

Environmental Impact Assessment

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Mongolia: Darkhan Wastewater Management Project

Prepared by Environ LLC for the Asian Development Bank.

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Environmental consulting company "Environ"
LLC

**A Detailed Environmental Impact
Assessment Report for
EXPANSION PROJECT OF CENTRAL
TREATMENT PLANT IN DARKHAN –
UUL PROVINCE**



Ulaanbaatar 2014

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**“ДАРХАН СУМЫН ТӨВ ЦЭВЭРЛЭХ БАЙГУУЛАМЖИЙГ ӨРГӨТГӨХ” ТӨСЛИЙН
БАЙГАЛЬ ОРЧНЫ НАРИЙВЧИЛСАН ҮНЭЛГЭЭНИЙ ТАЙЛАН**

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**A DETAILED ENVIRONMENTAL IMPACT ASSESSMENT REPORT
FOR EXPANSION PROJECT OF CENTRAL TREATMENT PLANT IN
DARKHAN-UUL PROVINCE**

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Ulaanbaatar 2014

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Background

The Government of Mongolia, acting through its Ministry of Construction and Urban Development and Darkhan Us Suvag LLC developed “Central Treatment Plant extension” project that is to be implemented in the territory of Darkhan county with financial assistance from Asian Development Bank’s credit ease, Darkhan Uul province and General Environmental Impact Assessment 2013/B007 was issued by Ministry of Environment and Green Development.

“Environ” LLC executed Environmental Detailed Impact Assessment according to request of Darkhan Us Suvag.

The goals of the Environmental Detailed Impact Assessment are as follows:
Issues of assessment of potential specific environmental impacts, development of operational guidance without impacts on human health and domestic conditions, development of preventive/mitigation measures for significant impacts, and Environmental Protection Plan needs to implement the project and Environmental Monitoring Programm; Approval by Ministry of Environment and Green Development; Submission to “Asian Development Bank”, “Ministry of Construction and Urban Development” and “Darkhan Us Suvag” LLC.

After collection of primary information and data regarding to the project, our experts and specialists conducted additional survey on site, took samples to analyse, met local governance and public. According to these data results, the report was developed.

The Environmental Detailed Impact Assessment was produced based on the 09 resolution of “Methodical instructions for Environmental Detailed Impact Assessment” approved by Minister of Environment in 2010, Methodology by UN Asia-Pacific Commission and methods of Environ LLC.

It consists of 8 chapters, 117 pages and covers Environmental Protection Plan, Environmental Monitoring Programm and Appendices.

CHAPTER 1. DESCRIPTION OF THE PROJECT AND RELATED DATA

1.1. General data of the Project

Project Name: Darkhan Wastewater Improvement Project

Project purposes

Project purposes are to make a significant contribution to improving the environment and surroundings of Darkhan city and to improve the water quality of the Kharaa River to agree international standards of river quality.

Project Implementer: Ministry of Construction and Urban Development, Darkhan Us Suvag

State registration number:

ID number: 2051222

Address of Project Implementer: Darkhan county, Darkhan province

Project location: The Project area is located at north latitude $49^{\circ} 30' 24''$ and east longitude $105^{\circ} 55' 31.3''$ in front of Waste Water Treatment Plant, Darkhan Us Suvag that is in Darkhan county, Darkhan province.

The sketch of the Project area:



Figure 1 Area where Waste Water Treatment to be expanded

Project demands: Darkhan is the third largest city in Mongolia after Ulaanbaatar and Erdenet city. It was established as an industrial center, and continues in this role with a thermal power plant, major metallurgical industries, cement and other construction materials manufacturing, and a host of smaller industrial units. However, despite this industrial heritage, there has been little new investment in either the manufacturing or processing industry in Darkhan in recent years. As a result, while the economic performance of the city has approximately matched that of the country as a whole, the city's population has stagnated. The registered population has remained much the same over the past decade, but has declined by almost seven per cent between 2010 and 2012.

As part of its socio-economic development strategy, the Government of Mongolia is committed to promoting further investment in industrial development in Darkhan. Furthermore, Darkhan has been identified as a model city in Mongolia and the Government is supporting the preparation of a new Darkhan General Plan that will set out the development strategy and plan for Darkhan to year 2028 as both a "smart city" and a "green city". There is also the prospect of significant industrial investment in the short- to medium-term. A new oil refinery is proposed for Darkhan, to be developed through joint Mongolian and Japanese financing, and the aiming government is keen to encourage expansion of the existing metallurgical and construction materials industries.

The proportion of the population living in ger district areas in Darkhan is smaller than most other urban areas in Mongolia, at only about 35% of the total urban population. Even though the population living in ger district areas occupies minor proportion, conditions within the ger district areas are poor – with water supply only obtainable from water kiosks, sanitation restricted to on-plot long-drop toilets, and no access to the centralized heating system. While conditions are significantly better within the core urban areas, with full household services provided to apartments and low-rise housing, both the water supply and sewer networks suffer from ageing and dilapidated infrastructure resulting in significant leakage from both systems, and frequent system failures. The three main wastewater pumping stations and central wastewater treatment plant function reasonably well most of the time, but are at, or beyond, the end of their economic life. The resulting occasional overloads and breakdowns cause pollution of the areas surrounding the pump stations and treatment plant with raw sewage. Taken together, these compromise the quality of the urban environment, and risk its progressive further deterioration.

A more significant issue is the age and degree of deterioration of the central wastewater treatment plant. Most elements of the system are now out of commission. Two out of three of the primary clarifiers and two out of three of the secondary clarifiers are no longer used and derelict, and many of the internal concrete walls of the aeration tanks are destroyed. Any mechanical equipment from the out-of-commission units has been cannibalized to keep the one remaining unit operational. Although planned for 50,000 cum/day, the plant is currently operating at a load of about 7,000 cum/day in summer with a peak flow of up to 13,000 cum/day in winter. The effluent has been measured to fail national effluent quality standards on 20 per cent of occasions, leading to elevated levels of nutrient in the Kharaa River.

1.2. The project description

Within the project 5 variations were put forward, an appropriate variation is to be selected based on comparison.

1.2.1. BASIC ACTIVATED SLUDGE PLANT

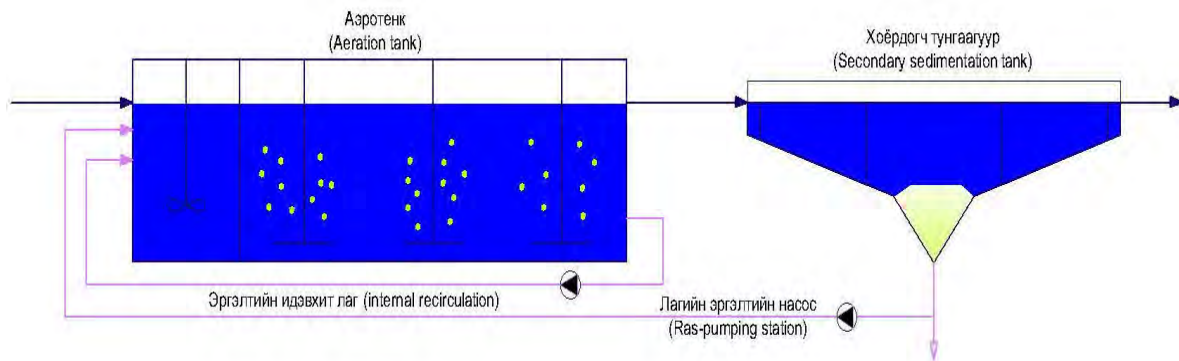


Figure 2 Flow diagram for the activated sludge plant

The traditional activated sludge systems have been widely used in many countries and for many years and a number of developments have been made to improve this basic process.

The main reasons for the efforts to improve the basic activated sludge system are:

1. Nitric oxides, such as nitrites and nitrates, and sulphurous oxides, such as sulphites and sulphates are only poorly decomposed in the traditional activated sludge process. When these elements remain in the treated effluent water discharged to rivers to rivers and lakes, nitrogen and phosphorus oxides are then decomposed in the natural environment which results in undesirable environmental consequences such as algal blooms, which in turn damage aquatic environments. In extreme cases this can lead to eutrophication of water bodies with disastrous impacts on aquatic life.
2. Further problems were experienced with traditional activated sludge plants when the sludge volume index was high, leading to problems maintaining optimal MLSS concentrations, sludge bulking and sludge carry-over.

As a result, in order to improve the process of decomposition of the oxides of nitrogen and phosphorous through additional aeration, systems were developed which extended the aeration period. However, the disadvantage of this process was that it requires an increase in the capacity of blowers and total volume of tanks.

In order to resolve these disadvantages, some additional processes were introduced – such as improved decomposition of nitrogen oxide – by changing the ways, rates and locations at which return sludge is returned to the system. There have over recent years been many changes and technological innovations introduced to the activated sludge system.

All these systems use the same basic principles as the activated sludge system, and consequently they can all be considered to be developed variations of the activated sludge system. The advantages and disadvantages of all these systems are well covered in the feasibility study for the WWTP in Buyant-Ukhua, Ulaanbaatar carried out by GITEC Consult GmbH Dusseldorf, Germany⁵ for the construction of a plant of with a capacity of 20,000m³/day. The main advantages and disadvantages mentioned are as follows:

The advantages of the step-feed ASP technology are that it provides a high level of treatment without the operation complexities inherent in SBR system. Furthermore, raw sludge and excess activated sludge can be used to produce energy through sludge digestion which is both environmentally-friendly and can provide energy through the bio-gas produced which offsets some of the energy costs of operation

The potential disadvantages of the system are that when extending the capacity of the WWTP there will be a need for additional primary and secondary sedimentation tanks, aeration tanks and other basins, which will add to the cost of modular capacity enhancement. It will also require increases the number of sewage pipelines and other interconnecting pipe work and appurtenances.

In general, activated sludge systems do not provide a high level of nutrient removal, but the step-feed process is designed to improve the nutrient removal performance of the system, so this should not constitute a problem in achieving discharge standards. The addition of anaerobic digestion to generate bio-gas as a resource to reduce energy should be beneficial, but there is some doubt as to the applicability and efficiency of biogas digesters under Mongolian conditions where relatively high water consumption (150 l/c/d) and low organic loads (27 g/c/d) lead to low BOD₅ and SS concentrations in raw sewage (BOD₅ 90-95mg/l, SS ~150mg/l)

LAYOUT OF WWTP IN BUYANT-UKHAA WITH MODIFIED STEP-FEED ACTIVATED SLUDGE TECHNOLOGY

САЙЖРУУЛСАН ИДЭВХИТ ЛАГИЙН ТЕХНОЛОГИЙН ЗАРЧМЫН СХЕМ

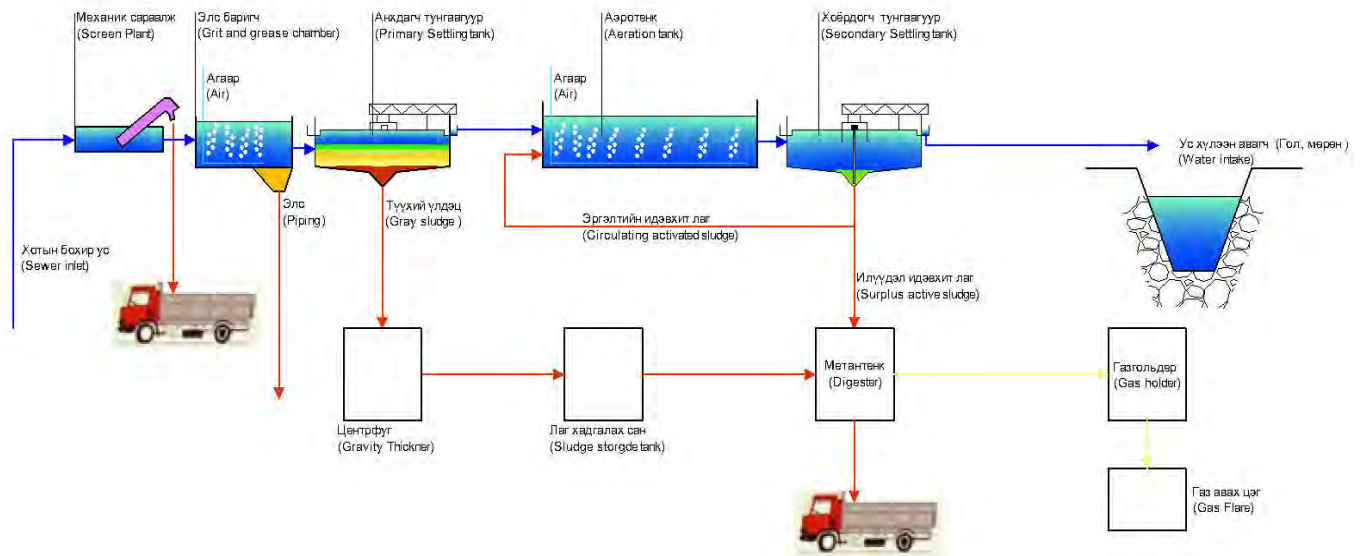
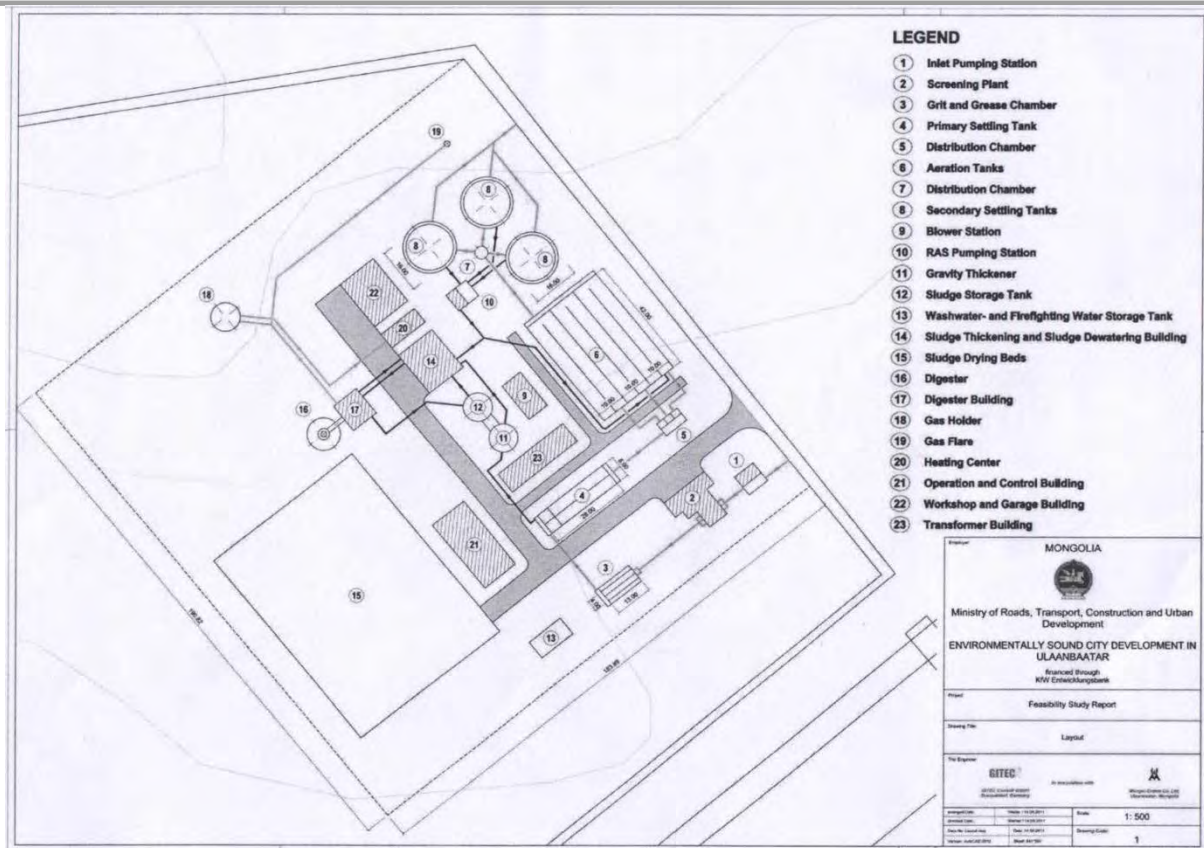


Figure 3 Layout of Activated Sludge System

Figure 4 Layout of Step Feed Activated Sludge System, WWTP (20,000m³/d) in Buyant-Ukhaa (10000 m³)



1.2.2. SEQUENCING BATCH REACTOR (SBR)

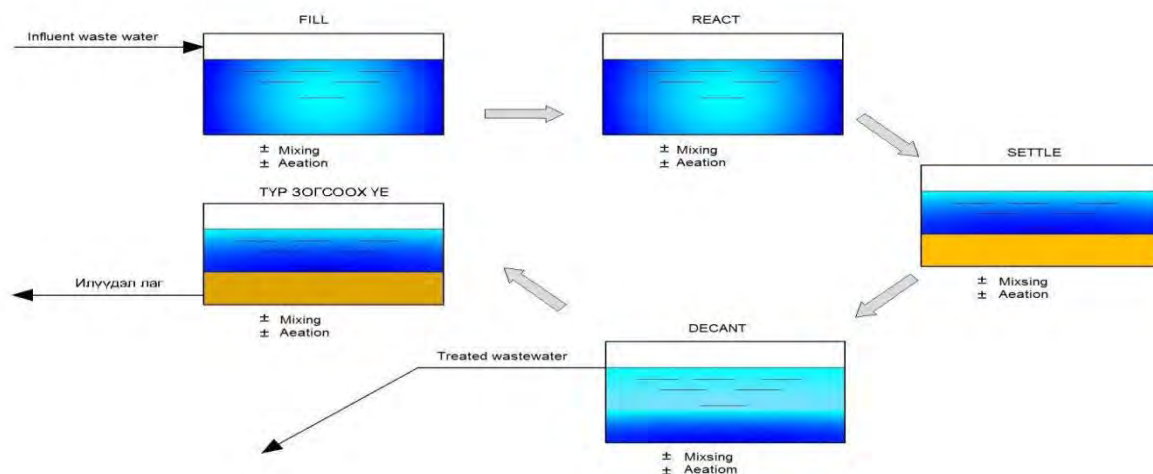


Figure 5 Major phases of the SBR Operations Cycle

The SBR process is one of those biological treatment processes that have been increasingly adopted in recent years, as it provides a modern and potentially more efficient variation on the activated sludge process. It effectively replaces a physical sequencing of reactors by a single reactor in which the treatment phases are themselves sequenced.

In the traditional activated sludge system, influent wastewater is purified on its passage through several tanks. Under the SBR system, all the treatment phases are carried out in a single tank. Within this basic configuration that can be there can be a number of construction options. The simplest one is one tank with one bioreactor, but for larger flows or to provide greater operational flexibility there can be one tank with 2-3 bioreactors. The SBR system is most suitable for relatively small city or town residential populations and industries.

The operation of a SBR is based on the following steps.

1. Filling: During the fill phase, influent wastewater enters the tank and neither the mixer nor aeration is active, although under a mixed-fill scenario, mechanical mixers are active. At this stage anoxic conditions are present and nitrogen is released, and at the same time denitrification is promoted and the biomass undergoes a release of phosphorous. During the third phase, both the aerators and the mechanical mixing unit are activated to promote denitrification there is no aeration for certain time, and an anoxic condition is present, which allows both denitrification and nitrification. During this phase, sedimentation is also supported.
2. React: No wastewater enters the basin and the mechanical mixing and aeration units are on, and carbonaceous BOD removal occurs in this phase. The duration of this phase makes up half the duration of all phases. The duration of all phases including switching the oxygen on and off and receiving influent wastewater can be timer-controlled or automatically controlled. In general, the duration for all the phases is 6-8 hours.
3. Settle: During this phase, no mixing and aeration takes place. Under these conditions, the activated sludge tends to settle as a flocculent mass, forming a distinctive interface with the clear supernatant. The sludge mass is called the sludge blanket.
4. Decant: During this phase, a pump or a floating decanter is used to remove the clear supernatant effluent to the outlet arrangements or next treatment stage.
5. Idle: This step occurs between the decanting and fill phases. During this phase, excess sludge is pumped out by measured volume.

ADVANTAGES OF THE SBR SYSTEM:

1. Excess sludge is minimized.
2. Because all of the operations are carried out in a single tank, the reactor footprint can be minimized.
3. The system is provided with fully automated operation.

4. The aeration device has a timing unit, so there is no need to plan for high capacity aeration.
5. Operation is highly flexible and can accommodate varying ambient temperatures, hydraulic, organic or nutrient loads.
6. There are low pumping requirements as no sludge return is required
7. 7. Compact facilities reduce exposure to weathering
8. 8. Good removal of nitrates at low temperatures and high organic loadings.

DISADVANTAGES OF THE SBR SYSTEM:

1. A higher level of sophistication is required because an automated timing unit controls the step feed bioreactor.
2. The operation relies on automated systems which demand a higher level of maintenance associated with automated switches, valves and shut offs.
3. Higher cost of maintenance of automated facilities.
4. It is risky to stop the inflow of raw sewage for a lengthy period (for 6-8 hours) during which anaerobic conditions are maintained and water temperature goes down ($<10^{\circ}\text{C}$) which will impact negatively on the microbial mass.
5. It requires the construction of buildings with oxide-proof materials, and good quality of heat-insulation. Normal reinforced concrete cannot be used and if polypropylene is used it impacts negatively on cost and treatment times.

