore, in order to support this, the following action is required:

(i) Comprehensive training of WWTP operatives to ensure the staff understand how to effectively operate the WWTP under all conditions including emergencies.

243. **Water Resources**. A potential impact on water resources may result from the use of the rehabilitated tertiary sewer pipe at the secondary pumping station (Component A2) which is above ground. The pipe is particularly low risk, as it is not currently used at all and following repair will only be used in emergencies; Us Suvag staff were unable to confirm when the pipe was last used. However as it is above ground, the action of frost on the pipe may cause it to break. Replacing the pipe with an underground section would require the additional costs in terms of construction and maintenance of additional pumps to life the sewage to the secondary pumping station. Therefore if the pipe is to remain above ground, when it is returned to a useable condition, in order to protect the pipe from the cold and to maintain its integrity, the key mitigation measures are:

(i) Adequate layering and packing of earth around the pipe in order to protect it from cold weather. The depth of the material to be advised by a cold weather engineering specialist.
(ii) Installation of stock proof fencing either side of the pipe in order to protect it from trampling by grazing stock, thus maintaining its integrity.
(iii) Us Suvag to regularly inspect the pipe and ensure the packed earth is in good condition and to implement repairs if required.

244. **Soil resources.** The inappropriate disposal of sludge has potential to cause pollution to the soil in the WWTP area. It should be noted that during the preparation of this IEE, no evidence was found to suggest that the existing sludge management is causing environmental pollution, however the quality of the sludge should be maintained throughout project implementation and is likely to be improved by the project.

245. Sludge quality will be confirmed by obtaining baseline information on the sludge from the current WWTP and testing its chemical content during commissioning. This will enable further options for sludge use to be investigated. The sludge is currently dried in beds and remains there. However if it was tested and proved to be beneficial, it could be applied to land or put to other beneficial use. The PIU-ESS is charged with researching beneficial use options for sludge during construction. This is supported by additional funding for a national specialist in order to understand the feasible options for sludge in Darkhan. The research report into sludge options will include:

(i) Discussion on sludge analysis results (see Project Monitoring in **Error! Reference source not found.**).
(ii) Options for sludge in Darkhan, taking into account chosen WWTP technology
(iii) Costs and benefits of options for beneficial sludge management
(iv) Actions needed to implement beneficial sludge management.
(v) Consultation with Us Suvag and Darkhan Uul *Aimag* regarding recommendations.

246. Currently, the existing sludge treatment (drying in beds) is a zero cost activity for Darkhan Uul and Us Suvag. Any future options for using sludge should be economically realistic in order to be sustainable and be implementable by the *aimag* authorities.

G. Cumulative, Induced and Indirect Impacts - Operation

247. **Potential negative cumulative, induced and indirect impacts - Operation.** When the WWTP and related infrastructure is operational, no negative cumulative, induced and indirect impacts are anticipated. The impacts resulting from the operation of the WWTP following project implementation are anticipated to be positive.

248. If any unanticipated impacts become apparent during project implementation, the borrower will (i) inform and seek ADB's advice; (ii) assess the significance of such unanticipated impacts; (iii) evaluate the options available to address them; and (iv) prepare or update the EIA and EMP.

VIII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATIONS

A. Consultations during Project Preparation

249. **Consultation with Government Officers and Experts**. During the preparation of this IEE, individual consultation meetings were held with experts and Government officers in September 2013 in order to discuss this IEE and to obtain baseline data. The names of those consulted are in Table 24.

Table 24: Officers and Experts Consulted

Name	Role/Department
Ms Enkkhtuya Project Engineer	Us Suvag LLC.,
Ms. Sarangerel Head of Laboratory	Us Suvag LLC., Laboratory
Ms Sainsay Laboratory Engineer	*Aimag* Meteorological Office
Ms Handolgion Head of Environmental Department	*Aimag* Meteorological Office
Mr Khurelchuluun Senior Environment Specialist	*Aimag* Environment Protection Agency
Mr Bayasgalan Policy Department Chief	*Aimag* Policy Development Department
Mr Ravjaadelgerekh Senior Specialist	*Aimag* Policy Development Department
Mr Munkh-Erdene Head of Land Administration	*Aimag* Land Administration
Mr Olonbayar Senior Land Officer	*Aimag* Land Administration

Source: ADB Study Team

250. **Consultation with *aimag* Us Suvag.** Key discussion points: (i) joint field visits to project sites, (ii) provision of data on aspects of wastewater treatment, industrial wastewater, current and planned activities and environmental monitoring.

251. **Consultation with *aimag* Meteorological Institute**. Key discussion points: (i) Data was provided, (ii) the monitoring routine was confirmed, (iii) key environmental problems associated with not meeting national standards.

252. **Consultation with *aimag* Environmental Protection Agency.** Key discussion points: (i) The agency confirmed that it is not aware of any particular current environmental problems which will impact on this project; (ii) The agency staff confirmed that their current key concerns were around the illegal fire wood collection, artisanal mining and forest fires; (iii) provision of information on protected areas, waste management, environmental education.

253. **Consultation with *aimag* Policy Development Department.** Key discussion points: (i) Consultation on GRM approach, (ii) provision of data.

254. **Consultation with *aimag* Land Administration**. Key discussion points: (i) land use within Darkhan *soum*, (ii) Land use around WWTP (iii) provision of maps and data.

255. **Consultation with residents and affected people.** Public consultation and information disclosure was undertaken at twice during the preparation of this IEE. The consultation was facilitated by the company undertaking the Detailed EIA as required under Mongolian law.

256. **Public Opinion Survey on Water Supply and Wastewater treatment, 22-27 January 2014.** The consultees were selected from 100 households from apartment residents and 100 households from the ger district in Darkhan City. The survey covered the following issues:

(i) Socio-economic status of survey covered households
(ii) Current situation and consumers satisfaction with the current water supply and waste water treatment services; and
(iii) Needs for improvement of water supply and wastewater treatment services.

257. A summary of the findings from the survey is as follows: .

(i) For ger area households, poverty incidence is 44.0%, while it is 9.0% for apartment area households;
(ii) Awareness on information about the water supply and sanitation services in Darkhan city is low; 25% of residents are not aware of the organizations which provide these services.
(iii) Many residents do not realize that there are problems with the water supply and wastewater services but awareness is lower in apartments
(iv) Poor sanitation services was ranked 8th of 12 environmental and social infrastructure issues
(v) No ger area residents are satisfied with the current sanitation situation as opposed to 80% apartment area residents who are satisfied
(vi) Air pollution and pollution of Kharaa river were ranked first and second respectively amongst selected environmental and social infrastructure issues
(vii) 64% of respondents supported re-use of grey water e.g. for toilet flushing.

258. In summary the consultation showed a difference between the ger area and apartment residents. Ger residents are unhappy with their current sanitation and see a need for improved sanitation services, whereas apartment residents are largely satisfied.

259. **Public consultation and information dissemination February – March 2014**. Consultation took place during the data collection process for detailed environmental impact assessment. At this stage, public consultation focused on potential project beneficiaries. Two criteria were considered in selecting the consultees:

(i) Select and interview those households, whose geographical location is downwind of the dominant wind direction of the proposed wastewater extension project location and current wastewater treatment plant;
(ii) Select and interview those households, whose location is around or nearby the WWTP effluent outlet.

260. During the consultation, information on the project was disseminated by and introductions were given by Mr. Azjargal, Darkhan *soum* governor and Mr. Batzul, *soum* environmental inspector. Consultees included:

(i) Bagh governors, Ms. Tuya, governor of 3rd bagh
(ii) Speakers of bagh citizen representatives, Ms. Tungalag, local bagh speaker; and

(iii) Residents of affected by the WWTP, covering approximately 100 households, consulted through individual interviews.

261. **Figure 34** shows interviews being undertaken with local residents, the results of which are shown in

Figure 34: Interviews with local residents

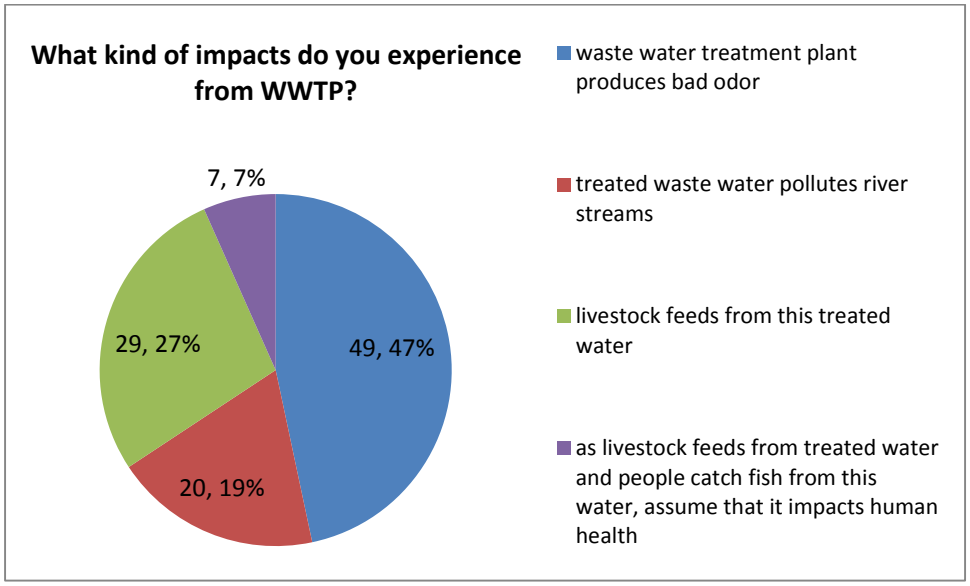
Source: Environ, Domestic Environmental Impact Assessment