The MoMo project has been operating a pilot SBR in Darkhan for a period of almost two years. It is proposed to observe this pilot to determine its applicability for the conditions in Darkhan with a view to the development of a full-scale SBR plant¹.

¹Source: Heppeler, Jörn. Optimization of the operation of a sequencing batch reactor (SBR) – On the example of the pilot wastewater treatment plant in Darkhan, Mongolia, University of Stuttgart, Stuttgart, 2012

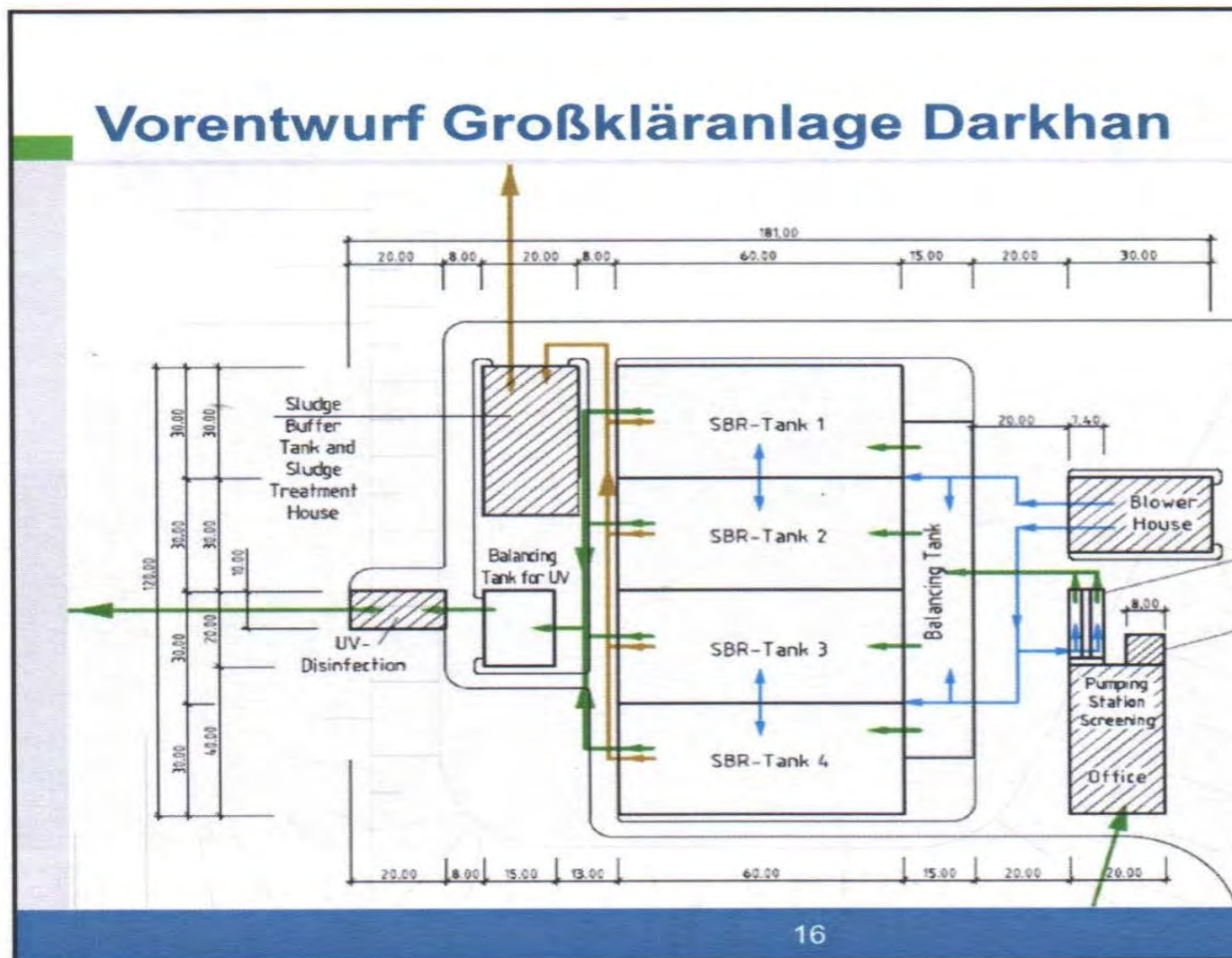


Figure 6 The Sequencing Batch Reactor WWTP Proposed for Darkhan under the Momo Project. The Plant is designed for a flow rate of 20,000 cum/day.

1.2.3. MEMBRANE BIO-REACTOR SYSTEM

Under the artificial biological technology systems, separating the effluent treated wastewater from activated sludge through the use of a secondary sedimentation tank has been the best method.

In addition, to provide further effluent improvement a deep purifying filter has been used to improve the purification of the effluent, although these systems have frequently suffered bad effects from the build-up of bacteria and some fungus increase which adds to the concentration of the activated sludge, but results in blocking of the filter media, thus causing its performance to deteriorate. In order to resolve these problems without having to dramatically increase the area, systems that provide better control of these problems have been developed. One of the technologies, are becoming more widely used in the membrane bio filtration technology.

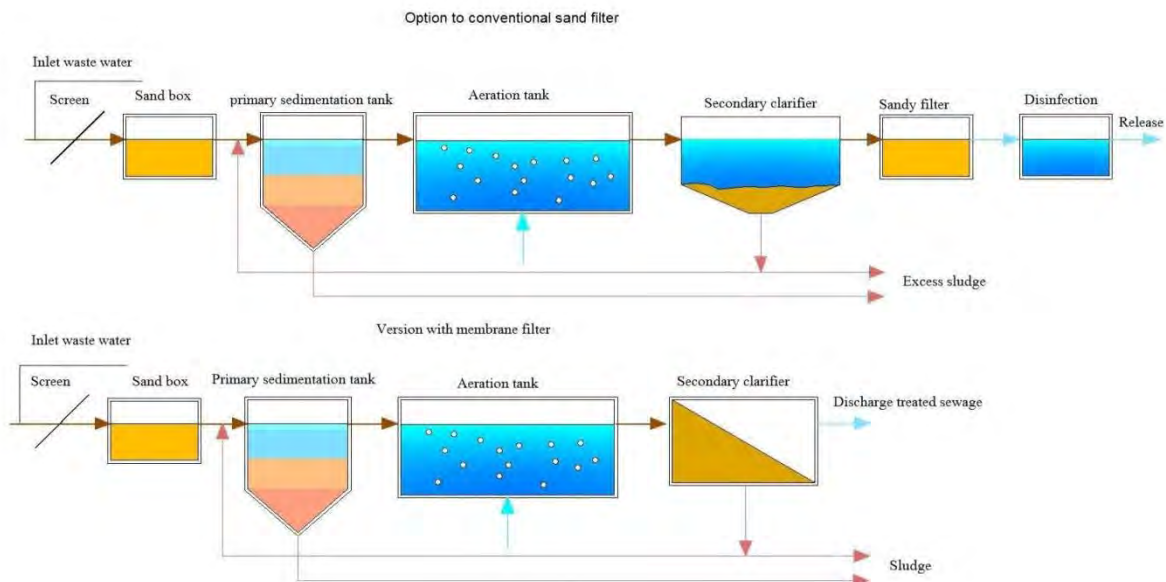


Figure 7 Flow diagram for the Membrane Bio-Reactor system

The Advantages and Disadvantages of the Membrane Bioreactor

The advantages can be summarized as:

1. It provides a high level of treatment efficiency.
2. By increasing the sludge volume in the aeration tank, it allows greater treatment capacity.
3. It allows the treatment plant to have a small area footprint, as there is no need for a secondary sedimentation tank and various tertiary filters.
4. It promotes the reduction of excess sludge.
5. It obviates the need for disinfection facilities for the treated effluent.

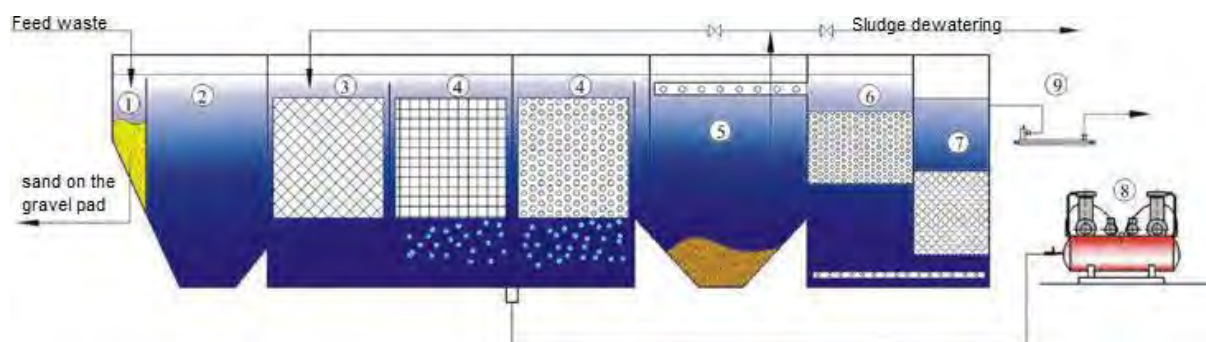
The disadvantages can be summarized as:

1. Based on experience of using membranes in Mongolia, when there is failure of systems – for instance due to power cuts - the micro filter gets polluted and requires constant cleaning – high maintenance.
2. The membrane cartridges need to be changed often, are imported, and are consequently very expensive.
3. To operate micro filters, vacuum pumps are required and these are considerably more expensive to operate than using secondary sedimentation tanks.

1.2.4 THREE-SLUDGE SYSTEM, (A MODULE ORGANISED ACTIVATED SLUDGE SYSTEM)

In the late 1980s, Culikov, a Russian scientist and academician, developed a synthetic artificial algae installation in bio-reactors. Moreover, the scientist developed the current step-feed bio-reactor method.

Layout of the three-sludge treatment technology:



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

Principles of the operation of the three-sludge technology

From the equalization tank, wastewater is pumped and discharged into the full biological treatment tank as follows:

- Denitrification tank
- Nitrification tank
- Thin-layer sedimentation tank
- Full purification bioreactor
- Fine filter

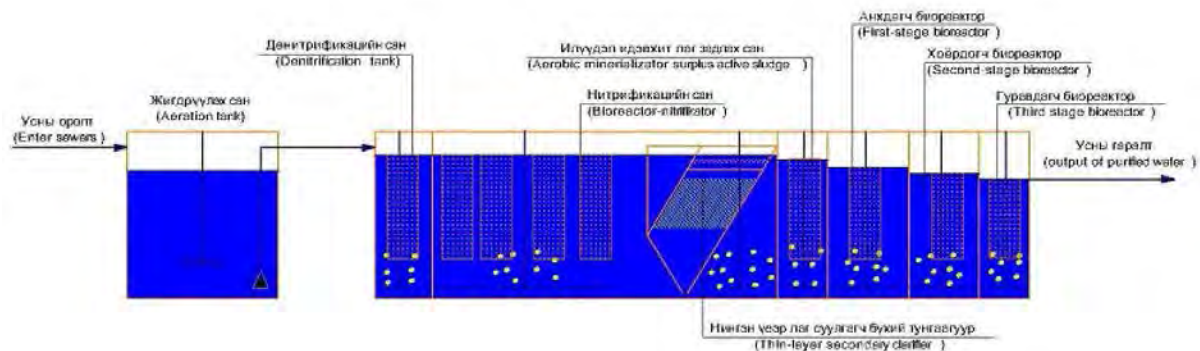
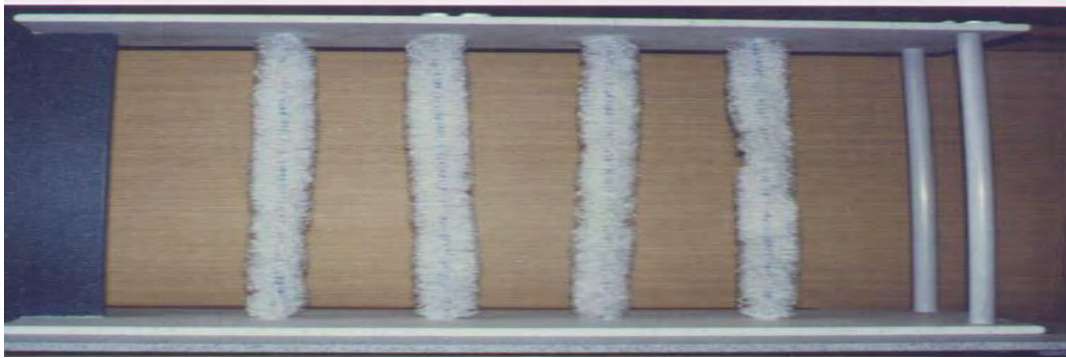


Figure 8 Layout for the Three-Sludge System

The key feature of this system is to build the wastewater treatment aquatic food chain from the specific bacterial micro-organisms which operate most effectively under different sets of conditions which best suit predatory-feeders, active filter-feeders and bottom-feeders. The objective is to create a value chain or bio-conveyor of a sewage treatment to provide the various types of microorganisms required to effect full treatment, optimal or near-optimal conditions for their existence and reproduction. This can significantly reduce the amount of work and time required for treatment, and can in turn reduce the amount of sludge that must be processed.

Artificial algae exterior view



The first sludge system works with a high load, mostly of bacterial activated sludge. The sedimentation of this type of activated sludge is not always high. Therefore, it is more efficient to settle the activated sludge onto stable artificial algae and fungus. By this process, there is no need to include a sedimentation stage after the primary sludge system.

The specific speed of oxidation of sludge in the first sludge system is about 40mg BOD (1g of raw sludge substance) per liter hour, and wastewater at the outlet of the system has a concentration of organic contaminants on the BOD level of about 40-60 mg/l. Under the three-sludge system, the concentration of organic matter in the wastewater after the first stage of the cleaning system should be adequate for effective denitrification in the next stage of purification.

The second sludge system reduces the concentration of organic substances in wastewater by BPK20 of 15 mg/l, and removes nitrogen by primary denitrification. The primary denitrification tank uses organic substances in the wastewater, so air consumption at this stage in the treatment process is reduced. The second sludge system uses a set of heterotrophic bacterial microorganisms and also copiotrophic bacterial microorganisms that mineralize the activated sludge to some extent. The process operates at low loads of active sludge and is accompanied by nitrification. It demonstrates the sludge functioning in different ways at each stage of the treatment process – which is the fundamental characteristic of the three-sludge system. Therefore, it is necessary to construct two separate reactor sections of second sludge system to operate on the same activated sludge complex for both denitrification and nitrification. Anoxic conditions are necessary for denitrification, so when mixing sludge with air, the concentration of dissolved oxygen should not be greater than 2 mg/l. However, at nitrification, the concentration of dissolved oxygen should not be greater than 4 mg/l. To achieve this balance, air-ball diffusers, located on the bottom of the reactors, provide aeration.

The third sludge system is used when BOD is already low and full treatment can be achieved. The microorganism fermentation in the third sludge stage removes the remaining dissolved organic substances and it provides nitrification and mineralization with fermentation. At this time, residual content of SS of about 3 mg/l, and full BOD of about 2 mg/l can be achieved. In addition, ammonium nitrogen is at about 0.4 mg/l. Phosphate concentration can be reduced with activated sludge floatation.

THE ADVANTAGES AND DISADVANTAGES OF THE THREE SLUDGES SYSTEM

ADVANTAGES OF THE THREE-SLUDGES SYSTEM:

1. It reduces the volume of sludge.
2. It improves the final purification results.
3. It allows the use of automated control systems.
4. It allows not only decreasing the number of independent construction units into one block, but also reduces the overall system volume, reduces the complexity of operation functions, reduces the overall operational costs, but also allowed a modular organization which facilitates adaption of the step feed process.
5. The operation is flexible so it can accommodate variations in flow rates and concentration.

DISADVANTAGES OF THE THREE-SLUDGES SYSTEM:

1. All technology functions are in accommodated in separate tanks, so in comparison with the sequencing batch reactor system, it occupies a larger footprint, as reactors are in sequence and construction extends along the direction of flow.
2. Aeration cannot be managed with time, as is the case with the SDR system. Consequently electricity costs are higher than with the SBR system.

1.2.5 REHABILITATION OF THE EXISTING WWTP

Team for feasibility study considered that lifetime of the most of facilities in the existing WWTP expired and some of them can be applied by rehabilitating. Repairing sedimentation tanks, rebuilding aeration tank, and replacing pump stations, closure and equipment are need to done. Rehabilitation of the existing WWTP is more economical than construction of new WWTP.

Some complication might be arisen during the WWTP rehabilitation. These include:

1. During the reconstruction of currently running units that would be a part of new system
2. Malfunction in wastewater treatment process and additional expense during the rehabilitation
3. Module expansion will be costly
4. Because of existing underground pipelines, freezing and treatment malfunction may occur
5. WWTP operation will be interrupted for certain period of time during the rehabilitation of existing plant.

The existing plant has a high potential of efficient treatment provided that nutrient quality is good. It is uncertain that activated basic sludge system can work without causing operational failures.

Team for feasibility study suggested complete rehabilitation of existing WWTP facilities and technological transfer into activated sludge system (3-sludge system). It concluded that a dry sludge production would be reduced by 1.5 times thanks to the 3-sludge system technology in comparison with the basic activated sludge system.

The project results

Surface and underground water contamination will decrease. Water quality of Kharaa River that is the source of Darkhan city will be conserved.

As a result of consistent cooperation of the project participants during construction work stage and operational stage, these consequences will be achieved. Furthermore project contractors and engineers should meet their activities to standard and proper operation and maintenance should be held after construction.

Technological variations' selection

Since above variations for wastewater treatment, relevant council in the Ministry of Construction and Urban Development hadn't discussed about it, Basic activated sludge system (first variation) has considered as an environmentally harmful and negatively influences on surroundings in construction and operation stages based on the assessment results of Feasibility Study experts. Owing to this, detailed environmental impact assessment was made.

1.3. Project capacity

As yet Darkhan has a separate sewer system – independent networks serve sanitary sewage and surface water. The sewer system of Darkhan conveys wastewater from both old and new Darkhan and the industrial estate to the central WWTP, which lies just to the north (downstream) of old Darkhan and about 500 m from the Kharaa River. The WWTP is about 650 m from the nearest dwelling – which is a ger on a recently issued khasha plot.

The first stage of the CWWTP was built during the construction phase of Darkhan in 1965, adopting Russian design and standards, and initially adopting a process of preliminary treatment followed by primary treatment in two primary clarifiers. In 1990 a major upgrade and expansion of the facilities was completed, with the provision of: (i) new grit channels, (ii) three new primary clarifiers, (iii) secondary biological treatment based on the activated sludge process, (iv) three secondary clarifiers, and (v) effluent chlorination facilities. This mechanical and biological plant had a design capacity of 50,000 cum/day, and was complemented by a series of constructed ponds providing: (i) polishing in maturation ponds, (ii) sludge drying beds, and (iii) sand and grit disposal ponds. The original primary clarifiers were decommissioned once the new plant came on stream. It is unclear whether all three streams of the 1990 plant were ever operated since the flow has seldom exceeded 10,000 cum/day, which is one fifth of the design capacity.

Most elements of the system are now out of commission. Two out of three of the primary clarifiers and two out of three of the secondary clarifiers are no longer used and derelict. Any mechanical equipment from the out-of-commission units has been cannibalized to keep the one remaining unit operational. Despite this, the plant is fully operational, with the exception of the chlorination facility. However, although planned for 50,000 cum per day, the plant is currently operating at a load of about 7,000 cum/day in summer and an average of 10,000 cum/day in winter, with a reported peak flow of less than 20,000 cum/day. Consequently, only one stream (out of three) of both primary and secondary clarifiers is necessary. However, all three streams of the activated sludge biological reactor are operated, resulting in excessively long aeration periods. During the month of August 2013, daily flow rates into the plant varied between 5,100 and 10,900, and averaged 7,100 cum/day¹⁸. The inflow rates are somewhat higher in winter due to the extensive use of hot water in apartments and institutions.

Despite being operational most of the time, the plant is in an advanced state of disrepair. Some of the original pumps are decommissioned and have been cannibalized to provide parts for remaining serviceable pumps. Most of the control equipment are no longer operational, which means that the plant is operating sub-optimally contributing to excessive operational costs and compromising effluent quality. Although most pumps are out of order, the pumping stages in the plant are kept operational by repaired pumps and new pumps brought in to replace those no longer operable. Occasional breakdown and insufficient duty and standby pump capacity causes occasional raw sewage overflow and pollution of the immediately surrounding area.

The operation of the mechanical treatment processes is severely compromised by the failure of the screens that allow bulky debris to enter the system and provide a potential risk to pipes and pumps. The efficiency of the sand and grease trap is doubtful as the intermittent operation of the inlet pumps results in high temporary loads on the sand and grease trap and the primary sedimentation tank – exceeding the capacity of both to do an adequate job.

The primary sedimentation process is sometimes overloaded as only one out of three tanks is operational, and the sedimentation process in the primary sedimentation tank appears insufficient as faeces, paper and other floating debris leave the tank. The biological treatment aeration tank is in a very poor structural condition, with parts of the concrete walls having been eroded away, resulting in very uneven spillover at the overflow weir. Aeration is very intensive, and visual inspections suggest the aeration rate is far too high, negatively impacting on treatment and wasting energy.

In sum, the plant is struggling to keep going, and suffers frequent breakdowns which compromise the treatment efficiency and risk pollution events. In summer and autumn of 2012 regular aeration failures were observed due to the breakdown of the blowers, which on occasion, lasted for more than one week. The repeated blackouts led to a loss of activated sludge and negatively impacted on the treatment efficiency.

1.4. Project duration

1.5. Infrastructure of Project Area

Aimag center- Darkhan city is the largest industrial center of Mongolia. Infrastructure highly developed in Darkhan and International auto road Ulaanbaatar-Altanbulag and international railway junction Ulaanbaatar-Sukhbaatar passes through the territory of Darkhan soum. It is connected to the central energy system and has high-speed coaxial cable, digital radio relay lines and portable communication services. Comparing to other provinces, its regular and reliable public transportation and cost of living are low-priced.

Population

Total population is 91093, of which 74526 live in Darkhan city. 64.5% of the total population are the youth up to 35 years old. In the province there are 24989 households, of which 67.5% live in residential apartment. As administrative unit, it has 4 counties- Darkhan, Orkhon, Khongor and Shariin gol, and 24 baghs.

Education

There are 29 public and private schools of general education in the province, where the number of the schoolchildren is 19813, and 4200 children go to 17 kindergartens. 10 state and private universities and institutes including Mongolian University of Science and Technology, Mongolian State University of Agriculture, Technical Institute, College of science of medicine, Darkhan Institute, where the number of students is 7447 and 2861 students study at vocational schools including Vocational schools and industrial center and Darkhan Urgoo.

Industry

Darkhan-Uul province was established with the status of industrial base city for the purpose of providing construction and raw materials to Mongolia. There are major industries including packinghouse and various factories for food and iron, brick, cement and vegetable oil. For instance: “Darkhan thermal power station”, “Darkhan metallurgic Plant”, “Darkhan Nekhii” and “Erel cement”.

Agriculture

70.7% or 231,7 thousand hectare of total area of Darkhan province occupies agricultural area, of which 81,5% or 188,5 thousand hectare is pasture, 3,9% or 9,1 thousand hectare is hay field and 13,9% or 33,3 thousand hectare is plantation field. The province is located in central area for agriculture and has overall 345,3 head of cattle.

Needs for meat and meat variety products are provided about 90%, flour 100% and vegetable 100% by own production. Based on this, agriculture of the province is the strategically vital field. Nowadays in Darkhan-Uul province, over 90 plants and workshops carry out operation and in which about 750 employees work.

CHAPTER 2. ENVIRONMENTAL BASELINE DATA AND ASSESSMENT OF PROJECT AREA

2.1 Geography

As geography land around Darkhan city belongs to the 14th circle of Darkhan-Tuul subregion of bioclimatical Khangai region. Darkbrown soil, fine brown soil, meadow brown soil, tuffy steppe soil are distributed across the region.

Darkhan city is located in east to the Kharaa river basin where is mixed with steppe and short hills at elevation of 700-850 m above sea level. To the northwest of Khentii mountain ranges there are southwestern low hills and ridges of Tsaidam mountain ranges and wide valleys between mountains among the Kharaa and Shar river. The highest mountains are Ugluu (1314m) and Tsogt Undur (1214m). Plan and mountainside neighbour with valleys of Kharaa, Shar and Bayan river. Nearby Darkhan city Kharaa river basin is about 3 km and width of confluence into Orkhon river reaches 8-10 km.

2.2. Baseline indicators of climate and meteorology

2.2.1. Climate indicators

Records issued by Darkhan station were used for the climate study of the Project region. Near Darkhan has a continental dominated tough climate. Daily and annual climate indications are basically symmetrical /Figure 9/.

Daily and annual air mean temperature

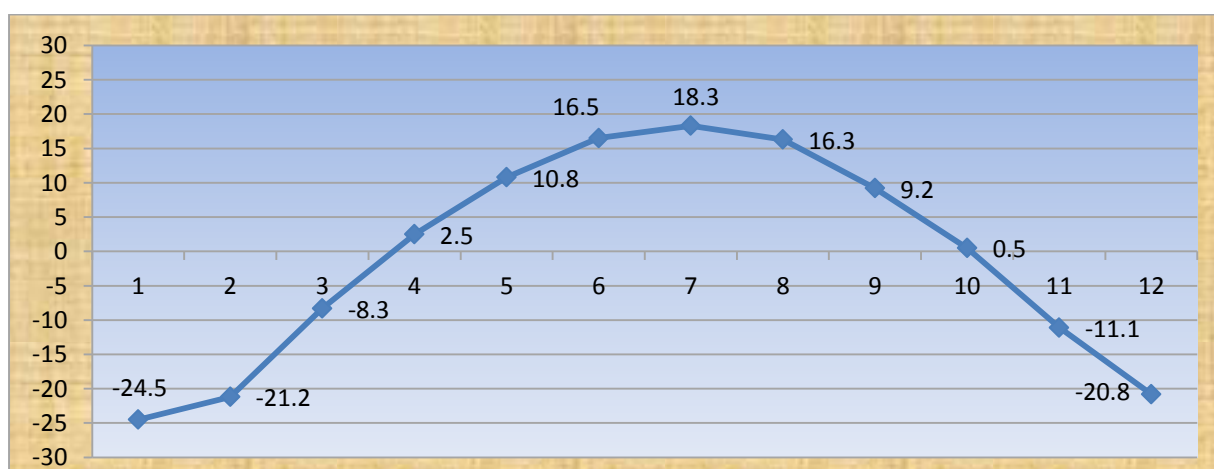


Figure 9 Air temperature near Darkhan County

Background climate context of the Project area belongs to Khentii mountain ranges and climate indications that originate from earth surface state were considered to character the climate of the Project.

Records of air temperature, pressure, sunshine, precipitation, wind speed and direction used /Table 1/.

Table 1 Multi year average climate indicators

Months	Air temperature (°C)			Precipitation /mm/	
	Monthly mean	Absolute maximum	Absolute minimum	Monthly mean	Daily maximum average
I	-24.5	1.9	-45.7	4.1	10.2
II	-21.2	7.8	-43.7	3.1	12.1
III	-8.3	20.6	-37.7	4.1	12.3
IV	2.5	29.8	-23.1	9.0	12.6
V	10.8	36.0	-9.8	25.8	25.8
VI	16.5	37.0	-6.7	54.7	57.4
VII	18.3	38.8	-8.7	82.7	76.6
VIII	16.3	36.4	-2.3	76.1	43.4
IX	9.2	30.1	-10.2	38.0	34.8
X	0.5	27.0	-24.5	11.1	22.8
XI	-11.1	14.1	-37.4	6.0	17.7
XII	-20.8	8.4	-42.8	4.9	6.0
Annual mean	-1.0	38.8	-45.7	319.6	76.6

Based on the table, it is warm in altitude in cold seasons and cold in lowland, contrary to it, daily air temperature varieties in warm season.

The long lasting mean temperature generally shows the highest air temperature is 38-40 degree Celsius (°C) and the lowest air temperature is -45-47°C. For instance, the maximum mean daily temperature of 43°C that hadn't occurred in last 60 years was recorded in July 1999 near Darkhan-Uul province.

2.2.2. Precipitation

The precipitation and humidity are purified surroundings and defined the surface water and underground water. The Project area receives about 320.00 mm precipitations throughout the year, of which over 90% occurs only around summer months.

41 rainy days and 8 gracious rainy days with hail at the mean throughout the year of which maximum 76 mm or 90% of all precipitation falls in July /Figure 10/.

Daily and annual mean precipitation /mm/

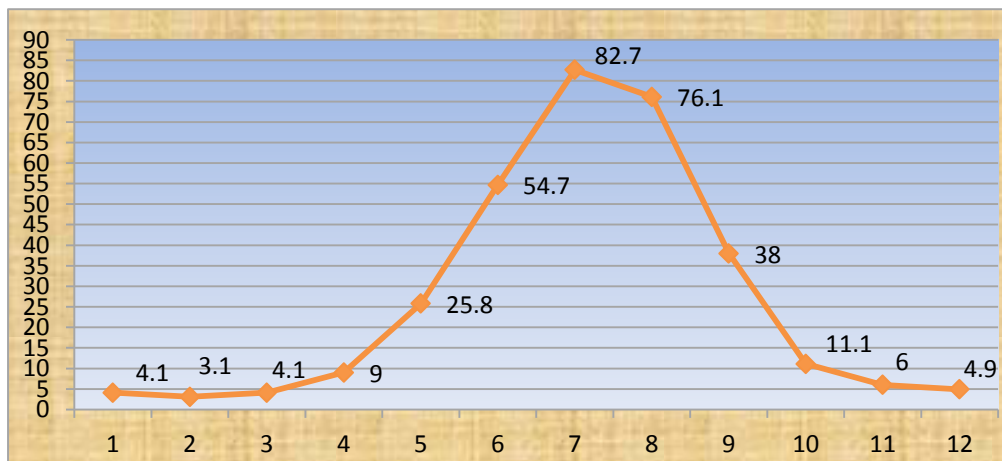


Figure 10 Precipitation near Darkhan County

Relative air humidity of the area is annually 66% and it shows near Darkhan county is one of the humid areas in Mongolia. Maximum relative humidity is 72-78% in winter months, 56-66% in summer months and 39.8-49% in spring.

Relative air humidity near Darkhan city is 65% at the mean. Maximum relative air humidity occurs in winter months with 70-80%, 35-45% in spring months, 55-65% in summer months and 40-49% in autumn months.

Snow

Snow permanently covers over 150 days from October through April in every year mainly with 7-10 cm thick and the thickest snow reaches 25-40 cm. Per a day 3-5 mm snow falls with $0.13-0.30 \text{ gr/cm}^3$ density on average and about 20-38 mm with water resource.

Because snow is generally not much, snow on the earth surface is $0.13-0.30 \text{ gr/cm}^3$ or 70 kg/m^2 and contains 20-38 mm water resource. While starting to melt snow or ice in the spring, spring flood might be happened.

2.2.3. Air pressure, humidity and wind

Depending upon the air pressure, medium adaptation varies. Air pressure variation in each days drastic changes originated from climate is 8 hectopascal /Figure 11/.

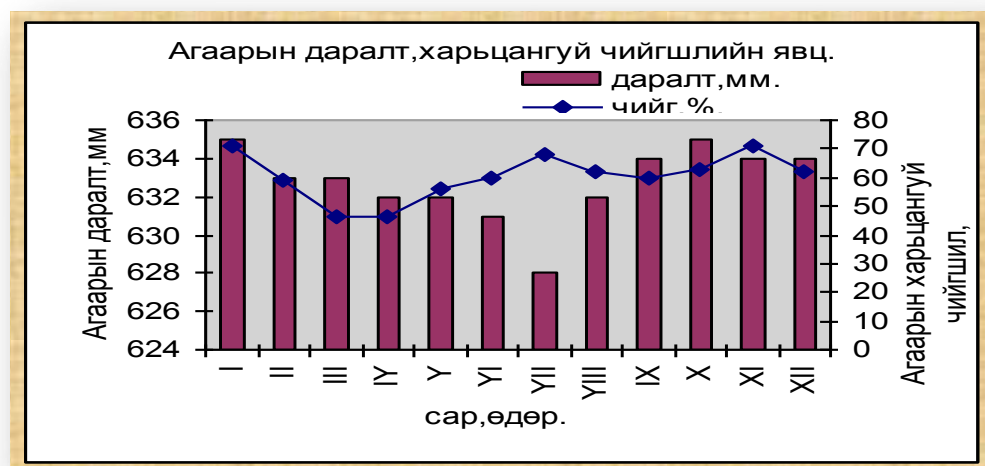


Figure 11 Gradient of air pressure and humidity

Air humidity. Air humidity reaches 65% on average per annum but it is 45-55% in spring, and the minimum of the air humidity is 30%. Also it might to be decreased. In winter months the air humidity reaches 75-77% and the second increase of the humidity (68%) occurs in rainy season. At daybreak maximum humidity and dew falls in 30-40 mornings in summer months.

Water vapor in the air or relative humidity is 4.5 hectopascal throughout the year on the average, 0.7-1.2 hectopascal in winter months and 8.9-12.1 hectopascal in summer months tracking daily and annual air temperature.

Wind and its speed: On the basis of result of 30 years' study, predominant direction of wind is north. At the multiyear mean wind from south and north direction is 24-36 times whereas wind from south and north direction was noticed with 12-23 excess days in 2013. Generally average wind speed is 3,4 m/sec, but it was lower by 2,1 m/sec in this year.

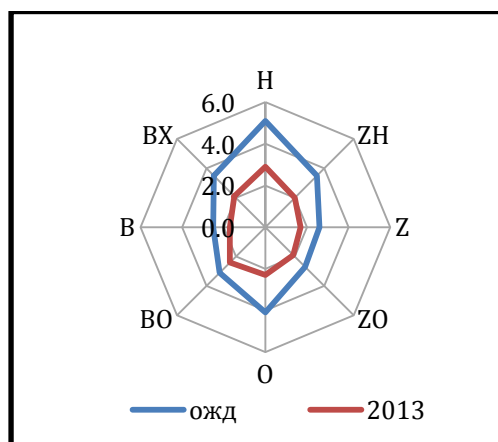


Figure 12 Speed comparison of wind frequency

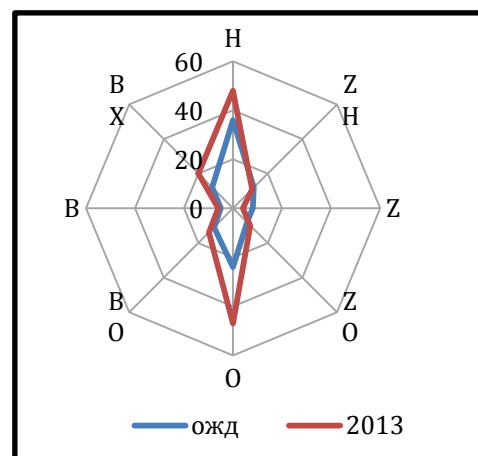


Figure 13 mean comparisons on wind direction

The maximum wind speed for multiyear occurred in January, 1998 with 24 m/sec, February, 1992 with 25 m/sec, March 1989 with 25 m/sec, April, 1992 with 30 m/sec, May, 1987 with 32 m/sec, June, 1985 with 30 m/sec, July, 1995 with 25 m/sec, August, 1996 with 30 m/sec, September, 1989 with 26 m/sec, October, 1991 with 30 m/sec, November, 2003 with 20 m/sec and December, 1989 with 25 m/sec.

The maximum wind speed reached 20 m/sec in May and October 2013.

60.8% of year period is windless and calm day and wind speed is commonly 3-5 m/sec. Every so often it reaches 15-25 m/sec and sometimes reaches 28-32 m/sec.

Usually it is calm and gentle at nights and wind has specific speed during the day.

2.2.4. Seasonal climate variations

Start and end date, and duration of 4 seasons compared considering climate conditions in seasons' differences /Table 2/.

Table 2 Seasonal climate variations and duration

Season	Start	End	Day
Winter	27.X	29.III	153
Spring	29.III	17.Y	49
Summer	17.Y	7.IX	113
Autumn	7.IX	27.X	50

Spring and autumn duration are almost equal by seasonal climate conditions, but winter duration is comparatively longer or it is a month and 10 days longer than the summer. It indicates a continental harsh climate. Season period ranges in 3-5 days depending on particular features for climate /Figure 14/.

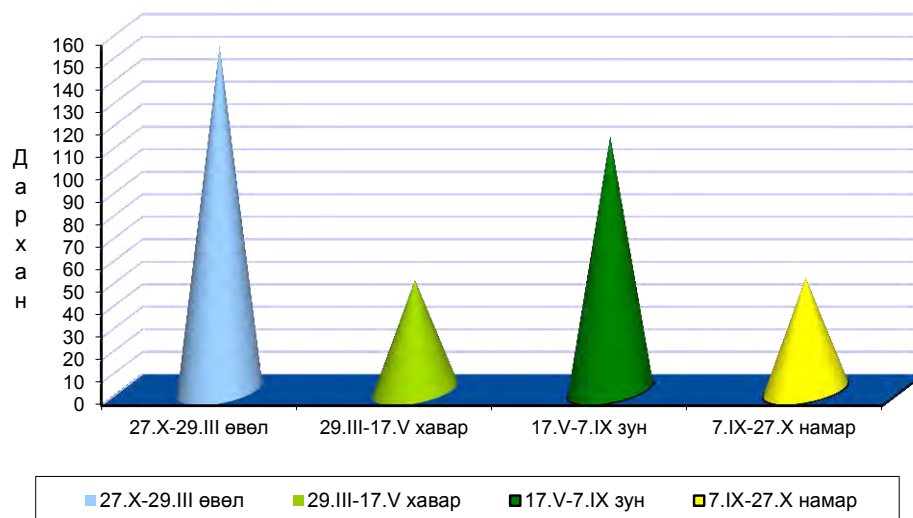


Figure 14 Seasonal climate variations

Winter. Winter starts in the 27th of October till to the 29th of March next year and continues 153 days. It is longer than mean period of the country. The main characteristics of winter are that weather is calm and gentle, heat of the sun becomes the lowest, warmth of sun reflection decreases, snow cover thickens and snow-wreath occurs. In some instances cold becomes strong and comes up to -47⁰ C.

Spring. Spring season starts from the end of winter to the 17th of May at the mean and lasts for 49 days. The specifics of spring are that anti cyclonic formation for winter climate breaks; weather becomes variable and warm day by day, but temperature amplitude and weather severity grows comparing to other seasons, in particular in the beginning of spring it is cold and frosty.

Summer. Summer reason relatively continues longer for warm feature. Summer starts from the 17th of May through the 7th of September and lasts for 113 days. Low-pressure air forms in summer and falls about 75% of overall precipitation, and increases the moisture. Sometimes it becomes flooded due to gracious rain and the water flood might impact to the roadbed, bridge and passage. Also, overheat occurs and reaches +38⁰C and +65⁰C in ground surface. Natural disasters including weltering heat, intense rain, thunder and lightning, and flood happens at times.

Autumn. Autumn starts from end of the summer through beginning of winter (7.IX-27.X) and lasts for 50 days. The main specifics of autumn are that it becomes cooler day-by-day, dew and frost fall, starts snowing at the end of autumn, goes down the precipitation, freezes ground surface and shortens day-time.

2.2.4. Seasonal climate variations

In winter months average temperature is -18-20 degrees around Project area, the warmest month July with 30 degree, and 14 degree in other months. Annual mean amplitude reaches 33 degree.

Even though daily and monthly mean amplitude increases during spring and autumn, and falls during winter and summer, it is higher than other countries with mild climate. Daily mean amplitude is 14-15 degree or 37-39 degree in absolute meaning.

The lowest absolute temperature is 0 in July and (-4)-(-48) in other months. The highest absolute temperature reaches in December and January (-1.3)-(-3.8) in some years and 7.7-38 degree in other months with 86 degree of absolute amplitude.

2.2.6. Solar radiation

The radiance of the sun, lightness and cloudiness depend upon sun altitude angle, overall sun ray reaches 4390 mJ/m^2 and straight sun ray reaches 2676 mJ/m^2 respectively. Sun radiates greatly in May and June when sun altitude angle is high and cloudiness is minor, and it radiates slightly in December or winter months when sun altitude angle is low.

Annual solar radiation is 2733 hours that occupies 60% in potential period. Solar radiation declines regarding to surrounding mountains, sun path overshadowing in the morning and evening, urban cloudiness, air pollution and urban weather. Sun lightness has extremely specific gradient during bright and clear days. Sun radiates about 7-8 hours on an average per a day and it varies in terms of cloudiness. However, it lights 8.5-9.5 hours in summer and shortens and lights 5-6.5 hours in winter.

2.3. Earth surface and underground

The wastewater treatment plant is located in mound of Kharaa river. Here alluvial sediments distributed and covered with fine sand, sandy and clay originated from deluvial-proluvial period.

Sewerage and drainage pipelines, well, faeces transmission plant and water distribution points are located at sediments originated from deluvial-proluvial, eluvial and eol period. Deluvial-proluvial period sediments are almost distributed in all area and consists of sand and sandy thin layers. Sand thickness reach 0.2-0.4 m near industrial region, and 5.2 m in some area. The sand is dusty and has medium density with moisture. Sandy soil has fine particles with some carbonate and its thickness is more than 10m.

Eluvial sediments are dense gravel with low moisture. Its thickness is 0.50-2.20 m. Eol sediments are distributed near biopond. It has fine dusty particles with 10-15m thick and occurs in sandy hills.

In this region physical and geological events were intensively arisen. Events and phenomena like sediment accumulation, cold originated hill, river erosion, flood, marsh, physical weathering and outgush occur.

2.4. Air quality

Meteorological Office Darkhan 01 in Darkhan county and Meteorological Office Shariin gol 02 has undertaken air quality survey under the guidance since 1989. In September 2013 Meteorological Office Darkhan 03 was established /by local budget to monitor industrial estate and new Darkhan/. Comparing to Mongolian other cities Darkhan city is high for pollution level in nitrogen dioxide and sulphur dioxide in air.

Vocational sector for air quality have been working by forming the monitoring system since 2007. Within the framework of this, Environmental Testing Laboratory of Office of Hydrology and Meteorology is constantly monitoring common ambient pollutants to air and environmental pollution including SO₂ /sulfur dioxide/, NO₂ /nitrogen dioxide/, CO /carbon monoxide/, coarse dust, and changes in radiation level.