262. Local residents were asked a number of questions in relation to their views on the and potential mitigation measures which could be taken in order to improve any negative impacts. The results of the consultations are given in

263. Figure **35** to

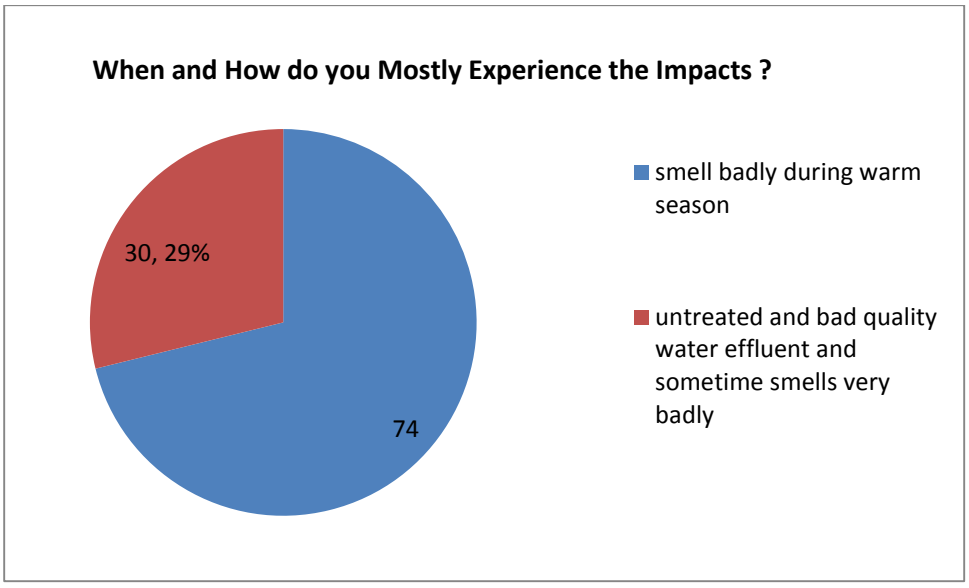
264. Figure **37**.

Figure 35: Results from consultation interviews question 1, 104 respondents



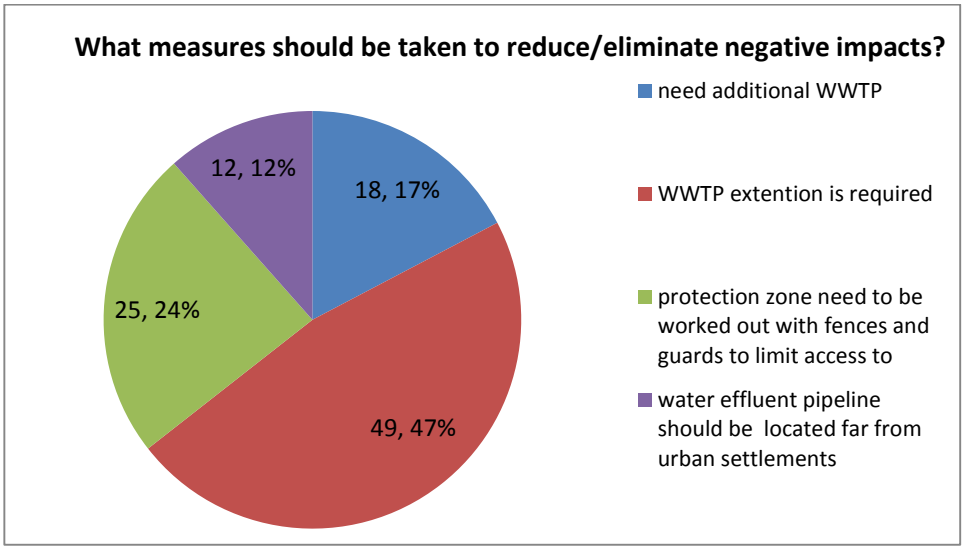
Source: Environ, Domestic Environmental Impact Assessment

Figure 36: Results from consultation interviews question 2, 104 respondents



Source: Environ, Domestic Environmental Impact Assessment

Figure 37: Results from consultation interviews question 3, 104 respondents



Source: Environ, Domestic Environmental Impact Assessment

265. The results show that residents are concerned about the negative impacts the WWTP is having on their quality of life. In particular strong views are expressed on the nuisance caused by the odor from the WWTP.

B. Integration of Consultation Information

266. Where appropriate, the recommendations provided during the consultation meetings are integrated into the mitigation measures in this IEE. This includes improvements to the WWTP which will include odor emissions; this is inherently integrated into the project as the use of improved modern technology will improve the mineralization and reduce the quantities of sludge which will reduce the odor particularly in summer. In general it appears that the project is supported as it will tackle a number of issues which are a concern for Darkhan residents.

C. Information Disclosure

267. Environmental information on the project was and will be disclosed as follows:

(i) This IEE will be disclosed on ADB's website (www.adb.org) for 120 days prior to Management consideration of the financing requests;
(ii) Copies of the project IEE reports will be made available upon request; and
(iii) During implementation, semi-annual monitoring reports on compliance with the Environmental Management Plan will be disclosed on ADB's website (www.adb.org).

IX. GRIEVANCE REDRESS MECHANISM

A. Grievance Redress Mechanism Objective

268. A grievance redress mechanism (GRM), consistent with the requirements of the ADB Safeguard Policy Statement (2009) will be established to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concerns about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM is accessible to all members of the community.

B. Proposed Grievance Redress System

269. The proposed GRM follows the existing approach taken for managing complaints about local issues by members of the public in Mongolia. Residents' complaints or concerns are generally taken to *bagh* or *soum* representatives for resolution, therefore this system is proposed for the GRM. The GRM approach also fits with the *aimag*'s existing approach to managing complaints for the public, which is focused on taking complaints to *soum*s. The *aimag* Government confirmed their support for the approach presented in this IEE[69].

270. In its capacity as the IA, the Darkhan *aimag* will establish a Public Complaints Unit (PCU). The PCU will be established within the PIU prior to construction to deal with complaints from affected people (AP) throughout implementation of the Project.

271. The PIU based Environmental and Social Specialist (PIU-ESS) will be responsible for ensuring the implementation of the GRM at a local level and will staff the PCU. They will be the key contact point for *bagh* and *soum* representatives who may require information about the project or who have an issue they would like to discuss. The PIU and PIU-ESS will issue public notices to inform the public within the project area of the GRM. The PCU's phone number, fax, address, email address will be disseminated to the people at the bagh and *soum* levels.

272. The PIU-ESS will have facilities to maintain a complaints database and communicate with the PIU, Site Engineers, Supervising Engineer, Governors of *aimag* and representatives of Darkhan *soum* and affected *baghs*.

C. GRM Steps and Timeframe

273. Procedures and timeframes for the grievance redress process are as follows and shown in Figure 38.

- **Stage 1: Access to GRM.** If a concern arises, the AP may resolve the issue of concern directly with the contractor/operator however is the issue is successfully resolved, the AP will make his/her complaint known to either the *bagh* or *soum*, whichever level of authority he/she is most comfortable with;
- **Stage 2: Official Complaint to PCU.** The *bagh/soum* representative will submit an oral or written complaint to the PCU. For an oral complaint the PCU must make

[69] Meeting with *aimag* Senior Mr Ravjaadelgerekh Senior Specialist in Engineering - project contact.

a written record. For each complaint, the PCU must assess its eligibility. If the complaint is not eligible, e.g. related to an issue outside the scope of the project, PCU will provide a clear reply within five working days to the AP.

- **Stage 3: PCU Complaint Resolution.** The PCU will register the eligible complaint informing the Darkhan *aimag*, the PIU and contractors. Together, the members of the PCU, facilitated by the PIU-ESS will take steps to investigate and resolve the issue. This may involve instructing the Contractor to take corrective actions. The complaint investigation will require close collaboration of the PCU members. Within seven days of the redress solution being agreed upon, the contractors during construction and the IAs/operators during operation should implement the redress solution and convey the outcome to the PCU;
- **Stage 4: Stakeholder Meeting.** If no solution can be identified by the PCU or if the AP is not satisfied with the suggested solution under Stage 3, within two weeks of the end of Stage 3, the PCU will organize a multi-stakeholder meeting under the auspices of the head of Darkhan *aimag*, where all relevant stakeholders will be invited. The meeting should result in a solution acceptable to all, and identify responsibilities and an action plan. The contractors during construction and the IAs/operators during operation should implement the agreed redress solution and convey the outcome to the PCU within seven working days;
- **Stage 4: *Aimag* Governor Resolution**. If the Multi-stakeholder meeting cannot resolve the problem, and the AP is unsatisfied, the PCU will set up a meeting with the *aimag* Governor. If a solution from the Governor is found, it will be implemented.
- **Stage 5: ADB Special Mission.** If the *aimag* Governor is unable find a resolution, the PCU will inform ADB and a special mission will be initiated to resolve the issue. Note that if the APs are still not satisfied with the outcome in Stage 4, they can go through local judicial proceedings.

274. **Reporting**. The PCU will record the complaint, investigation, and subsequent actions and results. The PIU-ESS will include this information in the monthly Environmental Management Plan progress reports. In the construction period and the initial operational period covered by loan covenants the EA will periodically report complaints and their resolution to ADB in the quarterly project progress reports and semi-annual environmental monitoring reports.

275. **Members and Responsibilities of the PCU**. The responsibilities of the PCU are implemented by the PIU-ESS, who is the PCU focal point. In addition to the PIU-ESS, the members of the PCC will be those in a position to resolve complaints and will include representatives of:

- PIU-ESS - focal point of PCU
- Darkhan Uul *aimag*
- Darkhan Us Suvag
- Darkhan *soum*
- Relevant *bagh* representatives

276. The responsibilities of the PCU are as follows:

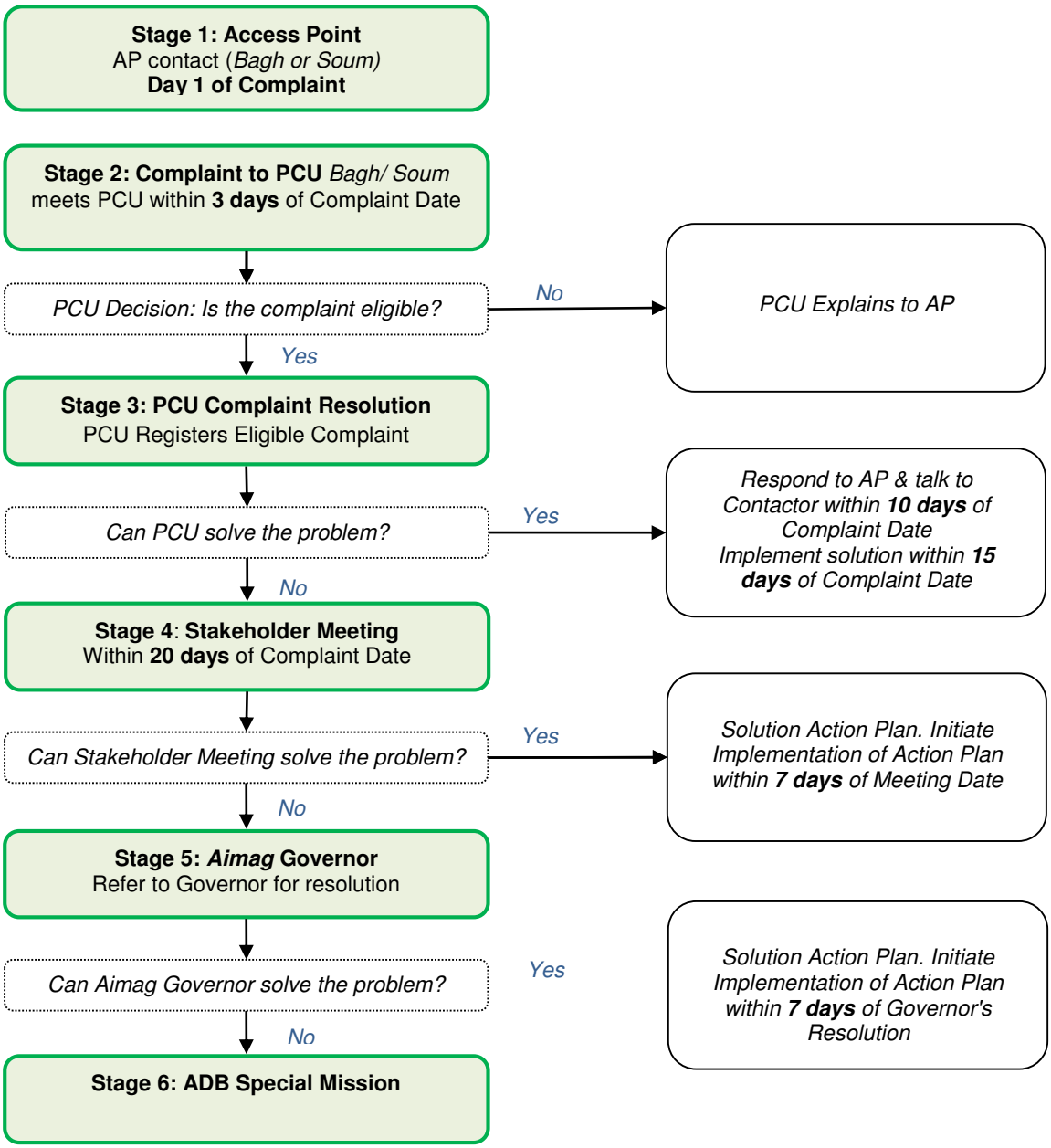
- The PCU will instruct contractors and construction supervisors to refer any complaints that they have received directly to the PCU. Similarly, the PCU will coordinate with local government departments capture complaints made directly to them.

- The PIU-ESS, as the focal point of the PCU, will log complaints and date of receipt onto a complaints database and inform the IA/PIU, Supervising Engineer and the Contractor.
- The PCU, with the Supervising Engineer and the Contractor, will investigate the complaint to determine its validity, and to assess whether the source of the problem is because of project activities, and identify appropriate corrective measures and responsible persons.
- The PCU will inform the AP of investigation results and the action taken.
- If a complaint is transferred from local government agencies, the PIU-ESS will submit an interim report to local government agencies on status of the complaint investigation and follow-up action within the time frame assigned by the above agencies.
- The PCU will review the Contractors response to the identified corrective measures, and the updated situation.
- The PCU will undertake additional monitoring, as necessary, to verify as well as review that any valid reason for complaint does not reoccur.
- The Supervising Engineer will ensure that the measures have been carried out by the Contractors.

277. The tracking and documenting of grievance resolution within the PCU and/or PIU will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) periodic reviews of complaints so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the EA and ADB.

278. **Multi-stakeholder meetings**. The invitees to this meeting will depend on the nature of the complaint. For example if the complaints relate to health, land disputes, or labour issues, the appropriate specialist in this field will be invited to the stakeholder meeting. This may include officers from the Land Administration (land rights issues), Mongolian Chamber of Commerce Policy & Representative (business/commercial issues), Women's Union NGO (gender issues), Health authority (health issues), MEGD (environmental issues), Ministry of Labor & Social Security Officer (labour issues).

Figure 38: Proposed Project GRM



Source: ADB Study Team

X. ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

279. The environmental management plan (EMP) for the project is presented in Appendix 2. The EMP defines the roles and responsibilities of the institutions involved in EMP implementation. Such institutions will seek to ensure continuous improvement of environmental protection activities during preconstruction, construction, and operation of the project in order to prevent, reduce, or mitigate adverse impacts.

280. The EMP has been prepared in line with ADB's SPS 2009. Specific measures are developed in relation to the design, construction and operation of each project component and the impacts identified in relation to physical, biological, cultural and socio-economic resources, as discussed in Section VI. Anticipated Impacts and Mitigation Measures.

281. The EMP is Appendix 2 also presents additional training requirements in

282. Table **27**, monitoring requirements in Table 28 and reporting requirements in Table 29. The mitigation measures to be undertaken during project design, construction and operation are identified in Table 31.

283. **Capacity Building and Training**. Capacity building will be implemented through the environmental specialist that will be engaged under the Project Implementation Unit. The specialist will work in co-ordination with the Implementing Agency and will provide additional environmental support and training in order to ensure compliance with EMP requirements during construction and operation. In addition, operational risks will be mitigated through the capacity building of Darkhan Us Suvag (the water undertaking) in order to improve the technical delivery of wastewater treatment in the city, and the effective and efficient use of the new technology in the WWTP. The training requirements of Uus Suvag in relation to WWTP operation are outside the scope of the IEE but necessarily impact upon the environmental risks and mitigation associated with WWTP operation.

V. CONCLUSIONS

A. Project Context

284. The project expected outcome and impact from the project is:

- **Impact**: sustainable urban environment in Dharkan city and the Kharaa River Basin.
- **Outcome**: improved wastewater treatment and management for domestic and industrial users in Darkhan city.

285. In addition, the project outputs will be (i) a modernized, efficient and expanded, or newly-constructed WWTP, and (ii) institutional capacity strengthened for the effective management of wastewater. The total number of the project's beneficiaries is expected to exceed 130,000 people, as well as industries and businesses in Darkhan.

286. Currently Darkhan suffers from an outdated and inefficient wastewater treatment plant which is at the end of its economic life. Due to the dilution capacity and turnover processes in the Kharaa river, the nutrient levels are moderate and there is a limited detectable impact on the ecology of the river, however it is possible that at times of low flow and with a predicted increase in housing and industry, the impacts on the river arising from the current WWTP would become more significant and the environmental sustainability will be compromised. This is increasingly likely as the outdated waste water treatment technology becomes progressively more unreliable with age.

B. Major Environmental Impacts and Mitigation Measures

287. **Alternative Analysis**. Alternatives are examined which relate to the project's location, design, technology, and components and their potential environmental and social impacts and consider the no project alternative. The "No Action Alternative" is also considered, addressing the likely consequences of not undertaking the proposed intervention. The Alternative Analysis considered that failure to rehabilitate the WWTP and improve the existing sewerage infrastructure may be an impediment to development of the Darkhan as a liveable city and may give rise to pollution of the Kharaa river basin as a result of failing WWTP equipment and a predicted increase in wastewater.