Main causes of air pollution increase in Darkhan-Uul province:

- As geographic location, Darkhan-Uul province is located at low ground near river valley and ground surface is extremely cold in winter season. Inverse temperature phase that the more elevated, the warmer consists. Thus, air circulating weakens and polluted air has long term of existing.
- As pollution source, low resource impacts are dominant. For instance: smoke from ger district area, vehicle exhausts, petrol station, industrial steam boiler, low pressure boiler and dust and waste from eroded area.

Air quality survey

Meteorological Office issued monitoring results of air quality for last 13 years in Darkhan county, Darkhan-Uul province in annual average.

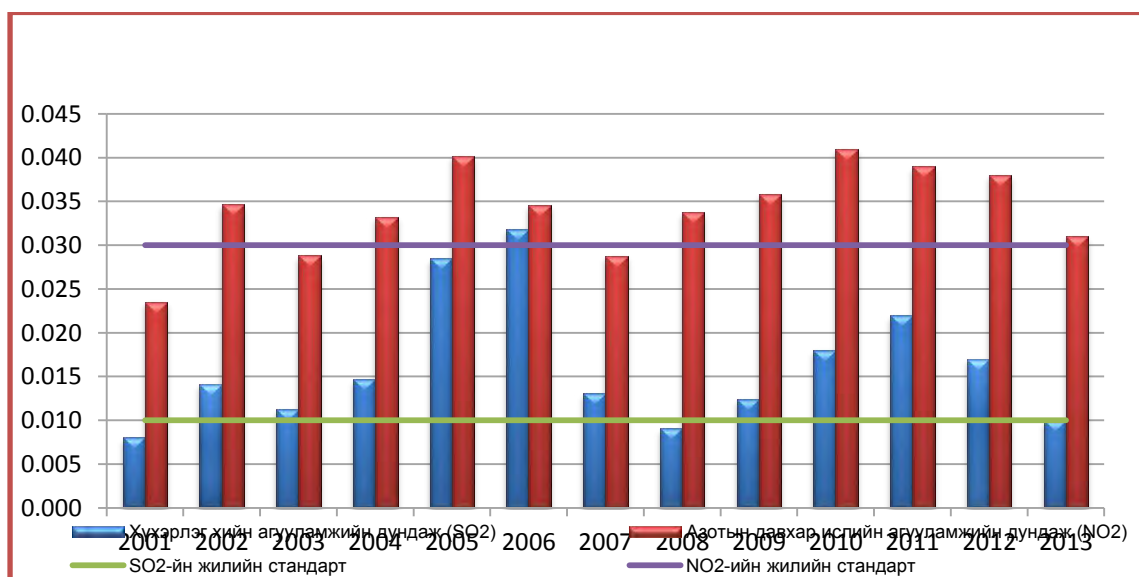


Figure 15 Annual mean content of SO₂, NO₂ in air /2000-2013/

As general approach for sulfur dioxide (SO₂), nitrogen dioxide (NO₂) in the air, number of ger district area with ordinary firing, automobiles, and small boilers and air pollution in cold season are relatively increasing in the province. Sulfur dioxide rised 3-5 times in winter and instances that of nitrogen dioxide increase are growing beyond “National Air Quality Standard”. In 2006, the highest increase of sulfur dioxide reached 0.032 mg/m³ and nitrogen dioxide reached 0.041 mg/m³. As well instances that of dust in the air are growing beyond the standard in recent years.



Figure 16 New Darkhan /2013.02.13/- when most polluted



Figure 17 Old Darkhan /Morning heating at the peak/

By the end of 2013 or currently: Sulfur dioxide, nitrogen dioxide, and dust are being measured daily twice near old Darkhan where the project to be implemented.

Mean sulfur dioxide reaches 0.008 mg/m^3 and the maximum sulfur dioxide 0.125 mg/m^3 , and it was up to acceptable level/ (average of 20 minutes, 450 mkg/m^3).

Mean nitrogen dioxides reaches 0.030 mg/m^3 and the maximum nitrogen dioxide 0.095 mg/m^3 , and it was contaminated exceeding 14 times out of acceptable level.

Mean content of large particle dust reaches 0.189 mg/m^3 , the maximum volume- 2.460 mg/m^3 exceeded 3 times out of annual mean volume. And Carbon monoxide CO is in allowed limit.

The total dust volume has been determined in time mode using automatic analyzer. The survey result shows that the dust volume increases in cold seasons and the maximum monthly mean volume (2006-2009) reaches 543 mg/m^3 that exceeded by 3.62 times out of allowed limit (average of 24 hours, 150 mg/m^3).

The mean volume of carbon monoxide is $100\text{-}5120 \text{ mg/m}^3$, the maximum volume reaches 5120 mg/m^3 near main office /Office of Hydrology and Meteorology/ and the carbon monoxide didn't exceed out of allowed limit (average of 30 minutes, 6000 mg/m^3). The highest pollution occurred around 17pm, 20pm and 23pm.

In 2013 pollution decreased in factor changes including mean air temperature in cold season (XI-II month) became warmer by $0.7\text{-}0.9^\circ\text{C}$ than multi year average relating to global warming and air flow is instable or frequency of wind speed that can scatter the pollution was higher than the multi year average as mind speed. /Before 16 December 2013 the weather was very warm and overall frequency number of wind was more than 26 cases comparing to previous year.

Table 3 The number of exceedances of nitrogen dioxide

Year	Case number of nitrogen dioxide exceeded standard in one time sampling /the average of 20 minutes, 85 mkg/m^3 /
2008	14
2009	22
2010	53
2011	43
2012	38
2013	14

In every year in the province, content of sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) in the air increased due to grow ger district area, automachine and small boilers, and overpressure. Air pollution increased and nitrogen dioxide (NO_2) is exceeding out of allowed limit as a general trend.

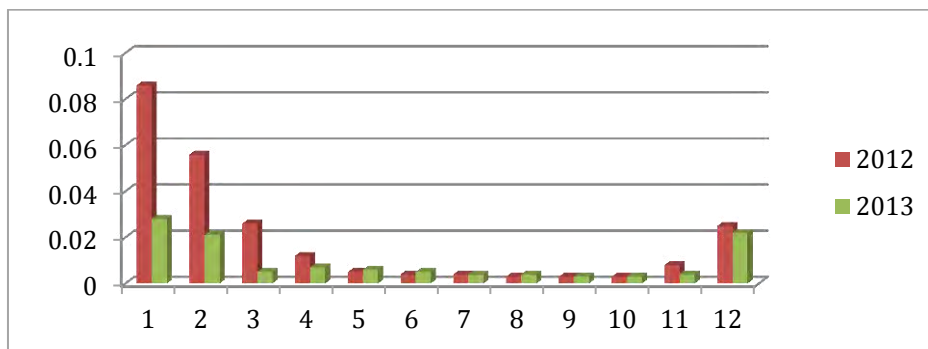


Figure 18 Monthly mean gradient of SO₂ in the air /2011-2013/

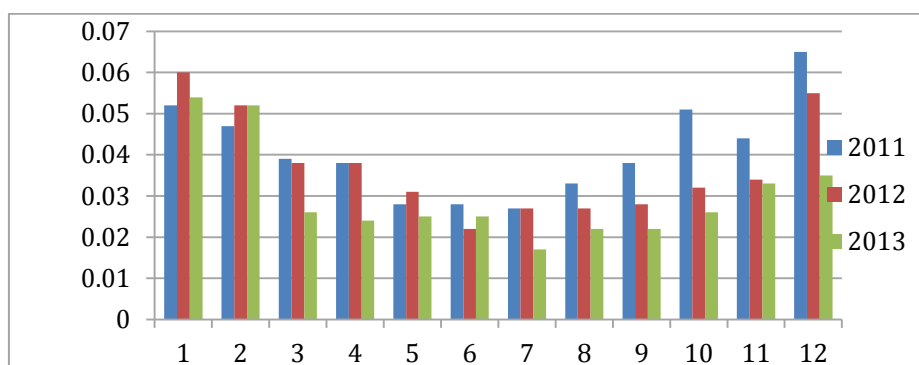


Figure 19 Monthly mean gradient of NO₂ in the air /2011-2013/

Field survey is being permanently taken near the project area and Tosgon that is located in west in winter when contamination can possibly influence on the air quality.

By the test result, sulfur dioxide (SO₂) was higher than other micro districts including Mangirt, but its acceptable level (the average of 20 minutes, 20 mkg/ m³) didn't exceed. And it reached 38mkg/ m³ in the average of 24 hours, found 1.9 times more pollution and nitrogen dioxide contamination exceeded in 1.2 in a single sampling. /2013.II.19/ It is related to ger district area that centralized by southwest near Project area.

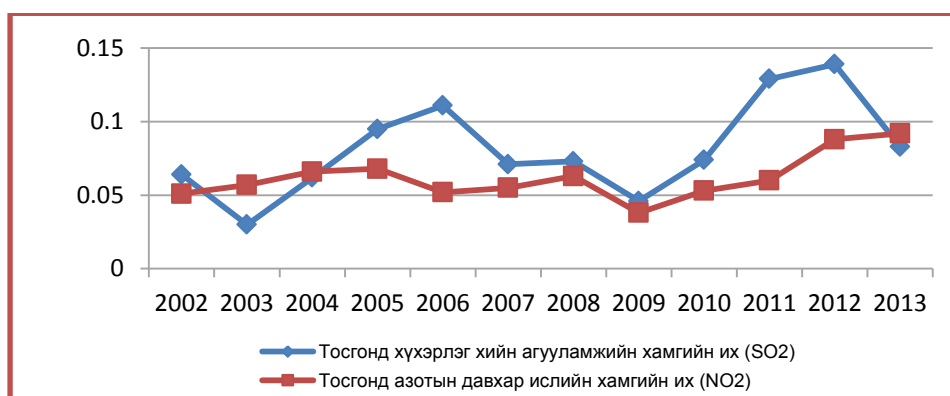


Figure 20 The maximum content of sulfur dioxide and nitrogen dioxide nearby Tosgon /2002-2013/

2.5. Soil quality

The soil cover of Darkhan-Uul province consists from mountain- meadow soil, mountain turf soil, mountain darkbrown soil, and hills, plain and river darkbrown soil /Mongolian National Atlas/.

Soil sampling of the project area was defined in Soil analysis laboratory of the Institute of Geography, Academy of Science as following:

- Humus - By Tyuriny
- Reaction medium - Potentiometric
- Carbonate - Volume
- Electrical conductivity - Ionomer
- Mobile phosphorus - Machigin
- Mobile calcium – Blaze photometric
- Mechanic composition - hydrometric
- Heavy metals - Blaze photometric

Soil along the Kharaa River. Nearby the Darkhan city, east bank of Kharaa river is wider by 2-3 km with 3-5m high platform. The platform center is even and has slightly convex. Along the river bank there are willows and meadow with cyperales grass, meadow with laminated grass are distributed in other parts of river.

Sewage networks, 18 groundwater wells that provide fresh water with Darkhan city (in the southwest of the city, northward of Kharaa river bridge), waste water treatment plant, and treated water disposal pipes (in the north of city) are located alongside of Kharaa River.

2.5.1. Record of soil outlook (morphology)

Samples were taken from 6 points by overall 6 sections in order to analyze soil characteristic on the 27th of February, 2014 and. Besides observations for morphology of these points and surface, we designed and marked the sampling points by GPS.

Section WWTP-1. The sample was taken from river bank in the southwestern side where effluent water comes into the river from WWTP.

Vegetation 15-20%.

Soil sampling location (coordinate)

49°30'31. 2"N 105°54'11.2"E
h-680



0-5cm. It is sandy brown coloured soil with slight moisture content, dense consistency, mechanic composition of sand and no carbonate, and covered with stones.

Soil name: Alluvial soil

Its humus content is 2.073% in the depth of 0-5cm. According to the result of analysis, soli reaction medium

(pH) is 8.73 or with medium alkaline. Mobile calcium is (K_2O) 16.2 mg/100gr that is higher than allowed limit. The layer has mobile phosphorus of (P_2O_5) 1.85 mg/100gr that is below the allowed limit. No carbonate. Easily dissolved salt content is 0.628 dS/m (Table 4).

Table 4 Chemical characteristic of soil

Section number	Coordinate	pH _{H₂O} (1:2.5)	CaCO ₃ %	Humus %	EC _{2.5} dS/m	Mobility, mg/100gr	
						P ₂ O ₅	K ₂ O
WWTP-1 River bank	49°30'31.3	8.73	0.00	2.073	0.628	1.8	16.2
	105°54'11.5					5	

Soil mechanic composition is sandy. Comparing to the mechanic composition of clay and slightly clay, mechanic composition of sandy often causes the water and wind erosion or is easily predisposed to water and wind. In the depth of 0-5cm, sand is 55.7%, dust 37.6% and clay 6.7%.

Table 5 Soil mechanic composition

Section number	Coordinate	Particle size, % (mm)			Soil mechanic composition
		Sand (2-0.05mm)	Dust (0.05-0.002mm)	Clay (<0.002mm)	
WWTP-1. River bank	49°30'31.3	55.7	37.6	6.7	Sandy
	105°54'11.5				

Heavy metals' content in the soil are in acceptable norm including chromium (Cr 15.5 mg/kg), lead (Pb 20.1 mg/kg), cadmium (Cd 0.23 mg/kg), nickel (Ni 7.1 mg/kg) and zinc (Zn 187.8 mg/kg).

Table 6 Heavy metall content in soil

Section number	Coordinate	Heavy metall content mg/kg				
		Cr	Pb	Cd	Ni	Zn
WWTP-1. River bank	49°30'31.3	15.5	20.1	0.23	7.1	187.8
	105°54'11.5					
Standard (MNS 5850 : 2008)		150	100	3	150	300

Section WWTP-2. The sample was taken from river bank sediment in the southwestern side where effluent water comes into the river from WWTP.

Soil sampling location (coordinate)

49°30'31.3"N 105°54'11.5"E
h-680



0-5cm. It is sandy brown coloured soil with slight moisture content, dense consistency, mechanic composition of sand and no carbonate, and covered with stones.

Soil name: Alluvial soil

Its humus content is 0.310% in the depth of 0-5cm. According to the result of analysis,

soil reaction medium (pH) is 8.60 or with medium alkaline. Mobile calcium is (K_2O) 7.2 mg/100gr that is higher than allowed limit. The layer has mobile phosphorus of (P_2O_5) 0.14 mg/100gr that is below the allowed limit. No carbonate. Easily dissolved salt content is 0.230 dS/m (Table 7).

Table 7 Chemical characteristic of soil

Section number	Coordinate	pH _{H₂O} (1:2.5)	CaCO ₃ %	Humus %	EC _{2.5} dS/m	Mobility, mg/100gr	
						P ₂ O ₅	K ₂ O
WWTP-2. River sediment	49°30'31.2	8.60	0.00	0.310	0.230	0.14	7.2
	105°54'11.2						

Soil mechanic composition is sandy. Comparing to the mechanic composition of clay and slightly clay, mechanic composition of sandy often causes the water and wind erosion or is easily predisposed to water and wind. In the depth of 0-5cm, sand is 74.7%, dust 20.3% and clay 4.9%.

Table 8 Soil mechanic composition

Section number	Coordinate	Particle size, % (mm)			Soil mechanic composition
		Sand (2- 0.05mm)	Dust (0.05- 0.002mm)	Clay (< 0.002mm)	
WWTP-2. River sediment	49°30'31.2	74.7	20.3	4.9	Sandy
	105°54'11.2				

Heavy metals' content in the soil are in acceptable norm including chromium (Cr 7.9 mg/kg), lead (Pb 5.5 mg/kg), cadmium (Cd 0.04 mg/kg), nickel (Ni 4.7 mg/kg) and zinc (Zn 23.5 mg/kg).

Table 9 Heavy metal content in soil

Section number	Coordinate	Heavy metal content mg/kg				
		Cr	Pb	Cd	Cr	Zn
WWTP-2. River sediment	49°30'31.2	7.9	5.5	0.04	4.7	23.5
	105°54'11.2					
Standard (MNS 5850 : 2008)		150	100	3	150	300

Section WWTP-3. The sample was taken from the area where to be built the extension in the southwest of WWTP.

Vegetation 75-80%.

Soil sampling location (coordinate)

49°30'24.3"N 105°55'28"E
h-679



0-5cm. It is sandy brown coloured soil with slight moisture content, dense consistency, mechanic composition of slight clay and no carbonate, and covered with stones.

Soil name: Sandy darkbrown soil

Its humus content is 6.537% in the depth of 0-5cm. According to the result of analysis, soli reaction medium (pH) is 8.40 or with medium alkaline. Mobile calcium is (K_2O) 3.14 mg/100gr that is higher than allowed limit. The layer has mobile phosphorus of (P_2O_5) 2.38 mg/100gr which is below the allowed limit. No carbonate. Easily dissolved salt content is 2.512 dS/m (Table 10).

Table 10 Chemical characteristic of soil

Section number	Coordinate	pHH ₂ O (1:2.5)	CaCO ₃ %	Humus %	EC _{2.5} dS/m	Mobility, mr/100r	
						P ₂ O ₅	K ₂ O
WWTP-3. Project area	49°30'24.3	8.40	0.00	6.537	2.512	2.38	31.4
	105°55'28						

Soil mechanic composition is muddy. Mechanic composition of clay and mud is less predisposed to water and wind than the mechanic composition of sand. In the depth of 0-5cm, sand is 26.4%, dust 56.3% and clay 17.2%.

Table 11 Chemical composition of soil

Section umber	Coordinate	Particle size, % (mm)			Mechanic composition of soil
		Sand (2- 0.05mm)	Dust (0.05- 0.002mm)	Clay (< 0.002mm)	
WWTP-5. Project area	49°30'24.3	26.4	56.3	17.2	Slightly muddy
	105°55'28				

Heavy metals' content in the soil are in acceptable norm including chromium (Cr 21.7 mg/kg), lead (Pb 18.7 mg/kg), cadmium (Cd 0.08 mg/kg), nickel (Ni 150mg/kg) and zinc (Zn 200.6 mg/kg).

Table 12 Heavy metall content in the soil

Section umber	Coordinate	Heavy metall content mg/kg				
		Cr	Pb	Cd	Ni	Zn
WWTP-3. Project area	49°30'24.3	21.7	18.7	0.08	21.5	200.6
	105°55'28					
Standard (MNS 5850 : 2008)		150	100	3	150	300

Section WWTP-4. The sample was taken from area of WWTP.

Vegetation 20-30%.

Soil sampling location (coordinate)

49°30'28.3"N 105°55'31.3"E

h-685



0-5cm. It is sandy brown coloured soil with slight moisture content, dense consistency, mechanic composition of slight clay and no carbonate, and covered with stones.

Soil name: Sandy darkbrown soil

Its humus content is 2.488% in the depth of 0-5cm. According to the result of analysis, soli reaction medium (pH) is 8.73 or with medium alkaline. Mobile calcium is (K_2O) 16.2 mg/100gr that is higher than allowed limit. The layer has mobile phosphorus of (P_2O_5) 1.954 mg/100gr which is below the allowed limit. No carbonate. Easily dissolved salt content is 0.195 dS/m (Table 13).

Table 13 Chemical characteristic of soil

Section number	Coordinate	pHH ₂ O (1:2.5)	CaCO ₃ %	Humus %	EC _{2.5} dS/m	Mobility, mg/100gr	
						P ₂ O ₅	K ₂ O
WWTP-4. WWTP area	49°30'28.3	8.36	0.00	2.488	0.195	1.954	16.2
	105°55'31.3						

Soil mechanic composition is muddy. Mechanic composition of clay and mud is less predisposed to water and wind than the mechanic composition of sand. In the depth of 0-5cm, sand is 30.8%, dust 53.3% and clay 15.9%.

Table 14 Chemical composition of soil

Section number	Coordinate	Particle size, % (mm)			Chemical composition of soil
		Sand (2- 0.05mm)	Dust (0.05- 0.002mm)	Clay (< 0.002mm)	
WWTP-4. WWTP area	49°30'28.3	30.8	53.3	15.9	Slightly muddy
	105°55'31.3				

Heavy metals' content in the soil are in acceptable norm including chromium (Cr 73.9 mg/kg), lead (Pb 12.3 mg/kg), cadmium (Cd 0.05 mg/kg), nickel (Ni 12.9 mg/kg) and zinc (Zn 94.8 mg/kg).

Table 15 Heavy metal content in the soil

Section number	Coordinate	Heavy metall content mg/kg				
		Cr	Pb	Cd	Ni	Zn
WWTP-4. WWTP area	49°30'28.3	73.9	12.3	0.05	12.9	94.8
	105°55'31.3					
Standard (MNS 5850 : 2008)		150	100	3	150	300

Section WWTP-5. The sample was taken from sludge area to the northe of WWTP. Vegetation is 80-90%.

Soil sampling location (coordinate)

49°30'33.1"N 105°55'36.9"E
h-680



0-5cm. It is brown coloured soil with slight moisture content, mechanic composition of clay and no carbonate, and covered with stones.

Soil name: Sandy darkbrown soil

Its humus content is 6.688% in the depth of 0-5cm. According to the result of analysis, soli reaction medium (pH) is 8.73 or with low alkaline. Mobile calcium is (K_2O) 42.7 mg/100gr that is higher than allowed limit. The layer has mobile phosphorus of (P_2O_5) 4.26 mg/100gr which is below the allowed limit. No carbonate. Easily dissolved salt content is 0.399 dS/m (Table 16).