288. The alternative analysis considered a number of possible technical alternatives. Given the context of the Darkhan WWTP, the technology alternatives evaluated as part of the Technical Assistance are:

- Option 1. rehabilitation of the existing WWTP as a modified activated sludge process;
- Option 2: construction of a step-feed activated sludge system;
- Option 3: construction of a sequencing batch reactor; and
- Option 4: construction of an IFAS process.

289. The performance of the treatment options is the key environmental and social concern. This includes the adequate mineralisation of sludge and the likelihood of accidents or errors in the WWTP operation which may result in the emission of untreated effluent. It is considered that all options are technically feasible in Mongolia and will be able to meet the necessary effluent

standards and sludge mineralisation requirements which is the biggest environmental concern. After further consideration and advice the IFAS is the chosen technology.

290. **Impacts from design.** Two key issues can be mitigated though project design: (i) resource use; and (ii) impact on surface water quality if the WWTP service is interrupted. The preferred design options include the reuse of existing buildings which are structurally sound, therefore reducing the need for additional resources and waste generation. Also the new WWTP will be commissioned before the existing WWTP is decommissioned, meaning that Darkhan will be continually served by a functioning WWTP.

291. **Impacts during construction.** Without mitigation, the principal impacts during construction will be on the sensitive human receptors in particular around old Darkhan hospital, including a school and the hospital itself. Likely impacts would arise from the noise and dust generated during excavation of current sewer pipes. Mitigation measures specified in the EMP will manage the impacts to acceptable levels and an emphasis will be placed on meetings and discussions with affected people, therefore school and hospital administrators/managers will be consulted on the timing of the construction activities.

292. Waste arisings are an inevitable consequence of a construction project. There is a likelihood that hazardous waste materials will be generated during the refurbishment of the New South Pumping Station and sewer pipes; anticipated wastes include PCBs, other oily wastes and asbestos pipes. In order to manage this sustainably and with least risk to the environment and human health, a robust forward looking Waste Management Plan will be developed and adhered to by the contractor.

293. Surface water quality and effluent will be measured regularly throughout the construction phase. The Kharaa River is already monitored by the *aimag* Meteorological Institute. This existing monitoring will be supported with project specific monitoring at the effluent outfall and of the effluent itself.

294. In the interests of good practice, although no evidence has been found to confirm that the existing sludge management practices are impacting negatively on the environment and human health, sludge will be analysed in order to understand its quality. When the quality of the sludge is known, alternatives to the existing drying beds can be sought which will put it to a more beneficial use.

295. **Impact during operation**. This IEE indicates that the project will improve the environmental performance of the WWTP. However this will require comprehensive training of WWTP operatives to ensure the staff understand how to effectively operate the WWTP under all conditions including emergencies. It is anticipated that the technology and operating systems will be new to them, therefore in order to reduce errors and associated potential impacts, training will be provided. This will assist Darkhan *aimag* with the long term provision of effective and efficient wastewater treatment.

C. Overall Conclusion

296. The findings of this IEE show that the project will not have any significant, long term or irreversible impacts on the physical, biological or socio-economic environment. The project will have short term impacts during construction which can be mitigated to an acceptable level through mitigation measures which seek to reduce the potential for harm to the environment and human health. These measures relate primarily to implementing good construction practice as well as

meeting the particular needs of the project area through consultation with affected people. Good practice through comprehensive training and appropriate technological design will also contribute significantly to reducing the operational impacts of the project.

297. The project will implement a robust Grievance Redress Mechanism and will engage an Environmental and Social Specialist to ensure that the GRM is well publicised and used effectively in order that that any negative or positive impacts from the project are captured and dealt with appropriately.

298. The stakeholder and consultation during the development of the IEE, particularly with Darkhan *aimag* and Us Suvag demonstrated that the project has local support as it will result in benefits in terms of the long term environmental and social sustainability of Darkhan's WWTP.

APPENDIX 1: ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

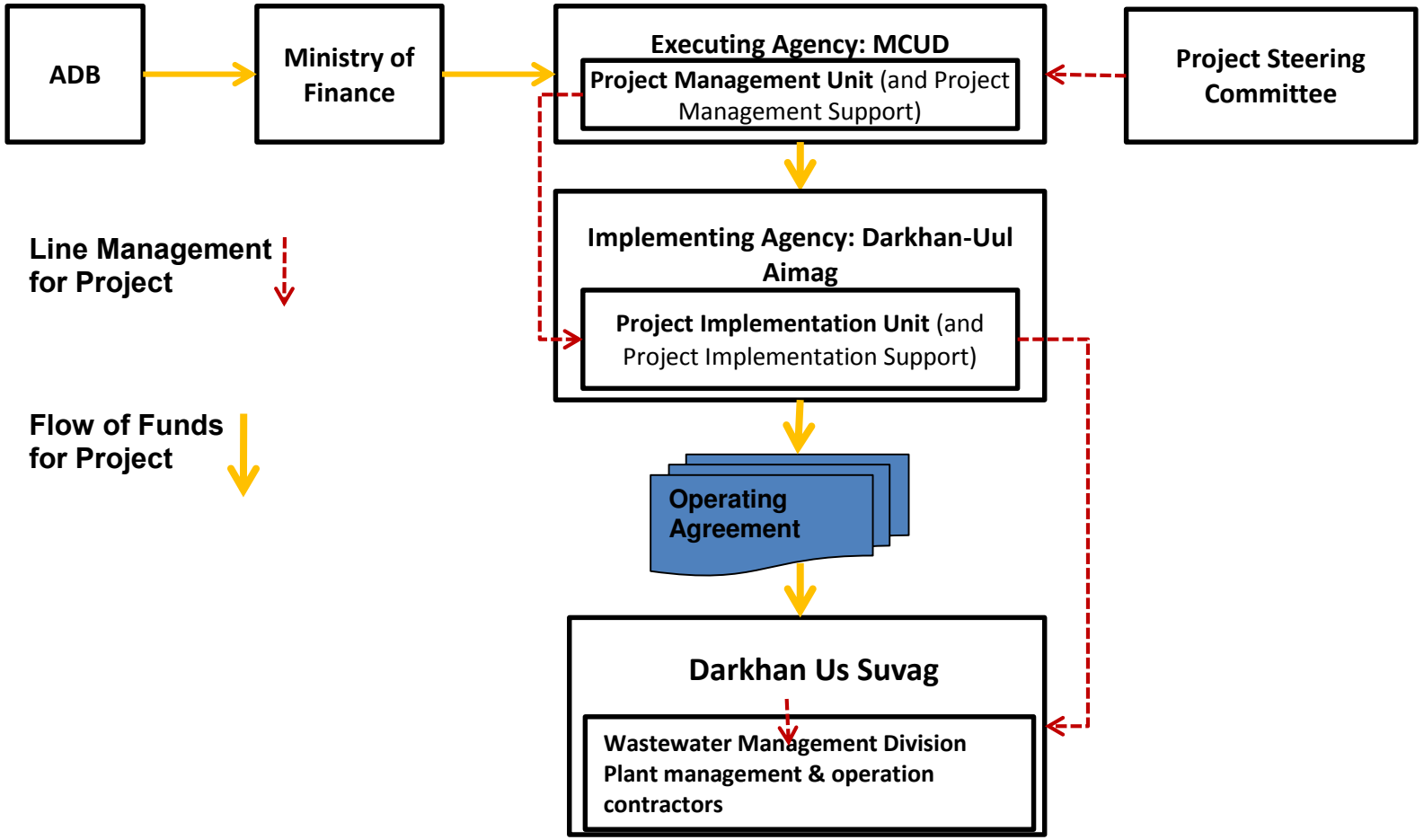
299. The environmental management plan (EMP) for the project defines mitigation and monitoring measures and describes the institutions, responsibilities and mechanisms to monitor and ensure compliance. Such institutions and mechanisms will seek to ensure continuous improvement of environmental protection activities during preconstruction, construction, and operation of the project in order to prevent, reduce, or mitigate adverse impacts. The EMP draws on the domestic EIA and on discussions had with the relevant government agencies. The EMP will be reviewed and updated if there are any changes to the detailed design. The final EIA and EMP will be disclosed on ADB's website following any required updates.

300. This EMP has been prepared in line with ADB's SPS 2009. Specific measures are developed in relation to the design, construction and operation of each project component and the impacts identified in relation to physical, biological, cultural and socio-economic resources, as discussed in Section VI. Anticipated Impacts and Mitigation Measure.

B. Organizational Structure for EMP Implementation

301. **Error! Reference source not found.** shows the implementation arrangements for the Project including management responsibilities and the flow of funds. The responsibilities for EMP implementation will be within these arrangements.

Figure 39: Project Implementation Arrangements



Source: ADB Study Team

C. Roles and Responsibilities

302. **Project Steering Committee (PSC).** The state-level PSC has been established for the Urban Sector Development Project for Mongolia (Loan 2301-MON) and will continue to provide overall policy guidance on the project and will have full powers to take decisions on matters relating to Project execution. The Project Coordinator is the Member Secretary and the committee is chaired by the State secretary of Ministry of Construction and Urban Development. Members of the committee include the Director Ministry of Economic Developments, Director Ministry of Finance, representatives of the MEDG and Industry and the *aimag* government of Darkhan-Uul. Once the Project is made effective, the PSC will meet at regular intervals (at least once every 3 months) to review project performance and take decisions on major issues, such as, counterpart funding, implementation bottlenecks, land disputes, special procurement, policy reforms, etc. Reports on EMP implementation will be provided to the Steering Committee by Executing Agency.

303. **Executing Agency (EA)**. The Ministry of Construction and Urban Development (MCUD) will be the EA of the Project. The EA has overall responsibility for the project and therefore is ultimately responsible for ensuring the implementation of the mitigation in the EMP and for ensuring compliance with loan covenants.

- **Project Management Unit (PMU)**. The existing PMU of the Urban Sector Development Project for Mongolia (Loan 2301-MON) will extend its existing responsibilities to include the Project. The PMU will continue to be headed by a Project Coordinator (PC). The PMU will reside in the EA and supports the EA in its duties.

304. **Implementing Agency (IA)**. Implementation of the WWTP improvements for Components 1 will be carried out by the Darkhan-Uul *aimag* government with assistance from MCUD.

- **Project Implementation Unit (PIU).** MCUD will establish a PIU in Darkhan-Uul which will reside in the IA, headed by a senior engineer or technical specialist experienced in environmental engineering, wastewater management construction and equipment installation, as the PIU Project Director. The PIU will engage an Environmental & Social Specialist (PIU-ESS) to monitor implementation of the EMP and engage with the community and other stakeholders for implementation of the Grievance Redress Mechanism.

305. **Role of Darkhan Us Suvag.** As the water undertaking, Us Suvag will continue to provide technical support to Darkhan-Uul *aimag* but will not have direct responsibilities for EMP implementation unless otherwise directed by the *aimag* government.

306. **Role of PIU-ESS**. The Terms of Reference for the PIU-ESS is provided in Appendix 2. In summary, the PIU-ESS will:

- Be engaged prior to construction and be employed during periods of construction
- Facilitate the implementation of the EMP and ensure the grievance redress mechanism functions effectively;
- Liaise with PIU and the Supervising Engineer to identify if there are any changes in the project design or baseline environmental conditions and review and update the EMP accordingly;
- Review and update tender and contractor documents to ensure all required environmental specifications are included;

- Prepare monthly (for EA/PIU), quarterly (for ADB Project Progress Report) and semi-annual Environmental Monitoring Reports (for ADB). The reports should review progress with project implementation, environmental performance and compliance, report results of environmental audits and monitoring, identify problems encountered, actions taken/or proposed to be taken to resolve problems and activities programmed for next monitoring period;
- Monitor the implementation of the mitigation and monitoring measures as set out in the environmental management plan
- Provision of EMP specific training for contractors, PIU and other relevant stakeholders.

307. **Role of Supervising Engineer**. A supervising engineer (SE) will be engaged. The SE will:

- Supervise site environmental management system of the contractors, and provide corrective instructions;
- Review the EMP implementation by the contractors;
- Advise the PIU of any changes in design or contractor method statements in order for the PIU-ESS to revise the EMP if necessary;
- Undertake inspections to ensure the requirements of the EMP are implemented and take immediate corrective action if needed; and
- Report all corrective actions to PIU-ESS.

308. The EA will ensure that this EMP is made part of the contract documents. Bidding documents and detailed design contracts will be prepared and managed by MCUD. Contract documents shall explicitly indicate the requirement of these documents and plans and also state that all environmental protection measures should be included in the bid price unless otherwise specified.

309. **The Contractor.** In the technical specification for the civil works contract, activities to protect the environment will be prescribed in the EMP. During construction, contractors will strictly implement the EMP and will develop and implement the management plans required in the pre-construction phase:

(i) Water Protection Management Plan
(ii) Aggregate, Borrow Pits and Spoil Management Plan
(iii) Spill Management Plan
(iv) Hazardous and Non-Hazardous Waste Management Plan
(v) Soil Erosion Management Plan
(vi) Health and Safety Management Plan (HSMP)

310. The contractor will also fully cooperate with the external environmental inspections and provide information including reports, monitoring results or other information relating to EMP implementation as requested by the PIU, PIU-ESS or SE.

D. Performance Indicators

311. **Error! Reference source not found.** presents the Readiness Indicators which provide a measure of whether environmental commitments are being carried out and environmental management systems are in place before pre-construction.

Table 25: Readiness Indicators Pre-Construction

Indicator	Measurement Methods	Measurement	
Public involvement effectiveness	• Appropriate rounds of public consultation completed.	Yes	No
	• GRM established with contact points.	Yes	No
Surface water & effluent quality baseline monitoring	• Monitoring completed by Darkhan *Aimag* Meteorological Office and Us Suvag	Yes	No
Environmental Supervision in place	• PIU-ESS engaged and in position before construction	Yes	No
Bidding documents and contracts with environmental safeguards	• Bidding documents and contracts incorporate the environmental loan assurances	Yes	No
	• Bidding documents and contracts incorporate the EMP mitigation and monitoring requirements	Yes	No
EMP financial support	• The fund from ADB and/or the Government of Mongolia is in place to support the EMP implementation.	Yes	No
Contract documents	• Environmental requirements of EMP included in contract documents for civil works construction contractors.	Yes	No

Source: ADB Study Team

312. Performance indicators for monitoring environmental performance in relation to key project risks and impacts during construction are set out in Error! Reference source not found..

Table 26: Performance Indicators During Construction

Indicator	Measurement Methods	Measurement	
Stakeholder Interviews	• Monthly structured interviews with stakeholders in project area, submitted to Darkhan Uul *aimag* by PIU-ESS	Yes	No
Water & Effluent Monitoring	• Monthly measurements weekly submitted to Darkhan *aimag*	Yes	No
Health & Safety Reporting	• Weekly reports submitted to Darkhan Uul *aimag*	Yes	No
EMP Implementation	• PIU-ESS monitors mitigation implementation and confirms compliance, reporting monthly to PIU	Yes	No

Source: ADB Study Team

E. Environmental Training Requirements

313. The Terms of Reference for the PIU-ESS state that she/he will be responsible for providing EMP specific training during the project. The focus will be on the *aimag* officers, PIU staff, supervision engineers and the contractors regarding EMP implementation. Training on specific issues associated with operation of the WWTP will be provided to Us Suvag and appropriate *aimag* staff by the technology provider. Additional budget is provided to allow external technical specialists to deliver requested specific relevant training in order to develop Institutional Capacity.

Table 27: Training Requirements

Training Participant & Provider	Topic	Timescale	Cost
Participants: Us Suvag and *Aimag* staff **Provider**: WWTP technology provider	- Use and maintenance of WWTP Technology	Pre-operation phase	Outside IEE - included in WWTP costs
Participants: *aimag* staff, bagh representatives **Provider**: PIU-ESS	- Use and purpose of GRM - ADB requirements for GRM	Pre-operation phase	$500
Participants: *aimag* staff, contractors, Us Suvag, PIU **Provider**: PIU-ESS	- EMP: Purpose, Scope, and Contractor Responsibilities - Purpose and implication of EMP updates or revisions	On arrival	$500
Participants: Us Suvag, *aimag* meteorological office **Provider**: PIU-ESS	- Environmental Monitoring for EMP - purpose, requirements and data analysis	Pre-construction	$1000
Participants: As required, e.g. Us Suvag, *aimag* meteorological office, *aimag* environment protection team, PIU **Provider**: External Experts if required	Example training if required: - Environmental mitigation activities for construction, - Construction good practice, - Climate change - Waste management	As needed	$3000
Total			$5000

Source: ADB Study Team

314. Additional awareness raising will be provided for the contractors by the EHSO from the contracted company in order to ensure construction contractors are aware of the management plans which are to be adhered to during the construction.

F. Environmental Monitoring

315. The project monitoring requirements for are set out in **Error! Reference source not found.**. The Terms of Reference for (i) surface water and effluent monitoring and (ii) sludge monitoring are in Appendix 3.