Table 16 Chemical characteristic of soil

Section number	Coordinate	pHH ₂ O (1:2.5)	CaCO ₃ %	Humus %	EC _{2.5} dS/m	Mobility, mg/100gr	
						P ₂ O ₅	K ₂ O
WWTP-5. Sludge pond	49°30'33.1 105°55'36.9	7.59	0.00	6.688	0.399	4.26	42.7

Soil mechanic composition is muddy. Mechanic composition of clay and mud is less predisposed to water and wind than the mechanic composition of sand. In the depth of 0-5cm, sand is 52.8%, dust 37.0% and clay 10.2%.

Table 17 Chemical composition of soil

Section number	Coordinate	Particle size, % (mm)			Chemical composition of soil
		Sand (2- 0.05mm)	Dust (0.05- 0.002mm)	Clay (< 0.002mm)	
WWTP-5. Sludge pond	49°30'33.1 105°55'36.9	52.8	37.0	10.2	Muddy

Heavy metall's content in the soil are in acceptable norm including chromium (Cr 60.3 mg\kg), lead (Pb 63.8 mg\kg), cadmium (Cd 0.11 mg\kg), nickel (Ni 8.1 mg\kg) and zinc (Zn 192.7 mg\kg).

Table 18 Heavy metall content in the soil

Section number	Coordinate	Hevay metall content mg\kg				
		Cr	Pb	Cd	Ni	Zn
WWTP-5. Sludge pond	49°30'33.1 105°55'36.9	60.3	63.8	0.11	8.1	192.7
Standard (MNS 5850 : 2008)		150	100	3	150	300

Section WWTP-6. In order to compare results of other sample, the sample was taken from mountain slope to the east of WWTP. Vegetation is 80-90%.

Soil sampling location (coordinate)

49°30'22.9"N 105°56'02"E

h- 741



0-5cm. It is sandy brown coloured soil with slight moisture content, dense consistency, mechanic composition of sand and no carbonate, and covered with stones.

Soil name: Darkbrown soil

Its humus content is 2.270% in the depth of 0-5cm. According to the result of analysis, soli reaction medium (pH) is 7.95 or with low alkaline. Mobile calcium is (K_2O) 30.8 mg/100gr that is higher than allowed limit. The layer has mobile phosphorus of (P_2O_5) 1.86 mg/100gr which is below the allowed limit. No carbonate. Easily dissolved salt content is 0.840 dS/m (Table 19).

Table 19 Chemical characteristic of soil

Section number	Coordinate	pHH ₂ O (1:2.5)	CaCO ₃ %	Humus %	EC _{2.5} dS/m	Mobility, mg/100gr	
						P ₂ O ₅	K ₂ O
WWTP-6. Mountain slope	49°30'22.9	7.95	12.72	2.270	0.840	1.86	30.8
	105°56'02						

Soil mechanic composition is muddy. Mechanic composition of clay and mud is less predisposed to water and wind than the mechanic composition of sand. In the depth of 0-5cm, sand is 33.8%, dust 50.6% and clay 15.3%.

Table 20 Mechanic composition of soil

Section number	Coordinate	Particle size, % (mm)			Mechanic composition of soil
		Sand (2- 0.05mm)	Dust (0.05- 0.002mm)	Clay (< 0.002mm)	
WWTP-6. Mountain slope	49°30'22.9	33.8	50.6	15.3	Slightly clay
	105°56'02				

Heavy metals' content in the soil are in acceptable norm including chromium (Cr 16.9 mg/kg), lead (Pb 15.2 mg/kg), cadmium (Cd 0.07 mg/kg), nickel (Ni 10.6 mg/kg) and zinc (Zn 68.5 mg/kg).

Table 21 Heavy metall content in the soil

Section number	Coordinate	Heavy metall content mg/kg				
		Cr	Pb	Cd	Ni	Zn
WWTP-6. Mountain slope	49°30'22.9	16.9	15.2	0.07	10.6	68.5
	105°56'02					
Standard (MNS 5850 : 2008)		150	100	3	150	300

2.6. Surface and underground water

2.6.1. Surface water

Kharaa River is direct and indirect source for water supply in great population city of Darkhan. There are various importance such as the river is provider for ground water wells because river water has hydrological links with main sources of fresh water – ground water wells besides direct apply for river water. Therefore it would be necessary to contextualize the river with any industrial process and water usage in Darkhan city. Around wastewater treatment plant in Darkhan soum, Darkhan province there is no spring and Kharaa River flows in near distance – 500 meters from WWTP. The river belongs to Arctic Ocean basin /Figure 24/.



Figure 21 Arctic Ocean basin, 2- Pacific Ocean, 3- Төв Азийн гадагш урсацгүй ай сав

Bayangol which effluents from southeast mountains of Khentii mountain ranges is Kharaa river water head, flows in Sognogor river or river mouth into Sognogor river is called Kharaa river. It has pure water and constant current, and belongs to region that its multi year surface run-off is more than 100 mm. During spring flood and summer rainy term springs emerge /Figure 22/.



Figure 22 Ice cover forms from edge of the Kharaa River since the 10th of November

Table 22 Indicators for multi year mean current of Kharaa River

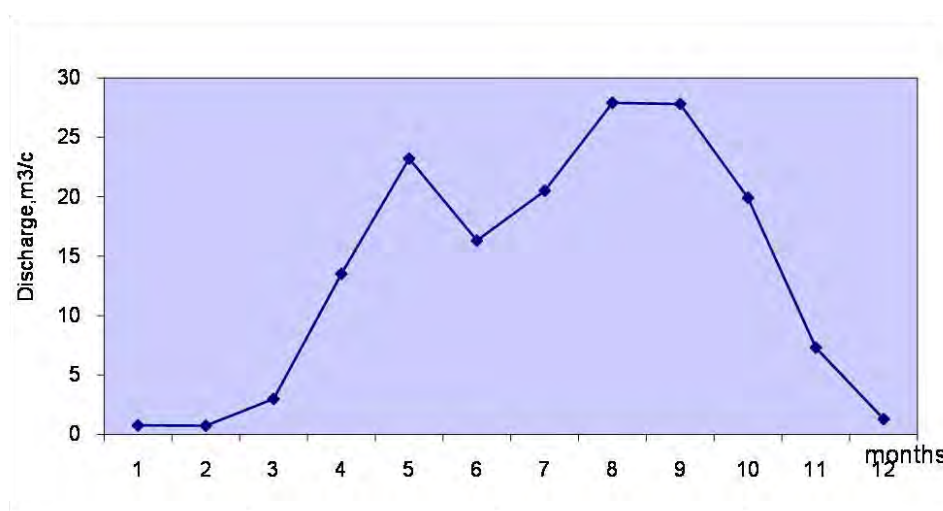
Meteorological Office	Catchment area m ²	Average multi year discharge /m ³ /sec/	Current modul /l/sec*km ² /	Current volume /m ³ /
Kharaa river Kharaa- Darkhan Meteorological	15050	11,3	0,75	0,35 km ³

Office				
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Comparing to current gradient of Kharaa river 2007 current distribution is as follows:
 Kharaa river becomes flooded during spring flood and summer rainy term.
 Stream phases - spring flood (SF), rainfall flood (RF) and winter drought (WD)
 apperntly emerges in annual stream of Kharaa river and in general spring
 flood starts 20th of April.

It has the maximum water by flooding in summer and autumn rainfall term and it often lasts from end of the June through end of the September. Draught time happens for short term from spring to summer and from summer to autumn, winter draught time slowly lasts since the ice cover forms to April and it has the minimum stream at this time. As annual stream distribution it is 84% in spring- summer, 14% in autumn, 2% in winter or the maximum discharge is observed during spring-summer flood.

Figure 23 Multi year mean current of Kharaa River



In catchment area stream loss is caused by evaporation of flood water and absorption in soil during warm season and snow evaporation during cold season.

Precipitation falls 250-350 mm on the average in river basin and 65-70% of annual precepitation occurs VII-VIII months. Multi year average by Darkhan station is P=330 mm. As the station survey for water balance, evaporation up to 600 mm occurs from the water surface.

Water quality of Kharaa river

Water quality of Kharaa river includes to less polluted classification and has pure water in pure level classification.

Water quality of Kharaa river was compared to surface water standard by contamination main elements of water chemical parameters.

Table 23 Comparison between water contamination parameters and surface water standard

	Parameters	Kharaa bridge	Kharaa-Darkhan Meteorological Office	Standard	Estimation
1	PH	8,12	8,14	6.5-8.5	didn't exceed
2	Solute O ₂	9,63	9,67	6.00	didn't exceed
3	NH ₄	0,2	1,02	0.50	exceeded
4	NO ₂	0,009	0,019	0.02	didn't exceed
5	NO ₃	0,029	1,22	9.00	didn't exceed
6	P	0,043	0,061	0.100	didn't exceed
7	PICH	3,2	3,5	10.0	didn't exceed
8	BOD ₅	2,39	3,02	3.00	exceeded

Ammonia nitrogen is one of the common elements found in the river.

Allowed limit of it shall not exceed 0.5 in natural water, but result shows this amount exceeded in two times out of the allowed limit. Waste water from waste water treatment plant, contamination of surface stream through melted snow water and rainfall water, and pollutants from animal source influence this contamination. As well NH₄ is from domestic waste water and it is less harmful than NH₃.

Being much BOD₅ may be due to nitrogen compounds. Because nitrogen compounds' oxidation belongs to biological necessary oxygen. When the much organic contamination, the much BOD₅ is, as well. BOD₅ exceeded out of water quality standard by Darkhan- Uul Meteorological Office. But it is considered if BOD₅ < 4, water to be capable of self purification.

2.6.2. Resource of ground water and quality

Ground water provider is formed by precipitation and air humidity. Kharaa river can be the largest medium for surface water that regards ground water.

Because there is no feeding permafrost and rock Kharaa River is related to groundwater hydraulic. In general precipitation, water vapor concentration, formation from tectonic fracture, in particular regional large fracture lead to process to form ground water resource.

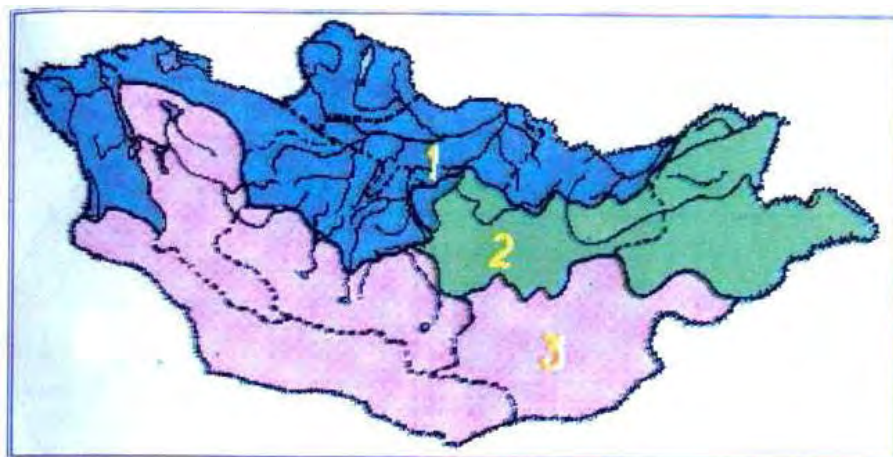


Figure 24 Underground water classification 1- temporary sufficient nutrition, 2- seasonal medium nutrition, and 3- seasonal lack of nutrition

As ground water classification Kharaa River basin belongs to seasonal maximum mid provider.

Drinking water extraction comes from 18 ground water wells along Kharaa river basin near Darkhan city and less than 10000 m³ of water is extracted per a day. To look at the estimation for water usage and demand in Darkhan city, it might be increased by two times 2012-2040. Current capacity of pure water supply in Darkhan city is 70000m³/day which is 2 times more than demand prospect /Table 24/.

Table 24 Water demand prospect in Darkhan city

Year	2012	2015	2020	2025	2030	2035	2040
Darkhan county	71,784	75,063	82,876	91,501	101,025	108,832	117,244
Central region	46,660	52,544	60,085	68,626	78,294	87,066	96,726
Ger district area	25,124	22,519	22,791	22,875	22,731	21,766	20,518
Pure water prospect							
Central residential area							
Net consumption of one person l/person/day	125	128	134	141	148	150	150
Loss %	0,40	0,38	0,36	0,34	0,32	0,30	0,28
Total consumption of one person l/person/day	175	176	182	188	195	195	192
Total consumption m ³ /day	8,165	9,245	10,940	12,927	15,254	16,978	18,571

	Industrial area						
Total consumption	3,000	3,300	3,960	4,752	5,702	6,843	8,211
	Ger district area						
Consumption of one person l/person/day	20	21	23	24	25	27	28
Total consumption m ³ /day	502	473	526	555	579	582	576
Total m ³ /day	11,668	13,018	15,426	18,233	21,535	24,403	27,359

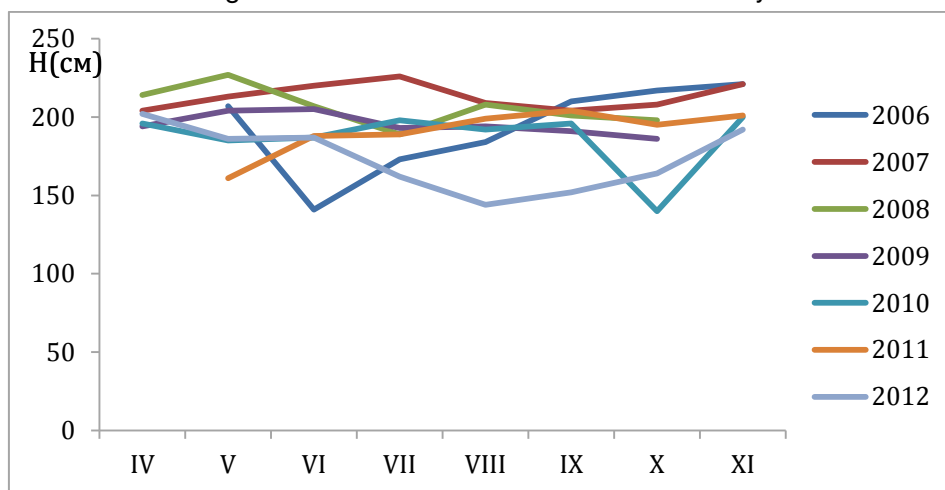
Because ground water transfers through pores of mealy sediments belongs to vulnerable condition may be easily polluted, any activities need to be carried out carefully.



Figure 25 Water sampling points

Few ground water survey for Kharaa river was taken and groundwater level fluctuation by Office of Hydrology and Meteorology in Darkhan-Uul province shown in figure.

Figure 26 Ground water level near Darkhan city



Results of the water analysis shown below as follows:

Sample name:

- **B- 560** – waste water into WWTP
- **B- 561** – water after the primary sedimentation tank
- **B- 562** – water after the secondary sedimentation tank
- **B-563** – water after the complete purification

Table 25 Results of water analysis

	Standard method	Parameters	Unit	B-560	B-561	B-562	PL	B-563
1	MNS ISO 10523:2001	Water medium /pH value/		8.44	8	7.82	6 - 9	8.09
2	MNS ISO 4810:1999	Electrical conductivity	$\mu\text{S/cm}$ $\mu\text{S/cm}$	896	1082	1219		1148
3	MNS ISO 11923:2001	Suspended solids	mg/L	486	96	9.8	50	5.8
4	MNS ISO 6060:2001	Chemical oxygen demand; COD-Cr	mgO ₂ /L	607.7	409	85.4	50	99
5	MNS ISO 5815:2001	Biochemical oxygen demand; BOD ₅	mgO ₂ /L	249	195	14.5	20	13.5
6	MNS ISO 6777:2001	Nitrite	mgNO ₂ /L	0.03	0.03	12.1		15.3
7	MNS ISO 7890-3:2001	Nitrate	mgNO ₃ /L	0.2	0	1.92		0.95
8	MNS 4428:1997	Ammonium nitrogen	mgNH ₄ -N/L	65	54.3	29.4	6	25
9	MNS ISO 6878:2001	Total phosphorus	mgPO ₄ -P/L	7.61	4.09	0.86	0.3	1.98
10	MNS ISO 5663:2001	Kjeldahl nitrogen	mg/L	92.19	40.33	37.27		34.47

Table 26 Analysis result of Bacteriological section

	Standard method	Parameters	B-560	B-561	B-562	PL	B-563
1	MNS 5668:2008	Total bacterial count in 1 ml	174×10^4	112×10^4	32×10^3		21×10^3
2		Coli-titr	0.00004	0.00004	0.0004		0.043
3		Coli-index	23800000	23800000	2300000		23000
4		Coliform organisms in 1 ml	found	found	found		found
5		Pathogenic bacteria in 1 ml	didn't find	didn't find	didn't find	can't find	didn't find
6		Enterococcus in 1 ml	found	found	found		found
7		Clostridium perfringens in 1 ml	10^{-3} found	10^{-3} found	10^{-2} found		10^{-1} found

Based on the results of analysis pH value of waste water into WWTP is pH-8.44 whereas pH value in purified water into river is 8.09. After aerotank a decrease of pH-7.82 occurs in water sample from the secondary sedimentation tank. It shows that water pH value might increased activating some bacteria by using blower.

Suspended solids occurred in waste water into WWTP with 486 mg/L whereas 5.8 mg/L suspended solids occurred in purified water that to be entered into the river. It indicates the efficiency of 98.8% for mechanical treatment. Based on standard norm, the treatment efficiency is 88.4%.

607.7 mg/L of chemical oxygen demand in waste water and 99 mg/L in purified water show the treatment efficiency of 83.7%.

249 mg/L of biochemical oxygen demand in waste water and 13.5 mg/L in purified water show the treatment efficiency of 94.6%. Comparing to standard norm, it is lower by 6.5 mg/L. This is an indicator of well purification for organic contaminant.

Total phosphorus increase of 1.68 mg/L and ammonium nitrogen increase of 19 mg/L represent intensive mineralisation is being carried out during the water treatment. By bacteriological test pathogenic bacteria in 1 ml didn't find.

This research is only one time research, thus it is required to make multitime test with daily average sample and to evaluate.

2.7. Vegetation

In accordance with botanic-geographical classification, the project area nearby the wastewater treatment plant in the territory of Darkhan city belongs to transition zone of Mongolian-Daurian mountain steppe. WWTP area in Kharaa river basin is primary mound of the river (голын нэгдүгээр дэнж) and generally feather grass found here.

Because Kharaa river flows in lake Baigali by transmitting Selenge river, Kharaa river presents a sensitive ecosystem. Treated wastewater from WWTP directly flows in Kharaa river. Due to some unsatisfactory parameters for purification standard, parameter that shows increase of river nutrient level certainly raises the issue to expand and reconstruct. As a result of the project it is possible to (i) to make a significant and measurable contribution to improving the urban environment of Darkhan city, and (ii) to improve the water quality of the Kharaa River to meet international river quality standards.

Mongolian-Daurian mountain steppe

Mongolian-Daurian mountain steppe includes marginal mountains of Khentii mountain ranges and encircles as half circle. Short hills and mounds combines. To the west lie Orkhon-Tuul confluence, Tuul river bend, mouth of Zeltger, Yroo, Kharaa and Shariin gol, and mountain ranges of Noyon, Zaamar and Jargalant; to the east belong mounds nearby Ereen Balj, Tsenkhermandal and Binder, and Ulz and Onon rivers. Mounds of 1400-1800 m, but mean predominant mounds of 800- 1500 m, and valleys are elevated at 1100-1200 m high, among which elevated at 800- 1000 near Shaamar. Larch forest with various grasses along the shady side of mountain found to the east and west beside birch-pine forest, birch- larch forest, birch forest and brushwood; Near Onon, Shaamar and Altanbulag there is a thick piny forest, and to the south forest is very rare, but partial larch-wood and calligonum found around here. Deciduous and mixed forest and partial larch forest occur in this area and poplar-wood nearby the marginal mountains.



Figure 27 Vegetation component nearby the Project area

Mountain steppe genus

1. *Agropyron cristatum* (L) P.B

- ерхөг салсан

2. <i>Artemisia Adamsii</i>	- явган (үмхий) шарилж
3. <i>A. Changaica</i>	- хангай шарилж
4. <i>A. macrocephala</i>	- царвай шарилж
5. <i>A. palustris</i>	- алтан шарилж
6. <i>Bromus enermis</i>	- соргүй согоовор
7. <i>C. enervis</i>	- улалж
8. <i>C. caespitosa</i>	- өлөн
9. <i>Chamaerhodos altaica</i>	- ягаан ботуул
10. <i>Chenopodium acuminatum</i>	- лууль шорной
11. <i>Ch. album</i>	- цагаан лууль
12. <i>Ch. aristatum</i>	- өргөст лууль
13. <i>Iris lactea</i>	- цахилдаг
14. <i>Medicago falcata</i>	- шар царгас
15. <i>Oxytropis sp</i>	- цагаан ортууз
16. <i>Plantago major</i>	- таван салаа
17. <i>Poa attenuata</i>	- дагуурын биелэг
18. <i>P.pratensis</i>	- нугын биелэг
19. <i>P.bifurga</i>	- зангуу
20. <i>Puccinella ambigua</i>	- үет өвс
21. <i>Salsola collina</i>	- хамхуул
22. <i>Stipa capillata</i>	- шивээт хялгана
23. <i>S. baicalensis</i>	- байгалийн хялгана
24. <i>S. sibirica</i>	- Сибирийн хялгана
25. <i>Urtica angustifolia</i>	- халгай

Vegetation, the main constituent of the mountain ecosystem, is diet source for some animals. Thus, it is significant to damage the vegetation as less as possible and to take protection measures in order to maintain and protect the ecosystem.