Table 28: Project Monitoring Requirements

Environmental Media/Issue	Location, Parameters, Monitoring Technique	Responsibility & Frequency
Pre-Construction Phase		
Project readiness	• **Method:** Review of Project Readiness based on indicators in **Error! Reference source not found.** • **Parameters: Error! Reference source not found.**	Darkhan Uul *aimag*
Noise	• **Method, Location:** Establish baseline noise data at sensitive receptors for:	Contractor Once before construction

Environmental Media/Issue	Location, Parameters, Monitoring Technique	Responsibility & Frequency
	• Component A2 Old Darkhan Hospital, School No. 16 and gers at Secondary and New South pumping stations. **Parameters:** Db(A) at receptors (dwellings) outside and inside if possible.	
Air Quality	• **Method, Location:** Baseline air quality data for sensitive receptors for: • Component A2 Old Darkhan Hospital, School No. 16 and gers at Secondary and New South pumping stations. • **Parameters:** SOx NOx	Contractor Once
Surface water and Effluent quality	• **Method, Location:** Establish project specific baseline water quality within 200m downstream of WWTP effluent outfall and effluent. • **Parameters:** Temperature, Suspended particles pH, Dissolved oxygen, Chemical oxygen demand, Biological oxygen demand, Hydrocarbon, Micro-organisms such as faecal coliforms (according to laboratory capabilities in Darkhan, including laboratory in Us Suvag)	Darkhan *aimag* Meteorological Office or appropriate institution Once
Sludge quality	• **Method, Location:** Establish baseline for current sludge quality at sludge drying beds • **Parameters:** Heavy metals, ammonia, nitrate, phosphorous, micro-organisms such as faecal coliforms (according to laboratory capabilities in Darkhan, including laboratory in Us Suvag)	Appropriate Laboratory / Institution - Once
Construction Phase		
Soil erosion contamination and borrow pits	• **Method, Location:** Visual inspection of all active construction sites. • **Parameters:** (i) adequacy of soil erosion prevention measures; (ii) adequacy of soil contamination prevention techniques; (iii) location of borrow pits according to Aggregate/Borrow Pits and Spoil Management Plan (vi) adherence to Spill Management Plan and Soil Management Plan	PIU-ESS – Weekly
Solid and liquid waste management	• **Method, Location:** Visual inspection of all active construction sites. • **Parameters:** Adherence to Site Waste Management Plan and Construction Camp Management Plan.	PIU-ESS – Weekly
Occupational health and safety	• **Method, Location:** Visual inspection and interviews with construction workers and contractors at active construction sites • **Parameters:** (i) adherence to the approved Environmental, Health and Safety Management Plan (EHSMP); (ii) performance of the EHSO; (iii) worker complaints and concerns and recorded incidents.	EHSO - Weekly
Community health and safety and GRM	• **Method, Location:** Visual inspection of all active construction sites, informal interviews with nearby residents. • **Parameters:** (i) availability of information on GRM; (ii) adequacy of construction site signage and fencing; (iii) adequacy of relevant mitigation measures; (iv)	PIU-ESS – Monthly

Environmental Media/Issue	Location, Parameters, Monitoring Technique	Responsibility & Frequency
	accidents involving public and workers; (v) emergencies and responses; (v) public complaints about issues such as noise, air pollution, construction site safety;	
Surface water and effluent quality	• **Method, Location:** As per pre-construction phase • **Parameters:** As per pre-construction phase	Darkhan *aimag* Meteorological Office Monthly during construction
Air quality	• **Method, Location:** As per pre-construction phase • **Parameters:** As per pre-construction phase	Contractor – Monthly During construction
Air Quality – dust	• **Method, Location:** Visual observation of dust at receptors/dwellings near construction sites. Observations to record if dust generated by construction activities crosses property boundaries. • **Parameters:** Fugitive dust emissions	PIU-ESS – Twice monthly During Construction
Noise	• **Method, Location:** As per pre-construction phase • **Parameters:** As per pre-construction phase	Contractor – Monthly During construction
Interview with APs	• **Method, Location**: Interview with potentially affected people (AP) adjacent to construction sites including street vendors, near Old Darkhan market/hospital and Getsogdarjaalin Monastery monks • **Parameters:** Discussion on environmental and socio-economic issues.	PIU-ESS - Twice monthly
EMP Compliance Monitoring	• **Method, Location:** Review of project's adherence with EMP and loan covenants • **Parameters:** EMP and loan covenants	MCUD – Semi-Annually
Construction Completion		
Sludge quality	• **Method, Location:** As per pre-construction phase • **Parameters:** As per pre-construction phase	Appropriate Laboratory / Institution - During commissioning
Post-construction site inspection	• **Method, Location:** Visual inspection, post-construction environmental condition assessment at each construction site. • **Parameters:** Performance checked against the management plans submitted before construction for specific aspects such as aggregate, borrow pit and spoil management plan.	PIU-ESS – twice: two weeks before completion of construction activities, once after completion

Source: ADB Study Team

G. Environmental Reporting

316. Environmental reporting requirements for the project are set out in **Error! Reference source not found.**:

Table 29: Project Reporting Requirements

Report From	Report To	Purpose	Frequency
Contractor EHSO	Contractor & Supervising Engineer	Health and Safety Issues	Weekly
Contractor EHSO	Supervising Engineer	Progress/Issues with EMP Implementation	Monthly

Report From	Report To	Purpose	Frequency
Supervising Engineer	Darkhan *aimag*	Progress/Issues with EMP Implementation	Monthly
PIU-ESS	Darkhan *aimag*	Progress with EMP Implementation	Monthly
Darkhan *aimag*	ADB through MCUD	Progress Report and Issues Arising	Quarterly
MCUD	ADB	Environmental Monitoring Report	Semi-Annual

Source: ADB Study Team

317. **Feedback and Adjustment Mechanism**. During project implementation a mechanism for feedback and adjustment of the EMP is required. This will be done through the reporting process for non-urgent issues. This includes issues which will not have an immediate adverse impact on human health or the environment. For urgent issues which may have an immediate impact on health and safety or environmental resources, the Supervising Engineer will directly contact Darkhan *aimag* in order to discuss the issue.

318. PIU will disseminate monthly progress reports as appropriate and should Darkhan *aimag*, MCUD, ADB or other stakeholders identify an area of concern, the EMP will be adjusted accordingly.

H. Budget

319. The environmental mitigation and monitoring measures requiring a specific budget outside the civil works contract and the budget allocated for PIU, are shown in **Error! Reference source not found.**.

Table 30: EMP Budget

Mitigation / Monitoring	Timeframe	Estimated Cost $USD
Consultant: PIU Environmental & Social Specialist in PIU (36 pm)	During Construction	$ 80,000
Monitoring: Water & Effluent Quality	Pre-construction and during construction	$ 50,000
Monitoring/testing: Sludge	Pre-construction and at commissioning	$ 10,000
Sludge options: additional expertise to support PIU-ESS	During Construction	$ 10,000
	Total	$ 150,000

Source: ADB Study Team

Table 31: Environmental Mitigation Plan

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
Pre-Construction						
EMP & GRM Implementation	All	Appointment of one **environmental monitoring and social specialis**t within PIU	Pre-construction	$80,000	PIU	MCUD
EMP contractual obligations	All	Tender and contract documents to include EMP obligations	Tender Preparation	No additional cost	MCUD	ADB
Health and Safety	All	**Health and Safety Management Plan (HSMP)** to be submitted and approved pre-construction	Pre-Construction Approval 1 month before construction commences	Included in contractor costs	Contractor	SE / PIU
Soil	All	**Soil Erosion Management Plan** to be submitted and approved pre-construction	Pre-construction Approval 1 month before construction commences	Included in contractor costs	Contractor	MCUD
Soil and land use	All	**Aggregate/Borrow Pits and Spoil Management Plan** to be submitted and approved pre-construction	Pre-construction Approval 1 month before construction commences	Included in contractor costs	Contractor	MCUD
Soil and Water Quality	All	**Spill Management Plan** **Hazardous and Non-Hazardous Waste Management Plan** **Water Protection Management Plan** All to be submitted and approved pre-construction	Pre-construction Approval 1 month before construction commences	Included in contractor costs	Contractor	MCUD
Consultation	Component A2	**Consultation** with Monastery, School No. 15, Old Darkhan Hospital, street vendors and affected residents regarding construction timing and approach.	Pre-construction	No additional cost	PIU-ESS	PIU
Utilities Provision	All	Consult relevant *aimag* departments to confirm location of utilities for each site	Pre-construction	Included in contractor costs	Contractor	MCUD
Construction Phase: Physical Resources						
Soil Resources - Erosion	All	- Ensure contractors aware of all soil erosion vulnerabilities (areas requiring particular attention) and Aggregate/Borrow Pits Management Plan and Soil Erosion Management Plan - If necessary, construct berms to direct rainwater runoff away from exposed soil surfaces.	During construction	Included in contractors costs	Contractor	PIU /MCUD

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
		- If necessary, install drainage ditches and sedimentation tanks in temporary construction areas to prevent soil erosion and to manage run-off particularly on Kharaa river flood plain - Stabilize all cut slopes and other erosion prone working areas while works are ongoing. - Implement permanent stabilization measures as soon as possible, at least within 30 days. - In areas where vegetation cover on soil has been disturbed, re-seed to re-vegetate with appropriate species of local provenance - Pay close attention to drainage provision and establishment of vegetation cover on backfilled areas to prevent soil erosion. - Ensure adequate aftercare to maximize survival of any re-vegetated surfaces. - Separate topsoil from subsoil during the excavation works, store and reuse during restoration; - During restoration reshape the slope surface by notching, blazing and pocking to enhance seedling survivability				
Soil Resources – Erosion	Tertiary pipe at Secondary Pumping Station (Component A2	- Re-seed to re-vegetate with appropriate species of local provenance including cover on tertiary pipe - Stockproof fencing along length of pipe to ensure animals do not erode soil covering	During construction	Included in contractor's costs	Contractor	PIU/ MCUD
Soil Resources – Contamination	All sites	- Ensure contractors aware of requirements in Spill Management Plan. - Properly store hazardous chemicals and wastes on hard standing with containment tray or bunding. - Keep a stock of absorbent materials (e.g. sand, earth or commercial products) onsite to deal with spillages and train staff in their use. - Ensure wastes from spill management are suitably disposed of. - Record any spill events and actions taken in environmental monitoring logs and report to PIU-ESS. - Store fuel in a bunded tank and ensure refueling of vehicles takes place on hard standing - Remove all construction waste from the site to approved waste disposal sites.	During construction	Included in contractor's costs	Contractor	PIU/ MCUD

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
Soil Resources – Borrow pits	All sites – borrow pits	- Pit restoration will follow the completion of works in full compliance with the agreed Borrow Pit Management Plan - Appropriate restoration of borrow areas required before final acceptance and payment under the terms of contracts; - Borrow pit areas will be graded to ensure drainage and visual uniformity; - Topsoil from borrow pit areas will be saved and reused in re-vegetating the pits; and - Additional borrow pits will not be opened without the restoration of those areas no longer in use	During construction	Included in contractor's costs	Contractor	PIU/ MCUD
Air Quality – dust	All construction sites	- Manage stockpile areas to avoid mobilization of fine material, cover with tarpaulin and/or spray with water. - Fill material should be delivered to construction sites in a damp condition - Water sprays or a dust suppression agent should be correctly applied to reduce dust emissions and reduce water usage - Any raw material spills should be removed promptly - Do not overload trucks transporting earth materials. - Equip trucks transporting earth materials with covers or tarpaulin to cover loads during transport. - Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying mud onto public roads. - Immediately clean up all mud on public roads. - Frequent watering of unpaved areas and excavations to suppress dust. - Adjust practices as necessary to increase dust suppression if nomadic herders relocate to be near construction sites, such as more frequent watering of stockpiles and roads - Regularly inspect and certify vehicle and equipment emissions and maintain to a high standard. - Concrete batching or asphalt (or other pavement surface) plants to be sited at least 500 m from the nearest dwelling and locate downwind.	Throughout construction	No additional cost	Contractor	PIU / MCUD
Water Quality	Central WWTP Component A1	- Adequate WWTP capacity will be maintained at all times	Throughout construction	No additional cost	PIU	MCUD

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
Water Quality	Component A2 Tertiary pipe; secondary pumping station	- Temporary drainage provision will be provided during construction - Contaminated water will be removed off-site for disposal in the facilities identified in the Construction Site Management Plan	Throughout construction	No additional cost	Contractor	PIU / MCUD
Water Quality	All construction sites	- Develop and implement contingency plans for control of spills of oil and other hazardous substances (Spill Management Plan); - Fuel storage, maintenance shop and vehicle cleaning areas must be stationed at least 300m away from the nearest water body and will include enclosed drainage to ensure contaminated water does not cause pollution and storage, maintenance and cleaning activities will be on hard standing; - -Enclosed drainage around chemical storage areas on construction sites and storage will be on hard standing. - Construction wastes and materials (e.g. fuel) will be properly contained during construction on hard standing and fuel tanks will be located in a bunded area which has a capacity of 110% of the fuel tank. Wastes will be stored in a hard standing area which is protected from rain and wind and waste removed from site and taken to approved disposal facilities.	Pre-construction & during construction	No additional cost	Contractor	PIU / MCUD
Waste Management	All sites	- Waste Hierarchy to be the guiding principal in the Hazardous and Non-Hazardous Waste Management Plan and Aggregate, Borrow Pit and Spoil management plan - Document consideration of waste prevention and reuse through procurement options if feasible - Provide appropriate covered waste storage containers for all wastes and adequately segregate hazardous and non-hazardous waste streams - Install confined storage points of solid and liquid wastes away from sensitive receptors, - Regularly haul wastes to an approved disposal facility as agreed with *aimag* authorities if appropriate - If waste is removed by a third party, ensure the contractor is approved by the *aimag* authorities - Contractors to be responsible for proper removal and disposal of any significant residual materials, wastes and	Pre-construction and during construction	Included in contractors costs	Contractor	PIU / MCUD

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
		contaminated soils prior to construction camp site handover; - Spoil will be disposed on only in sites which are approved by MCUD in accordance with the Aggregate, Borrow Pit and Spoil Management Plan; - Spoil will not be disposed of on slopes or near pasture land where it may impact on vegetation; - Rehabilitate and restore spoil disposal sites in accordance with the agreed plan. - Prohibit burning of waste at all times - Hazardous and Non-Hazardous Waste Management Plan to include (i) PCB assessment and management plan for all pumping station sites (ii) scope for long term storage of hazardous liquid waste (including PCB containing oils) which requires high temperature incineration and (iii) plan for asbestos waste management - Prohibit burning of waste at all times - Schedule of disinfection for each waste storage area to be implemented.				
Construction Phase: Biological Resources						
Biological Resources - Fauna	All	- Adequate WWTP capacity will be maintained at all times. - Temporary drainage provision will be provided during construction at the Secondary pumping Station tertiary pipes site to ensure that any storm water running off construction areas will be controlled. - Contaminated water will be removed off-site for disposal in the facilities identified in the Construction Site Management Plan - Enclosed drainage around chemical storage areas on construction sites and storage will be on hard standing. - Develop and implement contingency plans for control of spills of oil and other hazardous substances (Spill Management Plan); - Fuel storage, maintenance shop and vehicle cleaning areas must be stationed at least 300 m away from the nearest water body and will include enclosed drainage to ensure contaminated water does not cause pollution and storage, maintenance and cleaning activities will be on hard standing;	During construction	Included in contractors costs	Contractor	PIU /MCUD

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
		- Construction wastes and materials (e.g. fuel) will be properly contained during construction on hard standing and fuel tanks will be located in a bunded area which has a capacity of 110% of the fuel tank. - Wastes to be stored in a hard standing area which is protected from rain and wind and waste removed from site and taken to approved disposal facilities				
Construction Phase: Socio-economic Resources						
Cultural Heritage	Component A2 (Old Darkhan Hospital site- Getsogdarjaalin Monastery	- Maintain dialogue with Getsogdarjaalin Monastery monks during construction - Feedback corrective mitigation actions to PIU as required	During Construction	Included in PIU staff costs	PIU-ESS Contractor	PIU / MCUD PIU / MCUD
Community Health and Safety - Noise	All sites	- Schedule construction activities, avoid noisy equipment working concurrently. - Avoid construction works from 1800hrs to 0800hrs - If night time construction needed, consult nearby residents beforehand for their consensus. - Locate sites for rock crushing, concrete mixing and other noisy activities at least 500m away from sensitive noise receptors which are present at the time of set-up. - On public roads, minimize the use of whistles and horns. - Ensure regular maintenance of vehicles and machinery - Provide notices for advance warning of excavation works particularly for school and hospital on timing of noisy activities. - Ensure GRM information disseminated. - All construction workers to use appropriate Personal Protective Equipment for protection against damage from noise.	Throughout construction	No additional cost	Contractor PIU-ESS	PIU / MCUD
Pasture Land – Economic Resource	Component A2 - Tertiary pipe at secondary pumping station; and new south pumping station	- Spoil is to be disposed of only in areas delineated in the Aggregate, Borrow Pit and Spoil Management plan which should avoid productive pasture land. - Borrow pits are to be only in areas delineated in the Aggregate, Borrow Pit and Spoil Management plan which should avoid productive pasture land - GRM will be signposted at each of the sites in order for those with grazing animals to contact the project if they have a problem with the construction works. - Notices in advance of construction work will be put up to warn residents, including owners of animals, that the	During Construction	Included in contractor costs	Contractor	PIU / MCUD

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
		work will commence including start/end dates and details of work.				
Community Health and Safety	All sites	- Clear signs placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials and excavation and raising awareness on safety issues - Heavy machinery will not be used after day light and all such equipment will be returned to its overnight storage area/position before night. - All sites, particularly pipe excavations will be made secure, discouraging access by members of the public through fencing or security personnel, whenever appropriate. - Specific notices will be issued to the School Number 16, opposite Old Darkhan Hospital (Component A2) in order to inform children about construction site safety - Road safety awareness signage - road users and pedestrians made aware of changes to traffic flows through clear signage	During Construction	Included in contractor costs	Contractor	PIU / MCUD
Occupational Health and Safety	All sites	- An Environment Health and Safety Officer (EHSO) will be hired or nominated to implement and supervise a Health and Safety Management Plan (HSMP). - HSMP implementation will be monitored by the EHSO and all incidents recorded and report with corrective actions identified.	During Construction	Included in contractor costs	Contractor	PIU / MCUD
Induced impact - traffic	Component A2, Old Darkhan Hospital - main road	- Consult and maintain dialogue with relevant *aimag* authority on the timing of the road excavation, including departments responsible for transport and traffic police. - Signage to warn motorists of when the road closure will be operational; and - Use of appropriate traffic signals if alternate line traffic is required to maintain access along the road.	During Construction	Included in PIU and contractor costs	PIU-ESS Contractor	PIU / MCUD
Operation Phase: Physical Resources						
Water Quality	WWTP	- Comprehensive training of WWTP operatives to ensure the staff understand how to effectively operate the WWTP under all conditions including emergencies	During operation	Included in construction costs (technology provider)	Us Suvag	Darkhan *aimag*
Water Quality	Component A2 - Tertiary pipe,	- Adequate layering and packing of earth around the pipe in order to protect it from cold weather. The depth of the	During Operation	$2000*	Us Suvag	Darkhan *aimag*

Issue	Location/ Component	Mitigation	Timeframe	Estimated Cost $ USD	Implemented by:	Supervised/ Approved by:
	secondary pumping station	material to be advised by a cold weather engineering specialist. - Maintenance and repair of stock proof fencing either side of the pipe in order to protect it from trampling by grazing stock, thus maintaining its integrity. - Us Suvag to regularly inspect the pipe and ensure the packed earth is in good condition and to implement repairs if required				

*An estimate of costs for proposed operational maintenance measures for one year is provided but should be incorporated into Darkhan Uul *aimag* budgets for future planning.