Descrintion 1.

26.02.2014

Surface: In the fence of WWTP reached land degradaion, and santonica, straw, nettle and plantain mainly grow. Some dried vegetations at this time: santonica, stipa, steppe wheat grass, plantain and bind wood.

	
Plantain	Wind wood

	
Nettle	Straw

Figure 28 Vegetation species within the area of WWTP

Descrintion 2.

26.02.2014

The site is contaminated by fuel, lubricants and heavy materials due to near location to domestic waste, rail and road. Dominant species are fat hen, santonica, aspen, ulmus and black henbane.




		
Aspen	Ulmus	Black henbane

Figure 29 Vegetation species around WWTP



Figure 30 Overview of WWTP



Figure 31 Water from the secondary sedimentation tank

During the survey endangered and rare plants didn't found nearby the Project area.

2.8. Fauna

Mammals

As Bannikov fauna geographical zone, major territory of Darkhan- Selenge region belongs to "Mongolian Daurian mountain steppe" and southeast of the Darkhan (nearby Shariin gol) belongs to "Khentii mountainous region". As Mongolian Red List of Mammals, mammals might be found in Darkhan- Selenge region is as follows:

1. Daurian Hedgehogs (*Erinaceus dauricus*)
2. Whiskered bat (*Myotis mystacinus*)
3. Common bat (*Plecotus auritus*)
4. Tolai hare (*Lepus tolai*)
5. Dzungaria hamster (*Podopus sungorus*)
6. Siberian jerboa (*Alactaga sibirica*)
7. Brandt's vole (*Microtus brandti*)
8. Grey wolf (*Canis lupus*)
9. Common fox (*Vulpes vulpes*)
10. Corsac fox (*Vulpes corsac*)
11. Manul cat (*Otocolobus manul*)
12. Badger (*Meles meles*)
13. Alpine weasel (*Mustela altaica*)
14. Least weasel (*M. nivalis*)
15. Eversmann's polecat (*M. eversmanni*)
16. Mink (*M. vison*) and so forth wild animals and domestic animals including cow, horse, sheep, goat, pig, cat and dog are in the territory of the province.

Table 27 Mammal outline in Darkhan region

	Order	Species	Rare animals
1	Rodentia	14 genus, 22 species	Marmot
2	Leporidae	2 genus, 3 species	-
3	Insectivora	4 genus, 9 species	-

4	Chiroptera	6 genus, 7 species	-
5	Carnivora	10 genus, 14 species	Otter, sable, manul
6	Artiodactyla	2 genus, 3 species	Red deer

Before conduct a survey on birds and small mammals for WWTP (N49°30'31,3"; E105°55'20,0" alt:694m), it is need to taking into consideration into biotopes. Except artificial ecosystems including Kharaa riverbank, inch, practice area and arboretum, there are sandpits along the river basin. In Darkhan city these mediums are so few for not only small mammals but also bird to stay. Rodents and birds in these location points were compared to fauna study near to the WWTP.

Table 28 Animal habitat location near WWTP

	Habitat	Location	
1	Virgin land with broom grass	Arboriculture (urban landscaping office)	N 49°30'055" E105°53'880" alt:680i
2	Plough		N 49°30'068" E105°53'700" alt:680i
3	Land with poplar		N 49°29'090" E105°53'614" alt:679i
4	Sea buckthorn field	Genefond, Fruit	N 49°29'151" E105°53'439" alt:683i
5	Cultivated garden	Rehabilitating garden along the riverbank	N49°30'157" E105°52'981" alt: 682i

Large open water holes in adjacent sandpits are the waterbirds' medium to gather, pass the summer, to nest and to lay egg, as well as there are crucian, perch and pike. Also water birds and quagmire birds are shifting into sludge ponds from these mediums. Animals that marked permanently live nearby WWTP were designed in following ways. In order to do, ecologist tools - Sherman[®] (8:9:23 cm), trap (Vitor gopher) and cone were used.

Small mammals

Major territory of Darkhan- Selenge region belongs to "Mongolian Daurian mountain steppe" and southeast of the Darkhan (nearby Shariin gol) belongs to Khentii region. Across the region steppe class representatives are distributed that are *Ochotona daurica*, *Ochotona hyperborea* (Northern pica), Mongolian gerbil and *Spermophilus undulatus*, and wood mouse and brown mouse, *Myopus schisticolor* (Lilljeborg) across the forest (Dulamtseren, 1970; Sokolov, Orlov, 1980; Emma et al, 2006). 13 species rodents, 7 species insectivore, 2 species lagomorphs or 22 species small mammals are found in Darkhan region. Regarding the conservation status of these, 1 was evaluated as endangered, 4 lack of information and 17 unheeded. *Allactaga sibirica* (Siberian jerboa), *Cricetulus barabensis* (Striped hamster), *Ochotona daurica* (Daurian pica) and *Meriones unguiculatus* (Mongolian gerbil) are commonly widespread species that represent small mammals class for this region.

Unequal habitats including rootstock bush with feather grass, river valley, hills and mounds, and spring water around WWTP, but these are major habitats for the small mammals. Comparing these data and expert analysis, it was proved that 11 species small mammals such as *Microtus fortis* (Reed vole), *Ochotona daurica* (Daurian pica), *Spermophilus undulatus*, *Apodemus peninsulae* (Korean field mouse), *Ondatra zibethicus* (Muskrat), *Allactaga sibirica* (Siberian jerboa), *Meriones unguiculatus* (Mongolian gerbil), *Cricetulus barabensis* (Striped hamster), *Mus musculus* (House mouse), *Hemiechinus dauricus* (Daurian Hedgehogs), and *Lepus tolai* (Tolai hare) are abundant in Project area. Moreover rare and endangered mammals that listed in Mongolian Red List of Mammals and Appendices of Mongolian and international laws and conventions didn't distribute or these species are unheeded species. These include:

Table 29 Habitat and diet

	Species name	Habitats	Diet	Project impact
1	<i>Spermophilus undulatus</i>	Steppe and forest steppe with river valley and meadow	Plant scion	1
2	<i>Allactaga sibirica</i> (Siberian jerboa)	Steppe and forest steppe	Stem, grain, insect and larvae	1
3	<i>Microtus fortis</i>	Forest, forest steppe, river valley	Scion, root, bark	1
4	<i>Meriones unguiculatus</i> (Mongolian gerbil)	Steppe, forest steppe, semi dessert	Grain, scion	2
5	<i>Apodemus peninsulae</i> (Korean field mouse)	Forest, forest steppe	Plant, tree grain	1
6	<i>Ochotona daurica</i> (Daurian pica)	Steppe, forest steppe, semi dessert	Scion	2
7	<i>Cricetulus barabensis</i> (Striped hamster)	Steppe, forest steppe. Large rock, sandy land	Scion, grain, insect	2
8	<i>Mus musculus</i> (House mouse)	Forest, forest steppe, river valley	Omnivorous	0
9	<i>Ondatra zibethica</i> (Muskrat)	Forest, forest steppe, steppe	Plant	0
10	<i>Lepus tolai</i> (Tolai hare)	Forest, forest steppe, steppe	Insect	2
11	<i>Hemiechinus dauricus</i> (Daurian Hedgehogs)	Forest, forest steppe, river valley	Insect, larvae	3

Small mammals nearby the Waste Water Treatment Plant

***Cricetulus barabensis* – Striped hamster**

Its body colour is ash grayish, ear edge is white, upper side of tail is dark and lower half of the tail is bright. Hamsters are stout-bodied, with tails much shorter than body length and have a dark stripe down the middle of the back (Figure-32). The hamster weighs 40-60 g, and a body length of 85-124 mm with a tail of 20-33mm, back feet of 14-17 mm and ear of 13.5-18mm. They live in not much deep hole with many orifices. Breeding season is from April to October with 2-3 frequencies and it births 6-8 mouskins at each birth. Diet: They are active in late evening. Their diet consists mostly of grains but also includes fruit, roots, green parts of plants, and other small animals. None hibernates during winter and hoards food in burrow. In late summer the hamster carry various kind of grass near to burrow.



Figure 32 Striped hamster [Purev.G]

***Microtus fortis* – Reed vole**

Reed voles live in slope habitats at purlieu, river valley meadow and gain. In years of sufficient number, they even distribute across forest along the river and mixed forest.

They have large body and under parts are paler, ranging from white to gray to brown. Usually 5-6 humps found in paw. The vole weighs 100 g having a body length up to 155 mm and a tail up to 60 mm. Its teeth: anterior teeth 1/1, tusk 0/0, premolar 0/0 and molar 3/3 x 2= 16. In years with suitable climate breeding occurs up to 3 times (between March and October) and it births 2-10 mouskins at each birth. Gravidity period is 21-23 days. There are few reed voles those births twice in a year as our country climate.

Diet: feather grass, couch grass, festuca venusta and green parts of plant. The reed vole carries not much grass to their burrows.



Figure 33 Reed vole

***Ochotona daurica* – Daurian pica**

Daurian pica is distributed across steppe and forest steppe in Mongolia. In summer they are taupe and in winter more light with grey stomach. It is small short-legged and virtually tailless egg-shaped mammal. Daurian picas are active during the day and nightfall. Picas do not hibernate, and they are generalized herbivores. When innutrition occurs in spring, they confine their activity to early morning and late afternoon. (Figure 34) Most daurian picas weigh between 130-260 and 200 grams and are about 170-200 mm in length with feet of 25-29 mm. Mating season is in the middle of April and gravidity lasts for around 25 days. Breeding occurs twice a year, occasionally 3 times in years with suitable climate and female daurian pica produces 5-7 young picas, sometimes 8-10 young picas.



Figure 34 Daurian pica (By Shar.S)

Diet: In hot summer they stay in the burrow and they confine their activity to early morning and late afternoon till midnight in order to feed. From August or September picas hoard food in their nets, usually carry leguminous plants and thermopsis lanceolata and feeds with about 80 species of plants (Tsendjav.D et al, 1986). They like predominant plants in pasture that are feather grass, festuca venusta and coach grass. It is common to give a call in the morning and evening. Their nests are made deep in a labyrinth and they live in family groups up to 4 years as natural condition.

***Allactaga sibirica*- Siberian jerboa**

Siberian jerboa is one of commonly spread rodents in Mongolia. As general physical appearance Siberian jerboa is identical with other jerboas, but it is bigger in size (Figure 35). Jerboas are mouse like, with bodies ranging from 125 to 180 mm in length and long tails of 172 to 230 mm, feet of 64 to 81 mm and ear of 36 to 55 mm and weigh 85-100 gr. The backside of the body is light. Unique characteristics can be distinguished from the others such as light fur like ring occurs in black floccus and fine white stripe occurs along the tail between the black floccus. Its tag is bright white. Siberian jerboas are active during the night and live in burrow with length of 500 cm in depth of 70-150 cm. Brim diameter of the burrow is about 6 cm.



Figure 35 Siberian jerboa (by Shar.S)

After hibernate, breeding occurs. Female jerboa gives a birth once a year with 3- 6 puppies. Siberian jerboas live in a wide variety of habitats ranging from elevations to semi desert. Usually it lives near Bogd Mountain with steppe, forest steppe and dry steppe.

Diet: green leaves of plants, grain, bean and insect.

Meriones unguiculatus – Mongolian gerbil

Mongolian gerbil is widely spread rodent in Gobi steppe region with soft soil, bush, sagebrush and feather grass, and in river valley (Figure 36). Their nests are made in 1-1.5 meter deep with labyrinth brims. Mongolian gerbil weighs 60-73 gr with a body of 130 mm and tail of 100 mm in length.

The backside of body is fawny and stomach is light with black fur root. Upper part of the tail has dark fur while floccus has black brown tassel. They are active during all day, live in family group and hoard food with stems, leaves of grassy plants and grains (gerbils are harmful to ear of ripe grains). No hibernates during the winter and gravidity continues 25-30 days.

Breeding period lasts from March to October and female gerbil gives birth twice a year with 3-8 mice. They live 1-2 years as natural condition. Due to motility they can cause damage to grain depot and tillage (there is an instance Mongolian gerbil had carried 10 sacks of cereal). Mongolian gerbils are widely distributed across Orkhon and Selenge basin. Also it can be found near urban areas.



Figure 36 Mongolian gerbil (by Shar.S)

Diet: Even though they feed with various parts of plants, in summer with green part of plants and in winter and spring usually with grain.

Mus musculus – House mouse

House mouse is the most spread rodent through Mongolia (Figure 37).

Generally weighing 20 to 40 gr, the house mouse has small, slender body 70 to 110 mm long, tail 38-102 mm long, back feet 13-19 mm long and ear 10-15 mm long. The backside of the body is comparatively light and grey. They are active during the nightfall and midnight all around a year, but can be found during a day. They construct nests in any protected place and can contaminate food and damage property. Gestation lasts 20 days. Each female of



Figure 37 House mouse (Shar.S)

rodent can produce up to 14 litters per year (5 to 10 is usual). House mice live everywhere such as house, warehouse besides the nature.

Diet: They usually eat grain of grassy plants.

***Mesechinus dauricus* - Daurian Hedgehogs**

Daurian Hedgehogs are one of mammals that are listed in Red book of Mongolia as endangered species. It has a body of 230-270 mm length, tail of 33-45 mm and weighs 600-800gr. The short, stocky body is densely covered with spines except for the underside, legs, face, and ears. Their ear is comparatively short with 29-34 mm long. Daurian Hedgehogs are active during the nighttime and hibernates during the winter. They also use the burrows of other mammals, especially marmot, digger and steppe mouse. Breeding occurs in the middle of the June and gestation lasts 35-40 days. Female Hedgehogs give a birth with 5-7 litters. They live around 7 years as natural condition. Daurian Hedgehogs are distributed across steppe and forest steppe region in northeast and north of Mongolia. They might be found near Bogd Mountain including downhill, river valley, glade and grove.

Diet: The hedgehog's diet consists of insects, bird eggs, and small mammals.

It is proper to mention that human has relatively early affected around the Darkhan city along Kharaa River.

BIRDS

In Mongolia around 480 bird species listed of which 75% are migratory birds. 332 bird species [Tseveenmydag, 2005] were marked in Darkhan- Selenge region those are divided into modes of living in the following ways:

1. Marsh birds: 80 species including

Ardea cinerea, *Anas platyrhynchos*, *Aythya ferina*, *Podiceps cristatus*, *Phalacrocorax carbo*, *Platalea leucorodia*, *Ciconia nigra*, *Anser indica*, *Anser cygnoides*, *Totanus ferruginea*, *Cygnus cygnus*, *Circus cyaneus*, *Larus argentatus*, *Vanellus vanellus*, *Anthropoides virgo*, and *Grus vipio*.

2. Bush and tree birds: 80 species including

Accipiter nisus, *Buteo lagopus*, *Aquila clanga*, *Falco tinnunculus*, *Lyrurus tetrix*, *Tetrao parvirostris*, *Parus cyanus*, *Parus major*, *Sitta europaea*, *Acanthis flammea*, and *Coccothraustes coccothraustes*.

3. Steppe birds: 21 species including

Buteo hemilasius, *Aquila nipalensis*, *Falco cherrug*, *Tetrax dauricea*, *Coturnix coturnix*, *Otis tardo*, and *Nyctea scandiaca*.

4. Urban area

5. *Passer domesticus*, *Pica pica*, *Corvus corone*, *Corvus corax*, *Columba oenas*, *Columba livia*, *Upupa epops* are commonly found in urban area.

Research Battulga.S /2005/ marked 22 bird species of steppe and forest steppe near Mukhar river and Purev.G /2007-2012/ marked about 50 bird species nearby Darkhan city, in particular water water treatment plant, arboretum under control of City landscaping office, green area in city center, sandpit- reservoir and Kharaa river. These include:

Table 30 Bird list nearby WWTP in the territory of Darkhan county, Darkhan-Uul province:

Central WWP extension project in Darkhan county, Darkhan province

№	Bird name		Impact
	Монгол	Latin	
1	Hawfinch	<i>Coccothraustes coccothraustes</i>	0
2	Wind hover	<i>Falco tinnunculus</i>	0
3	Шилийн сар	<i>Buteo chemilasi</i>	0
4	Алтан цэгцүүхэй	<i>Acanthis flamma</i>	0
5	Оронгийн бор шувуу	<i>Passer domesticus</i>	0
6	Шунхан зулайт бужирга	<i>Acanthis hornemanni</i>	0
7	Хээрийн бор шувуу	<i>Passer montanus</i>	0
8	Нарийн хиазат	<i>Charadrius dubius</i>	2
9	Өвөгт тогоруу	<i>Anthropoides virgo</i>	1
10	Хавтгаалж	<i>Vanellus vanellus</i>	1
11	Хөх дэглий	<i>Ardea cinerea</i>	2
12	Мөнгөлөг цахлай	<i>Larus argentatus</i>	2
13	Дорнын хүүрзгэнэ	<i>Streptopelia orientalis</i>	0
14	Гээгт шумбуур	<i>Aythya fuligula</i>	2
15	Улаан хүзүүт шумбуур	<i>Aythya ferina</i>	2
16	Цагаан хөмсөгт нугас	<i>Anas quercuedula</i>	1
17	Дагуур ятуу	<i>Perdix dauurica</i>	0
18	Цагаан хэвэлт хөмрөг	<i>Emberiza pallasi</i>	0
19	Их хөх бух	<i>Parus mayor</i>	0
20	Савагт ууль	<i>Aegolius funereus</i>	0
21	Дорнын бүгээхэй	<i>Glaucidium passerinum</i>	0
22	Соотон гуйванга	<i>Asio otus</i>	0
23	Боролзой болжмор	<i>Alauda arvensis</i>	0
24	Бялзуумар	<i>Calandrella rufescens</i>	0
25	Өдөрч хөх бух	<i>Parus ater</i>	0
26	Аёаадооо ёуёуу	<i>Corvus daurica</i>	0
27	Цагаан элэгт	<i>Circus cyaneus</i>	0
28	Хөх цэгцгий	<i>Motacilla alba</i>	0
29	Жунгаа	<i>Pyrhocorax pyrrhocorax</i>	0
30	Хошуу галуу	<i>Anser cygnoides</i>	3
31	Зэрлэг нугас	<i>Anas platyrhynchos</i>	2
32	Ангир	<i>Todarno ferruginea</i>	3
33	Хүрэн толгойт цахлай	<i>Larus ridibundus</i>	2
34	Бор бүргэд	<i>Aquila clanga</i>	0
35	Өвөөлж	<i>Upupa epops</i>	2
36	Алаг хөөндэй	<i>Zoothera sibiricus</i>	2
37	Сүүл цагаан хөгчүү	<i>Tringa ochropus</i>	2
38	Ухаа дунхаа	<i>Lanius cristatus</i>	0
39	Шанаа цагаан хараалай	<i>Chlidonias hybridus</i>	2
40	Мяраан чогчого	<i>Oenanthe oenanthe</i>	0
41	Хондлой цагаан урацай	<i>Apus pacificus</i>	2
42	Оооаа айайе	<i>Phalacrocorax carbo</i>	1
43	Ооо ёуёуу	<i>Corvus corone</i>	1
44	Хон хэрээ	<i>Corvus corax</i>	1

45	Эгэл хөхөө	<i>Cuculus canorus</i>	0
46	Ойиоёд ооааооаа	<i>Columba livia</i>	0
47	Ойиоёд ооааооаа	<i>Columba oenas</i>	0
48	Сохор элээ	<i>Milvus migrans</i>	0
49	Амарын шонхор	<i>Falco amurensis</i>	0
50	Шаазгай	<i>Pica pica</i>	1
51	Шивэр энхэт бялзуухай	<i>Bombycilla garrulus</i>	0

Note. Birds in bold are waterbirds and semi waterbirds that transfer near WWTP.

Even though about 20 species birds are available to transfer from sludge pond between sandpit reservoir and Kharaa River in project area, there are no birds that registered in Red List, Red Book and international convention as endangered species. Nearby Darkhan city along the Kharaa River *Aquila clanga* (greater spotted eagle) and *Anser cygnoides* were labeled, and it is impossible to define whether they will be affected by adverse impact during the project implementation. In report of Red list of Bird (2006) it was highlighted that habitat loss, human impact, livestock and negative impacts of mining are producing direct and indirect affects.

Species that live close to WWTP are carrion crow, magpie, sparrow and raven. Because small birds are abundant in summer season near trees and bush, noise and dust should be produced as less as possible during the construction.

FISHES

Kharaa river effluents from northwestern mountains of Khan Khentii mountain ranges and flows into right side of Orkhon river. Even though there are several urban areas along the river, there is no fish farming for commercial. But livestock number is growing accompanying with number of illegal fishers and population density.

There are 15 species fishes that belongs to 9 genus in Kharaa River and their habitat varies, such as: lenok, ruff, dog fish are abundant in high current where rich in river stones, gravel and sandy sediments; pike, carp, crucian carp and ide are in calm flow with vegetations; amur catfish in calm flow with clays; and siberian stone loach and siberian spiny loach live in bottom water under the stone, sand and clay. It apparently shows fishes are abundant in any habitats of the river. Game fishes occupy 73% of above fishes of which 4 species- lake minnow, common minnow, siberian stone loach and siberian spiny loach are minnows which deceived by others. During breeding season taimen might propagate in Kharaa River /Table 31/.