APPENDIX 2: TERMS OF REFERENCE

A. PIU ENVIRONMENTAL AND SOCIAL SPECIALIST (PIU-ESS) (UNDER PIU) (NATIONAL 36 MONTHS - INTERMITTENT)

1. The specialist will have a minimum of 5 years practical experience in the implementation of EMPs and environmental monitoring, ability to work with a multidisciplinary team and dealing with all aspects of site-related environmental issues, and excellent communication skills. Previous experience as a National Environment Specialist for at least one ADB or World Bank funded project in Mongolia is desirable.

2. The PIU-ESS will facilitate the implementation of the EMP and ensure the grievance redress mechanism functions effectively. The expert will perform the following with respect to environmental monitoring:

(i) Review IEE and EMP to understand the environmental issues associated with the project area.
(ii) Consult with PIU to identify if there are any changes in the project sites or baseline environmental conditions. Assess impacts of any changes and update EMP.
(iii) Review the EMP and ensure that the location and timing of monitoring and environmental parameters are appropriate.
(iv) Assist the PIU in obtaining all necessary domestic environmental approvals to allow the projects to proceed, as required.
(v) Review Tender and Contractor Documents to ensure all required environmental specifications have been included, update as required.
(vi) Prepare or review (if already existing) environmental audit checklists for daily, weekly and monthly monitoring of implementation of the EMP by the contractor.
(vii) Prepare monthly (for EA/PIU), quarterly (for ADB Project Progress Report) and biannual Environmental Monitoring Reports (for ADB). The reports should review progress with project implementation, results of checking and monitoring, identify problems encountered, actions taken/or proposed to be taken to resolve problems and activities programmed for next monitoring period.
(viii) Conduct training events for field level implementing government agencies and contractors and supervision engineers on the requirements and implementation of the EMP. The training workshops must cover:
    a) Use and purpose of GRM
    b) ADB requirements for GRM
    c) EMP Purpose, Scope, and Contractor Responsibilities
    d) Purpose and implication of EMP updates or revisions
    e) Environmental Monitoring for EMP - purpose, requirements and data analysis
    f) Roles and responsibilities of the government, supervision consultants, contractor and other relevant agencies.

    The key outcome of the workshop must be to prepare the field staff of the implementing agency, supervision consultants and the contractor in implementing the EMP and monitoring the EMP including site audits, completion of checklists and other associated paperwork.

(ii) Monitor the implementation of the mitigation measures and monitoring requirements of the environmental management plan.
(iii) Review the plans for water quality and effluent monitoring and monitor implementation of the water quality monitoring program.
(iv) Include water quality and effluent sampling results and discussion in the monitoring reports and advise/support the contractor in taking remedial actions if any of the test results are not within the required limits.
(v) Facilitate implementation of Grievance Redress Mechanism and maintain proper records of all environment related grievances and details of how they were addressed.
(vi) Facilitate consultation between the contractor and local stakeholders including Bagh committees and Affected People (including residents, vendors, Old Darkhan Hospital, temple monks and School No. 16) with respect construction scheduling, and proposed mitigation measures to control dust, and to minimize disruption to local traffic.
(vii) Coordinate with the PIU staff responsible for the Grievance Redress Mechanism with respect to identification, investigation, and resolution of environmental and social complaints.
(viii) Conduct regular site visits to the project area during the construction period.
(ix) Undertake research to identify local solutions for sewage sludge based on sewage quality data analysis. Liaise with national experts if required.

3. The consultant will report directly to the PIU.

B. WATER QUALITY AND EFFLUENT MONITORING – INSTITUTE OF METEOROLOGY, HYDROLOGY AND ENVIRONMENT

4. **Background**. The Government of Mongolia, with financial support from Asian Development Bank (ADB) is upgrading the central Wastewater Treatment Plant in Darkhan. This includes the rehabilitation and upgrading of additional infrastructure including pumping stations and sewer pipes. The outcome of the Project will be an efficient and effective WWTP, better able to cope with the increasing demands put upon it by development of Darkhan city.

5. **Objective**. The primary objective of the assignment is to provide water quality and effluent monitoring support to the Project Implementation Unit (PIU) in the implementation of project environmental management and monitoring requirements during the construction of the project.

6. The main issue for the surface water quality at the effluent outfall and the effluent itself is regarding the adherence to Mongolian National Standards throughout project construction. Water quality monitoring is already undertaken by the *aimag* Meteorological Institute. These Terms of Reference are in addition to the regular monitoring undertaken in order to ensure that there will be project specific data collection.

7. This work is related to the environmental requirements in ADB's Safeguards Policy Statement (2009) and the consultant / institute should know these environmental requirements provided by Employer according to Environmental Assessment Guidelines and environmental safeguard policy of the ADB, and Environmental Impact Assessment Law of Mongolia. This monitoring will include basic parameters in line with Mongolian National Standards: Temperature, suspended particles, pH, Dissolved oxygen, Chemical oxygen demand, Biological oxygen demand, Hydrocarbon, Micro-organisms such as faecal coliforms.

8. **Tasks of the assignment**. The consultant / institute shall work closely with the PIU staff and PIU-ESS, and report directly to the project coordinator of the PIU. The tasks under this Terms of Reference include, but are not limited to:

(i) Review IEE or other relevant reports prepared for the project to understand the environmental issues associated with the project area and the mitigation and monitoring requirements;
(ii) Develop a water and effluent monitoring plan including monitoring protocol with monitoring points, sampling frequency, parameters to be monitored, analytical methods, monitoring schedule and reporting requirements;
(iii) Agree the detailed monitoring plan along with the monitoring protocol for review and approval by PIU and PIU-ESS;
(iv) Monitor water and effluent quality and check contamination through parameters agreed.
(v) Include water quality and effluent test analyses and discussion of results in the monitoring reports and advise/support the contractor in taking remedial actions if any of the test results are not within the required limits specified in Mongolian National Standards
(vi) Prepare or review (if already existing) and agree reporting formats for monthly, monitoring reports for water and effluent quality monitoring;
(vii) Conduct on the job or site based practical training for the contractors and PIU where necessary while implementing the water and effluent quality monitoring;

9. The following reports shall be submitted by consultant/specialist to PIU/Employer and ADB:

(i) Monthly analytical report for surface water and effluent in comparison to relevant national standards.
(ii) Special Reports on any training conducted if appropriate, within 1 week of event
(iii) Final water quality and effluent monitoring report for inclusion into semi-annual report of EA to ADB. Report includes all monitoring data in MS Word/Excel or other acceptable format and analysis, conclusions and recommendations.

C. SLUDGE MANAGEMENT – CONSULTANT/ TECHNICAL INSTITUTE

10. **Background**. The Government of Mongolia, with financial support from Asian Development Bank (ADB) is upgrading the central Wastewater Treatment Plant in Darkhan. This includes the rehabilitation and upgrading of additional infrastructure including pumping stations and sewer pipes. The outcome of the Project will be an efficient and effective WWTP, better able to cope with the increasing demands put upon it by development of Darkhan city.

11. **Objective**. The primary objective of the assignment is to provide scientific data on the quality of sludge generated by the WWTP in order to confirm: (i) that the existing practice of sludge disposal in sludge beds is not having an unacceptable impact on the environment or human health; and (ii) whether the sludge is appropriate for a more beneficial use elsewhere such as a soil improver; and (iii) support to the Project Implementation Unit (PIU) in the implementation of project environmental management and monitoring requirements during the construction of the project.

12. This work is related to the environmental requirements in ADB's Safeguards Policy Statement (2009) and the consultant / institute should know these environmental requirements provided by Employer according to Environmental Assessment Guidelines and environmental safeguard policy of the ADB, and Environmental Impact Assessment Law of Mongolia. This monitoring will include Heavy metals, ammonia, nitrate, phosphorous, micro-organisms such as faecal coliforms. In agreement with the EA, the parameter may be amended according to available practical laboratory facilities.

13. **Tasks of the assignment**. The consultant / institute shall work closely with the PIU staff and PIU-ESS, and report directly to the project coordinator of the PIU. The tasks under this Terms of Reference include, but are not limited to:

(i) Review IEE or other relevant reports prepared for the project to understand the environmental issues associated with the project area and the mitigation and monitoring requirements;
(ii) Develop a sludge testing approach including sampling protocol with parameters to be monitored, analytical methods, monitoring schedule and reporting requirements;
(iii) Agree the detailed monitoring plan along with the testing approach for review and approval by PIU and PIU-ESS;
(iv) Sample and test sludge quality and check contamination through parameters agreed.
(v) Prepare or review (if already existing) and agree reporting formats.

14. The following reports shall be submitted by consultant/specialist to PIU/Employer and ADB:

(i) Pre-Construction Report and Commissioning Report to PIU. Include test analyses and discussion of results in the monitoring reports and advise/support the contractor in taking remedial actions if any of the test results are not within the required limits specified in Mongolian National Standards (if relevant)