Within the framework of MoMo Project I and II by German finance, research on the biology and ecology of the siberian spiny loach was done. As a result of the research, it certifies that contamination volume during gold mining activities didn't influence to the group structure of siberian spiny loach /Chantuu, Erdenebat, 2010/. Otherwise detailed fish research on Kharaa river is rare.

As research conclusions of contamination causes in Kharaa River, gold mining is carried out nearby the Boroo and Kharaa river basins and mercury and arsenic are accumulated to river bottom sediments. But self purification process occurs during flow, its turbidity settles to the bottom and then flows into Orkhon river

/Erdenetsetseg, Javzan, 2013/. It brings awareness that WWTP has relatively less adverse impact to aquatic animals.

Since mid the of April breeding season starts and lasts from the mid of May to the beginning of July. Picking up place where reproduces, waiting till water temperature reaches appropriate degree, overcoming various negative influences are important parts for fish life period. In particular, infertility might occur unless these conditions lay down. Thus, we must protect any part of the river as in nature and clean.

Feeding organisms for fish varies by their habitats. Zooplanktons that live river bottom are major diet for fishes as well indicators for water purity and contamination. Aquatic insects, larvae of insects and larvae of some species humming birds are predominant in upper river water and shell, squat lobster, leech are abundant river bottom.

Table 31 Fish species in Kharaa River and their economic importance

Fish name			Valuable game fish	Game fish	Minnow	Sport game fish
Mongolian name	Common name	English name				
Family I Salmonidae						
1.Зэвэг	Brachymystax lenok P	Lenok	+			+
Family II Esocidae						
2. Цурхай	Esox lecius Linnaeus	Pike		+		+
Family III Siluridae						
3.Амарын цулбуурт	Silurus asotus L.	East Asian catfish		+		+
Family IV Odontobutidae						
4.Алгана	Perca fluviatilis L	Perch		+		+
Family V Gadidae						
5. Гутаарь				+		
Family VI Cyprinidae						
6. Бух сугас	Leuciscus idus L.	Ide		+		
7. Булуу цагаан	Cyprinus rubro fuscus Lacepede	Asian common carp.		+		
8. Мөнгөлөг хэлтэг	Carassius gibelio Bloch	Prussian carp		+		
9. Шивэр сугас	Leuciscus baicalensis Dybowski	Siberian dace		+		
10. Улаан нүдэн	Rutilus rutilus L.	Roach		+		
11. Нуурын варлан	Eupallasella percnurus P	Lake minnow			+	
12. Ердийн варлан	Phoxinis phoxinus L.	Common			+	

		minnow				
Family VII Thymallidae						
13. Шивэр хадран	Thymallus arcticus Ё.	Arcticus grayling	+			+
Family VIII Balitoridae						
14. Сахалт эрээлж	Orthrias toni /Barbatula toni Dyb /	Siberian stone loach			+	
Family IX Cobitidae						
15. Чимхүүр загас	Cobitis melanoleuca Nichols	Siberian spinny			+	

Zooplanktons are extremely rare in Kharaa River. Fero species are dominant including *Brachionus quadridentatus cluniorbicularis* Skorikov, *Euchlanis dilatata* Ehrenberg, *Keratella cochlearis* Gosse, *Acroperus harpae* Baird, *Alonella excise* Fischer, *Chydorus gibbus* Sars, *Chydorus sphaericus* Muller, *Macrothrix laticornis* Fischer, *Acanthocyclops viridis* Jurine, those are feeding organisms for fishes.

River water temperature, concentration of hydrogen ions and hydrogen produce direct influence to the fish breeding period. Their indicators vary depending upon season, climate, water purity and contamination. For instance: from the end of the April to May, lenok, grayling and pike breed in the water with 9,8-16,4⁰C and at mean 13,1⁰C; oxygen in the river water is 7,73-12,10 mgO₂/l, 10,14 mgO₂/l at mean; pH value is 7,42-8,60 and at mean 8,35 or pH is acidic.

Breeding period of Perch, catfish, Asian common carp, Ide, Sibirean dace and Roach occur in June and in the beginning of June. At this time river water temperature reaches 15,67 -22 ⁰C and 17,83⁰C at mean; oxygen in water is 7,64-9,40 mgO₂/l and 8,50 mgO₂/l at mean; pH value is 7,99-8,60and at mean 8,33. Based on this, oxygen in water is sufficient during the fish breeding period and concentration of hydrogen ions is slightly acid, but it don't influence in fish habitat.

And burbot breed from the mid of December to January and river water temperature reaches 1-3,8⁰C, oxygen in the water is 8,02-14,4 mgO₂/l and 10,56 mgO₂/l at mean; ph value is 7,77-8,90 and 8,26 at mean.

Cliamate and human impacts to aquatic animals in Kharaa river are increasing and fish numbers are greatly falling. Rooted in it fish deficiency can be classified as follows /Table 32/:

Table 32 Fish scarcity classification in Kharaa river basin

CR	EN Endangered	VU Vulnerable	NT Near Threatened	LC Least Concern
Siberian sturgeon	Taimen	Lenok	Arcticus grayling	Pike
		Ide	Asian	Perch

			common carp.	
			Burbot	Prussian carp
				Siberian dace
				Roach
				Lake minnow
				Common minnow
				Siberian sturgeon
				Siberian sculpin
				Catfish
				Kessler's sculpin
				Siberian sculpin

Note: Siberian sturgeon and taimen were included because of their existence in Orkhon river of Kharaa river effluent.

2.9 Historical and cultural items

According to the Law of Mongolia, Protection of Cultural Heritage (Article 16 (6)), protection zones around 0.1-3 km should be defined by Mongolian Government in order to conserve "dignity for historical and cultural immovable heritages including ancient city, settlement remainder, buildings and complexes" as well as according to Article 16 (7) of the Law, "Territory and bowel that are storing historical and cultural items and archaeological artifacts will be included in safety zone", preventative and protection measures are to be needed.

CHAPTER 3. INTERMEDIATE PRODUCT AND WASTE

Domestic trash generated during the construction of the expansion building was planned by the following rules. 3 coloured trash bins are to be places in the area and label and instruction showed below will be stucked in every trash bins. Environmental specialist is to monitor whether there is adherence of the instruction.

Solid wastes classification:

Bin (green)	Do not palce stained glass, lightbulb, mirror glass and window pane
Bin (blue)	Paper products such as paper, newspaper, magazine, paperbag and paperbox, and waterproof box. Before putting these into the bin, need to be folded in flat.
Bin (yellow)	Metal and plastic container, package, waterproof box and plastic. No rubber and sack.

By agreement with the secondary raw materials collection place, classified waste will be constantly delivered.

Garbage disposal and its regulation

Solid wastes from construction work need to be collected in one place and put into garbage fence. Then garbage disposal carries out to dumpsite. Monthly disinfection will be done for garbage fence and the fence should be placed at underneath of wind direction.

Rubbish disposal as maintenance of techniques and equipments failure is to be carried out under the relevant rule, as well preventing measures for workplace and surrounding.

The solid wastes include soil, rock, concrete, asphalt, and leftovers of water pipes and heat insulation materials. Executer who will build sewerage shall arrange rubbish disposal at dumping site under the agreement with Governor Office of Darkhan county where the project will be implemented.

The treatment plant is far from settlement area of Darkhan city at restricted space operating activities under the industrial internal rules. Industrial operation produce solid and liquid waste. Solid wastes are sludge filtered from waste water and solid rubbish not collapsed in crusher.

About 6300m³/day purified water of the plant with 80-92% refinement belongs to liquid waste, but waste water is directly discharged into the river without treatment as facility damage and accident. The main reason to cause the failure and accident is power cut. Signal for power cut is informed to dispatcher of Darkhan Us Suvag LL prior to about 10 minutes as well the power cut duration. The maximum occurance of power cut is 3-4 times within a year.

○ **Solid wastes**

Primary sedimentation tank for mechanical treatment- filter separates larger rubbish and waste than 16mm including fabric, and filtration capacity is not more than 0.2 m³/day. Waste from the primary sedimentation tank is to be put in crusher and disposal of waste that couldn't crushed will be done and disinfected by chlorine lime. Solid waste that couldn't crushed reaches approximately 10-15kg a day.

In addition the sludge filtered from waste water is the major waste. The plant is currently operating at a load of about 7,000 m³/day in summer with a peak flow of up to m³/day cum/day in winter with 834m³/day sludge.

- To discard the domestic and industrial waste nearby the plant at central dumping site and to monitor whether there is waste.
- To research and implement the measures and techniques for the purpose of change for wastewater discharge without treatment into the Kharaa river as facility damage.
- To develop and to implement comprehensive plan for waste issue
- To collect solid waste in special bins and to discard it at the central dumping site under the agreement with urban landscaping office.
- To clean the previous sludges at the sludge pond and to research wheter it is useful as fertilizer. To apply the useful parts of sludge and remove the parts that might cause harm to allowable dumping site.
- To apply the sludge to its maximum and incinerate the rest.

It needs to completely treat the sludge from new facility and produce of electricity for domestic demand. Properly mineralized sludge is possible to be reused as organic fertilizer.

CHAPTER 4. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1. Scope of the survey

4.1.1. Methodology to define environmental potential impacts

An Environmental Impact Assessment of a project pursue the general methodology, which described below:

- Scoping and prioritization of Impacts must be conducted within the limits of project scope.
- Environmental parameters will be measured to wide ranges of expected changes due to a project proposed activities: change in biodiversity species and natural resources; environmental changes, social impacts, impacts to natural beautiful places, historical and cultural items, archeological and paleontological findings and impacts to economics and environment and examine their impacts.
- Impacts can be divided as direct or indirect through its type, long-term and short-term through its duration and strong, medium and lower by its intensity.
- Both negative and positive factors that lead to impact are estimated.
- To assess impacts, justification must be based on results of data analysis and conclusions of experts of assessment team, as well as comparatively study findings of assessment report on feasibility study and a system approach method.
- Impact prioritization will be done in two steps: during construction of wastewater treatment plant and during the plant exploitation and maintenance through assessing impact scope, duration and intensity.

To evaluate impacts by using system approaches, checklist and matrix methods are used. Checklist method is based on principle that if a certain impact “exist” or “does not exist” and mark any negative impact as “x” and positive impact as “+”.

4.2. Potential and main environmental impacts

WWTP main impacts on environment might be arised due to facility location, capacity of the load exceeds, technological failures and accidents. Insufficient of appropriate and reliable technical system for the plant, the following adverse impacts derive:

- Surface and underground water contamination by imcomplete refined water or waster water
- Soil contamination, deterioration by sludge
- Mineral contamination in water
- Change in water level of soil, and emergence of outgush and marsh
- Change in species of aquatic animals, and population and distribution of waste water organisms, pathogens and vermins
- Odour volume raise
- Contamination from sludge and dry waste

- Insulation materials' disperse during pipe replacement
- Effects on human health including noise from the work of pipe replacement, waste water pumping stations, and dust.

Within treatment facility area and its the surrounding area of 5 km, residents and water environment, quality, and aquatic animals and plants' population along the Kharaa River near pipeline outlet might receive certain impacts. Failures and damages from facility reliability, equipments and technological stages, and sludge pond impact on water quality, environment contamination, soil structure, soil water quality and its level. Then it will produce adverse impact on the facility reliability, thus it is proper to adhere relevant legal standards, norms and rules included in detailed assessment about ensuring reliable operation of the facility and equipment.

Environmental main impacts have been identified based on general methodology and checklist methods using the UN Economic Commission for Asia-Pacific Society, the Asian Development Bank and the World Bank's environmental impact assessment guidelines and manuals in order to accurately define environmental impacts and develop the mitigation plan during the reconstruction and operation of the facility.

Environmental potential impacts' assessment

Table 33 Project main impacts

№	Environmental parameters	Impact state									
		Direct	Indirect	Self-regulated	Short term	Long term	Reversible impact	Irreversible	Low	Medium	Strong
Environmental changes											
1	Air pollution	x			x				x		
2	Soil deterioration and erosion	x			x			x	x		
3	Noise and vibration impacts (physical impacts)		x						x		
4	Unfavorable sensory impact	x			x					x	
5	Surface water resource	x				x				x	
6	Surface water quality	x				x					x
7	Underground water resource	x				x			x		

8	Underground water quality	x				x				x	
9	Climatic changes		x			x				x	
10	Geological formation		x						x		
Environmental risks											
11	Environmental risk probability cause its increase		x						x		
Social impacts (positive)											
12	Increase in local income	x				x		x		x	
13	Infrastructure including electricity and water supply, transportation, hospitals, and schools		x			x			x		
Economics and environment (positive)											
14	Increase in local income	x				x		x	x		
15	Increase in workplace	x					x		x		
16	Support in poverty reduction					x				x	
17	Water borne diseases and parasites spread	x			x						
Impact numbers		11	5		4	9	1	3	9	6	1

Direct impact – Most of the environmental potential impacts belong to the direct impacts. After wastewater treatment and sludge disposal, toxic gas emission occurs during the natural drying process as well surrounding soil pollutes by liquid spill and discharge due to equipment failure and accidental action. The waste water treatment plant create many efficiencies for socia-economic conditions including infrastructure development, workplace creation and revenue increase.

Indirect impact-. During the treatment operation, noise impact and number of machine and equipment are increasing and it will impact in any way on near residents. Near the project area the air pollution might be caused in warm season.

Short term impact-. In most cases air and soil contamination form short term impacts because of pipeline replacement and waste water discharge. Emission of poisonous fumes and dust generated by vehicles might occur near project area for short term. It is needful to avoid vehicle accumulation, road crossings, mitigate dust level, irrigate the unpaved roads in dry season and adhere safety operational rules.

Long term impacts-. The treatment activities produce long term impacts on ecosystem in some indicators. For instance: toxic gas impacts on human health through air, and streaming waste water impacts on soil permeating by soil pores. Thus clear up measures for contaminated soil need to be promptly taken. It can have a positive effect to local infrastructure development.

Impact intensity-. Based on above table, almost all impacts can be called low-intensity impacts. But it is proper to carry out operations emphasizing that impact

intensity might increase during the facility or operation failures. On the contrary having the medium-intensity impacts are operational value of the plant.

Impact consequences relating to the project location

Checklist method was used in order to define the impacts. Its results shown as follows:

Table 34 Environmental impact consequences

Environmental issues	Impact consequences			
	No impact	Low	Medium	Strong
1.Environmental issues relating to the project location				
Flood due to change of river bed and river bank damage	x			
Occurances of population migration regarding to project location and relocation demand		x		
Occurance of forest and wood cutting	x			
Damage of historical and cultural items	x			
Conflict with another entity regarding to water supply and water usage	x			
Whether surrounding population and goods are to be destroyed due to fire		x		
2. Environmental issues related to project solution and plans on operational quality				
Whether project operational process is conjenal with the local conditions, and equipment of contamination monitoring in operational phases			+X	
Plans on preventing employees from industrial accidents, job related illness, toxic gas and fire			+X	
Whether surface and groundwater protections are conjenal as spillage of wastewater as well as efficient operational possibilities			+X	
Whether there are dust, fume and gas at which special attention shoul be drawn		x		
Contamination of water, air and soil and generation of solid wastes and noise during operational phases				x
3. Environmental issues regarding to construction design, equipment and pipeline assmby				
Turbidity during construction work	x			

Soil erosion in construction stage and operation stage		x		
A various of accident risk vulnerability, toxic condition and emergence condition to contagious disease	x			
4. Environmental issues in project operational stage				
Whether plans and finance regarding to project operational quality are tangible				+X
Whether plans and finance regarding to plans on job related illness and safety operation			+X	
Whether mitigation of soil erosion and landscaping was involved in plan (flatten the surface, cover with topsoil and grow plants)		+X		
Contamination occurrences of soil and groundwater and influence in riverwater quality due to damage and breakdown in operational stage			x	
Rapid monitoring (whether duration and expenses were included in the project)			+X	
Unjustifiable squander of unrecoverable natural resources during the project life	x			
Unreasonable apply of poor resources need to be used for long term within too short term	x			
Hazardous damage to biological species by project result (such as influence in genetic pool, destruction of endangered and rare animals and plant)	x			

Location impacts - The treatment plant is operating on the territory of Darkhan city and Darkhan Us Suvag LLC needs to pay special attention on environmental issues relating to project location.

Environmental issues relating to the project solutions and plans- Based on the feasibility study of the project, advanced technologies and equipments that are to be applied in the facility show there is no surrounding contamination due to the large amount of wastewater escape in the course of operation.

Environmental issues relating to the construction and facility design, sewerage assembly and repair of pump stations- Technology for the facility has not selected yet. But it is not proper considering there is no harm in environment because repair of pump stations and network and sewerage expansion will be done within the possession area.

Environmental issues generated during the project implementation- Operational stages such as wastewater treatment and sludge drying impact on surrounding and environment in some degree. Thus it is a vital to include finances for permanent air monitoring and soil stripping as soil contamination in environment management plan. In some cases recompensation needs to be included.

Potential impacts relating to operational stages- The facility receive consumers' wastewater in Darkhan city, discharge disinfected wastewater into river, dry the sludge or produce electricity from the sludge by using full process. During these stages the following issues might emerge:

- Wastewater escape due to accident
- Danger of fire due to electrical equipments' breakdown
- Danger of fire due to employees' improper activities
- Large amount of wastewater escape due to breakdown of operational major equipments
- Fire and explosion due to force majeure (such as earthquake, flood and thunder).

Above mentioned potential dangers might occur in the course of the project implementation.

4.3. Adverse impacts of the project

Table 35 Environmental Assessment for the project

№	Ambience	Source and reason	Scope	Assessment			
				high	medium	low	No impact
1	Air	-Stench generated by sludge decomposition -Dust	- The treatment-sludge pond, and its surrounding 1500 meter area -Around 50 meter when sewerage repair	-x	-x		
2	Earth surface and soil	-Sludge -Solid wastes - Soil contamination when wastewater leakage and escape	Sludge pond and its grating, primary clarifier and stations' pump reservoir	-x -x	-x		
3	Ground water	- Leakage of wastewater - Rainwater	Within the project area		-x -x		
4	Underground water	- Wastewater percolate	Sewerage and network			-x	
5	Impact on	- Sludge, dry				-x	

	vegetation	wastes leakage and of wastewater -Landfill	Sewerage assembly		-X		
6	Vegetation	- Soil stripping - Land degradation -Forest deconstruction	Nearby project area and along road		-X -X		x
7	Fauna	- Animals runaway - Extinction of small animals	The project area			-X -X	
8	Object	- Resettlement -Deprivation of land own rights	If there is object close to work and hygienic area				x x
9	Noise and vibration	Construction work and equipment assembly stages	In work region			-X	
10	Solid wastes	-Solid wastes -Liquid waste	When waste accumulated in work region			-X -X	
11	Health	Leakage and spillage of wastewater from the facility and evaporation - Noise generated by equipments	Within work region		-X -X		
12	Road and field	-Road partition off - To grab owned land by others	Within work region			x	x
13	Historical and cultural items	- Transmission, extinction, and disturbance its value	There are no historical and cultural items near project area				x
14	Social economic impacts	-Econmical benefits -Impacts on the particular area	A certain amount of contribution in local budget Workplace increas	+X	+X		

		- Workplace		+X			
15	Accidents risk	- Due to natural disasters - Due to unintended human activity	Impacts on buildings due to flood		-X -X		

Based on the table, positive impacts were 3 of which 2 –high, 1- medium and negative impacts were 27 of which 3- high, medium- 11, low-8, no impact -5. Medium and low negative impacts are generally induced by human accidental activities and they are possible to prevent.

Preventative measures for accidents

- Due to natural disasters and flood, danger might occur in environment and it is proper to operate avoiding accidents.
- Thanks to permanent examination in equipment safety, detection of any breakdown and repair, impacts on environment can be decreased.
- All preventative measures from fire in maintenance stage and assembly work should be taken and management, raise awareness activities have to be constantly carried out.

4.3.1. Impacts on air quality

Impact sources on air quality:

- Off-road traffic with many road crossings
- Soil erosion and deterioration during the facility expansion and equipment assembly. Material dump
- Technical operations /machinery/
- Excavations including soil stripping /dust/
- Wastes and byproducts
- Direct coal burning without any process /special boiler/
- Odour generated from sludge pond and wastewater storage facility

4.3.2. Impacts on soils

The square of the project area is 2 hectares, current wastewater plant 3 hectares and sludge pond 120 hectares, and generally soil quality is infertile and affected by soil erosion.

Negative impacts on soil during the life of project:

- Sewerage breakdown generates significant soil erosion
- Leakage of the water forms subsidence and it leads to deformation and damage to neighboring buildings.

- Water leakage and escape from pump stations and storage ponds lead to the soil erosion.
- Wastewater leakage, overflow and discharge due to breakdown generate chemical and biological contamination to soil and vegetation.
- During the maintenance soil erosion occurs and plants are destroyed and repressed.
- Dredging, many road crossing and domestic and construction trashes disposal might negatively impact on soil fertility, sanitary conditions, water, plants as well as livestock.
- Due to wear down at some parts of fence round the treatment plant and sludge pond, livestock is the source to cause soil erosion.
- When the plant gets damage, safety valve is promptly closed and wastewater discharges through flood protection dam without treatment and pollutes surrounding soil.
- In the course of wastewater treatment soil might be polluted as collection and disposal of drywastes and leakage and overflow of wastewater from the facility. In the sludge pond of old treatment plant, accumulated sludge is the major pollutant for the soil.

4.3.3. Impacts on surface and ground water

- If treatment mode is changed such as suspension of some systems and tune-up, semi treated water is discharged into the Kharaa River and generates adverse effects on water quality.
- Trashes generated by construction work slightly impact on surface water.
- Adverse impacts on river water quality will fall down after the project and it will have a significant impact to ensure ecosystem sustainability in the future.
- Contamination in river water might increase during the construction work.
- Surface water nearby the project area is Kharaa River. Operations to implement project are one of the major contamination sources for the river. Pollution of water source deteriorates commorancies of surrounding residents, animals, vegetation and aquatic habitat and might induce direct and indirect impacts on human health.
- Based on analysis results for the facility water sample, nutrient level of the effluent water is high. Aquatic plant- algae is growing significantly depending upon the nutrients such as nitrogen and phosphorus and it leads baneful influence to fishes, animals and human.
- Treated water from the Darkhan central wastewater treatment plant might impact on surface water in the case of there are unsatisfactory standard quality and technological breakdown /power cut and exclusion of biological treatment/.

4.3.4. Impacts on vegetation

The project area has poor biodiversity and is located at damaged formation due to network assembly and road construction.

Potential changes of vegetation can cause by the following factors:

- Due to human activities and technique operations, vegetation is overpressed and plant regeneration capacity declined.
- Excessive dryness, decrease of water supply and increase of flood damage.
- Before Darkhan was underpopulated whereas its population is going to increase in the future. Thus domestic trashes and emission of poisonous fume will grow.
- Because of close to railway and main road, it is polluted by domestic trashes and might impact on regeneration capacity of some plants that grow along the roads, ravines and hollows.

4.3.5. Impacts on fauna

- Death risk for animals goes up by the vehicle hit occurrences due to increasing traffic of road route during the life of the project.
- Most of the mammals run away due to noise and dust generated by construction work.
- Due to wear down at some parts of fence round the treatment plant and sludge pond, livestock might get stuck in mud and disease spreads as a result of impure water.
- Owing to nearby Darkhan city along Kharaa River has been influenced by human activities relatively early, home range for the big mammals is inconvenient, and regenerative capacity is low whereas noise and dust generated by project implementation might negatively impact on rodents.

4.3.6. Social-economy impacts

Treatment facility that collects domestic wastewater from residents and entities in Darkhan city and treats is producing positive and negative impacts on these. But WWTP is an infrastructure with much positive impacts, because it collects all wastewater generated by consumers at once, treats and disposes in environmentally benign state. The WWTP receives consumers' wastewater continuously and effuses treating into environment.

On the other hand, most of the equipments in existing WWTP were worn due to not much maintenance.

Thanks to rehabilitation of existing WWTP, negative social economical impacts will go down.

- Lifetime for current wastewater treatment plant and equipments comes within an ace of end. By rehabilitating the plant, quality of residents life will improve in the future.
- A certain part of the population will get opportunity to involve in project implementation work.
- Wastewater treatment level will increase.
- Local tax revenues will go grow.
- Employees might injure due to breach of safety operational rules and instructions.

FIVE. MITIGATION MEASURES AND GUIDANCE

5.1. Guidance on negative impacts mitigation

Specialized experts in the course of releasing detailed environmental impact assessment for the project issued the following guidances to project implementers based on environmental baseline data nearby the project area and potential negative impacts generated by expansion construction.

- This guidance, “Environmental Protection Plan” and “Environmental Monitoring Program” are supportive materials aimed at mitigating negative impacts on environment. Annually define the environmental protection plan and implement.
- Estimate required cost for activities that included in environmental protection plan and environmental monitoring program and add in the budget every year.
- In the case of change of the project activities, detailed environmental impact assessment shall be done by “Environ” LLC.
- Present law on environmental protection to all employees and constantly give a guidance on practice apply.
- With the purpose to reduce and eliminate negative impacts to environment the following measures have to be taken:

5.1.1. Air quality

- Develop mitigation plan on maintaining current level and improving air quality in annual environmental protection plan and implement.
- Improve monitoring of air pollution sources and take preventative and mitigation steps for contamination in air ambient /sludge and waste issues need to resolved under the standard/
- Mitigation measure for odour that is the constant source of air pollution need to taken and research for low cost technology is to be conducted. These include: Grow aromatic plants round surrounding area and sludge pond.
- Draw attention to treatment quality including requirement for wastewater from other entities to the wastewater treatment plant to be agreeable to standards; conduct technological rehabilitation
- Intensify the implementation of law and regulation on environment
- Monitor air pollution key sources and take appropriate steps.
- Introduce technology with new pump.
- Oversee building heat loss and good quality assembly of equipments.
- Apply economic incentives within the legal framework.
- Carry out awareness raising activities
- Surrounding horticulture and pools
- Comprehensively resolve waste issues

Mitigation on offensive smell

In the course of natural drying process for sludge generated from project activities, offensive smell of sludge decomposition cause adverse and inconvenient conditions to surrounding residents especially during warm season. Also water during the

treatment process emits odour. Thus it is essential to comprehensive measures aimed at smell level mitigation. To accomplish this:

- Quickly dry the sludge using equipments
- Conduct research and experiment on substances that counteract the decomposition smell for quick drying process using equipment
- Cover the overgrazed land within project area with topsoil and vegetation.
- Previous years' dried sludge need to be disposed at allowable dumpsite or area.
- Install odor control equipments in facility
- Produce power, bio fuel and fertilizer fixing sludge processing equipments and utilize in domestic demand
- Smell limiting or controlling is main issue that need to be considered in preconstruction and operation stages. Take odor control equipments into consideration in the course of design phase. As well as mitigation measures for unpleasant odor especially hydrosulfuric acid with low concentration must be taken. Mitigation strategy should be developed including odor source location, chemicals and substances that emit smell and advanced technology. Many technologies have been used to reduce odour. Such as: sealing equipments, using chemicals and using chemical/biological system. In addition it needs to lay down conditions for installation of odor control equipments.

5.1.2. Impacts on soil

Potential impacts to soil cover shown in research during collection and disposal of sludge and solid wastes that generated by technological processes of wastewater treatment. So mitigation measures should be taken in every source.

- If treatment mode is changed such as suspension of some systems and tune-up, semi treated water is discharged into the Kharaa River and generates adverse effects on soil quality.
- Previous years' dried sludge need to be disposed at local dump site or area under the agreement
- Find solutions whether there is possibility to produce secondary raw material by sludge
- Maintain sewerage constant operation and clean trashes
- During rehabilitation stage, received wastewater will be treated in mechanical biological method. When modification of networks and demolishments of concrete structure, wastewater might pollute soil due to leakage of wastewater. Thus, operational regime and design should be adhered.
- Since there are excavated holes, trenches, many road crossings, overgrazed land and vegetation nearby treatment plant, cleaning and rehabilitating need to be intentionally carried out.

- Due to wear down at some parts of fence round the treatment plant and sludge pond, livestock is the source to cause soil erosion. Thus rebuilding fence round the plant is needful.

The standards should be adhered including

- MNS 5914:2008 Rehabilitation term and definition
- MNS 5918:2008 Revegetation technical requirements of damaged areas
- MNS 5916 : 2008 Fertile topsoil stripping during the excavation
- MNS 5850:2000 Soil quality assessment

5.1.3. Water quality

Even though there is no surface water in project area, treated water or factory effluent is directly discharged into the Kharaa River and it is one of the potential impacts on surface water. Also waste is transmitted by precipitation and flood water and distributed through the earth surface. It leads contamination sources. Thus it is appropriate to implement the following mitigation actions on water contamination. These include:

- Constantly clean the flood and drain systems and prevent from trash accumulation
- Build the flood and drainage lines of new treatment plant under the scheme
- Construct treatment plant with modern advanced technology, treat the wastewater in allowed limit and monitor its implementation
- Make analysis of wastewater receiving from other plants and facilities, monitor and eliminate any breaches
- Dispose solid wastes keeping from water sources
- Monitor underground water contamination, take samples for analysis and bore wells
- Collect domestic wastewater and rainwater, and irrigate vegetable
- Construction work cause most pollution in soil and earthsurface water. In the case of repair of pipeline outlet, a certain amount of suspended solids enters into surface water and contaminates. It will be one of the destroyer factors for homeranges including fishes and invertebrata. Thus relevant rules must be strictly followed and advice of specialists needs during construction work.
- Ground water removal may be carried out during construction work depending upon foundation depth. If the foundation is below bottomwater surface, flow direction of undder groundwater might be changed in case of soilwater revomal. It needs to avoid dropping chemicals used when build foundation.
- Human improper activities afefct water contamination. There are many improper relations with environment such as dropping litter and washing car along river, tending fire on lawn and burning wickers. Especially it is abundant in urban area and needs to take measures designed to halt.

5.1.4. Vegetation

Rehabilitation should be done after treatment plant project is completed. Majority of species in this area of meadow and shore plants as well as of weeds, which are prone to quick deterioration and depletion under intensive activities.

- Specially define the biological species of the area and utilize large amount of meadow and marsh plants their seeds in the course of rehabilitation
- Rehabilitate by using surrounding plant seeds and vegetative organs
- Resolve waste and sewerage issues in the area in proper ways
- Conduct research for possibilities to plant saplings along road and railway by establishing
- Search possibilities to derive profit from the saplings for resolving social issues of employees
- Destroy poisonous plants in the project area including *Hyoscyamus niger* L and *Solanaceae*
- Construction work of the treatment plant will cover overall 2 hectares and produce temporary impacts to vegetation. Thus supportive actions for plant and revegetation need to be held. During lifetime of the project, rehabilitation, revegetation and sowing bruches, trees, saplings in overgrazed area will be done by specialists under the standards and technologies

5.1.5. Fauna

- It is needful to catch small mammals in order to define their numbers
- Owing to nearby Darkhan city along Kharaa River has been influenced by human activities relatively early, home range for the big mammals is inconvenient, and regenerative capacity is low whereas noise and dust generated by project implementation might negatively impact on rodents. Construction work may cause negative impacts: traffic will be increased, animals might hit by machines, most mammals will get away due to noise and dust. To mitigate these impacts vehicles need to be moved in special way under speed limit.
- Once the plant is located next to Kharaa River, animals that water from Kharaa River might not reach to their water source so that measure for blazing a path around the plant to get river is to be taken. If necessary, the fence will be built.
- Vegetation preventative measures by digging holes in the soil of the project area to enhance air volume should be taken because significant insects that eat larvae and eggs of pests and pathogens are abundant.
- Due to wear down at some parts of fence round the treatment plant and sludge pond, livestock might get stuck in mud and disease spreads as a result of impure water so that it should be made a fence of enclosure.

5.1.6. Social-economic measures

- To provide operations at a high level of fire safety
- In order to prevent against the industrial accidents, all employees should be involved in specialized medical examination at least 2 times a year and required equipments need to be continuously provided

- Under the plan and design, to build green area in possessed area and to keep regular maintenance
- To organize permanent training on preventing fire and flood danger due to force majeure
- Employees should be adhere safety operational rules as well as permanently taken labour safety measures under the relevant law and rules
- To be conducted annual physical examination by professional doctors and taken building-up measures
- Safety operational rules should be followed in order to prevent chemicals poisoning and burning in laboratory
- Regularly provide staffs who work in laboratory and in toxic and hazardous conditions with dairy products such as yogurt, milk and curd

5.1.7 Mitigation measures for health adverse impacts

Because of permanent operation, employees should have special equipments and should adherence safety rules when dealing with electronics. Due to improper handling with equipments, employees might get potential injuries and accidents such as electric shock as well as loss of life. Since in aquatic environment, there is moist medium. Unfavourable conditions such as workplace has a high level of noise and relative humidity might generate adverse impacts.

Increase of temperature, humidity and noise in the workplace, and bad lighting not only reduce labour productivity but also increase risk of the accidents and adversely affect on health.

Rehabilitation stage including demolishment of the facility and construction can produce adverse impact on employees' health

Noise level in workplace:

- As a result of high level of noise, employees get rapid fatigue, attention distraction and insomnia, and their labour productivity reduces due to central nervous system that influenced by brain tissue damage
- Changes in cardiovascular system, pressure increase, and normality loss in metabolism and process of digestion
- Hearing organ will be hurt and gradually hearing will be lost
- Normal relationship between employees loses and because of noise and information, caution and signal are disturbed due to noise. Human hearing organ receives sound with up to 16-20 thousand Hz /Herz/.

In order to mitigate noise level, maintain good sealing for machinst cabinet and lubrication and maintenance of new equipments should be done according to the instruction.

CHAPTER 6. CONCLUSION

“Environmental Detailed Impact Assessment” for extension project of Wastewater Treatment Plant, Darkhan Us Suvag LLC in the territory of Darkhan county, Darkhan-Uul province was developed by environmental consulting company “Environ” LLC.

After Darkhan Us Suvag was established in 1965, the pumps were replaced by further Russian equipment, there has not been any further investment. First the plant had a design capacity of 50,000 cum/day, but the plant is currently operating at a load of about 7,000 cum/day in summer and an average of 10,000 cum/day in winter, with a reported peak flow of less than 20,000 cum/day. During the month of August 2013, daily flow rates into the plant varied between 5,100 and 10,900, and averaged 7,100 cum/day. Consequently, only one stream (out of three) of both primary and secondary clarifiers is necessary. However, all three streams of the activated sludge biological reactor are operated, resulting in excessively long aeration periods. And it operates at economy and time losses.

The plant is struggling to keep going, and suffers frequent breakdowns which compromise the treatment efficiency and risk pollution events. In summer and autumn of 2012 regular aeration failures were observed due to the breakdown of the blowers, which on occasion, lasted for more than one week. The repeated blackouts led to a loss of activated sludge and negatively impacted on the treatment efficiency

For new treatment plant, 4 technological options of treatment were proposed and Environmental Detailed Impact Assessment was done to Basic Activated Sludge System that negatively impacts on environment.

Based on the survey results:

- Main impacts on environment are earthworks during extension construction, and dust and noise generated by large vehicles might negatively influence earthsurface, soil, air and wild animals that live in surrounding area.
- Offensive odour from sludge pond (dry in nature without no apply with sludge) can cause negative consequences including aposematic and comfort disturbance to surrounding residents and animals due to treatment plant (with basic activated sludge system)
- 48 chemicals used in Laboratory of Darkhan Us Suvag are transported from Ulaanbaatar city. In case of incidental and undeliberate accidents, environment, animals, residents, passer-by might be affected.

But adverse impacts on environment are comparatively low because these chemicals are provided in the form of neutralized solution, transported with relatively small amount.

Adding treated wastewater (80-92%) to environment or river has unexampled positive impact so that the project is possible to be implemented in the case of adherence of mitigation guidance for negative impacts and environmental protection plan.

Батлав:
БОНХЯ-ны ерөнхий шинжээч

Шүүмж хийсэн:
БОНХЯ-ны шинжээч



Д. Энхбат

С. Баярцэцэг



**“ДАРХАН СУМЫН ТӨВ ЦЭВЭРЛЭХ БАЙГУУЛАМЖИЙГ ӨРГӨТГӨХ” ТӨСЛИЙН
БАЙГАЛЬ ОРЧНЫ НАРИЙВЧИЛСАН ҮНЭЛГЭЭНИЙ БАЙГАЛЬ ОРЧНЫ
МЕНЕЖМЕНТИЙН ТӨЛӨВЛӨГӨӨ**

Нарийвчилсан үнэлгээ хийсэн
Мэргэжлийн байгууллага:
Энвайрон ХХК-ийн захирал



Н. Эрдэнэсайхан

Төсөл хэрэгжүүлэгч:
Барилга хот байгуулалтын яамны
Орон сууц, нийтийн аж ахуйн бодлогын
хэрэгжилтийн зохицуулах газрын дарга



Р. Эрдэнэцэцэг

Төсөл хэрэгжих нутаг:
Дархан- Уул аймгийн засаг даргын орлогч,
Дархан сумын засаг дарга



Б. Азжаргал

Улаанбаатар хот
2014 он

Unofficial translation of approved page of EMP DEIA

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EIA Expert, MEGD



**ENVIRONMENTAL MANAGEMENT PLAN FOR
A DETAILED ENVIRONMENTAL IMPACT ASSESSMENT REPORT**

**FOR EXPANSION PROJECT OF CENTRAL TREATMENT PLANT IN
DARKHAN-UUL PROVINCE**

DEIA performed by:
DEIA licensed company

Mr. Erdenesaikhan N., Director, Environ LLC

Project Executing Agency:

Ms. Erdenetsetseg R., Director, Apartments and Public Utility Policy
Implementation Department, MCUD

Local Administration:

Mr. Azjargal B., Vice governor of Darkhan-Uul Province and Governor of Darkhan
County

Ulaanbaatar 2014

CHAPTER 7. ENVIRONMENTAL MANAGEMENT PLAN

7.1 Environmental Protection Plan

Environmental Management Plan consists of Environmental Protection Plan and Environmental Assessment Report.

Environmental Management Plan identifies main impacts of the proposed project activities to the environment and society and based on the identified impacts, it proposes activities aimed to reduce or remove negative impacts of the project and estimates required funding and costs to implement stated activities.

Roles and responsibilities of various organizations for EMP implementation are included in table 36.

Table 36 Involvement and Responsibilities of Organizations for Implementation of EMP

No.	Organizations	Relationship with project and EMP	Responsibilities for implementation of EMP
1	Ministry of Environment and Green Development of Mongolia (MEGD)	State Central Body for environmental policy setting and policy implementation	<ul style="list-style-type: none"> • Screening of project for general impact assessment • Review of DEIA report and EMP content • Approval of DEIA and EMP • Review of yearly report of EMP implementation • Approval of EMP for next year
2	Darkhan Us Suvag LLC	Executing central agency in charge of Darkhan wastewater treatment plant Executing agency in local	<ul style="list-style-type: none"> • Coordination between agencies responsible for projects, activity of project management committee • Provide guidance for implementation of EMP • Control EMP monitoring • Coordination of executing agency and consultants for wastewater treatment plant • Review of monthly, quarterly, yearly report of EMP and approval of EMP for next year • Submission of EMP to MEGD
3	State Professional Inspection Agency (SFIA)	State organization environmental enforcement monitoring Central for policy and	Environmental law enforcement agency <ul style="list-style-type: none"> • Annual and quarterly monitoring of EMP implementation through its

			Darkhan Uul province department
			<ul style="list-style-type: none"> • Report to MEGD on EMP implementation
4	Project implementation unit	Day to day activity of EMP	<ul style="list-style-type: none"> • Oversee of contractor's activity on EMP implementation • Coordination of Consultant and contractor for bridge and road construction and subcontractors activities for EMP • Organization of daily monitoring according to EMP • Submission of annual performance report for EMP • Development of EMP for next year

To develop Environmental Management Plan, we considered all the environmental protection activities that have been reflected in the Detailed Environmental Impact Assessment Report, its duration, required costs, institutional framework and implementation management, and monitoring mechanisms.

7.1.1 Prevention from air and environmental pollutions

Impact code- air

During the project implementation period polluting substances in the atmosphere will be increased due to increased dust during the wastewater treatment construction process, emissions from machines, mechanism and equipment. Thus, preventive measures are to be taken. To execute air quality standards shown at table 37 must be complied.

Table 37 **Air quality standard**

Parameters	Average temperature for measurement	Measurement unit	Acceptable content level
Chemical impact			
Sulfuric gas (SO ₂)	Average in 10 minutes	Mkg/m ³	500
	Average in 20 minutes		450
	24-hours average		20
	Annual average		10

Carbon monoxide (CO)	Average in 30 minutes 1 –hour average 8 –hours average	Mkg/m ³	80 000 30 000 10 000
Nitrogen dioxide (NO)	Average in 20 minutes 24-hours average Annual average	Mkg/m ³	85 40 30
Ozone /O/	8 –hours average	Mkg/m ³	100
Dust /total weighing substance/	Average in 30 minutes 24-hours average Annual average	Mkg/m ³	500 150 100
Coarse dust /PM10/	24-hours average Annual average	Mkg/m ³	100 50
Ground dust /PM2.5/	24-hours average Annual average	Mkg/m ³	50 25
Lead /Pb/	24-hours average Annual average	Mkg/m ³	1 0.5
Benzene /CH/	24-hours average	Mkg/m ³	0.001
Physical Impact			
Noise			
Daytime /7-23/	16-hours average	DB	60
Night time 23-07	8-hours average		45

Table 37 shows acceptable levels under the standard and norms and permitted level of pollution under the environmental license.

Table 38 **Acceptable maximum concentrations for dust and toxic gases in air**

Parameters	Maximum concentration	Daily average concentration
Dust, mkg/m ³	500	150
Carbon monoxide, mkg/m ³	80,000	30,000
Nitrogen dioxide, mkg/m ³	85	40
Sulphuric gas, mkg/m ³	500	30

Observation and monitoring requirement:

It is necessary to be done detailed monitoring and examinations to prevent air contamination during the life of project. These include:

- To regularly control dust, noise levels
- During the project implementation period, air sample will be taken by professional institution and it should be analyzed
- To held annual medical examination for employees in order to make medical controls for symptoms of occupational diseases

Financing source

Project implementer has to cover expenses for mitigating negative impacts to environment in annual financial plan and to conduct activities according to the plan.

Table 39 shows expense estimation for preventive measures from air pollution.

Table 39 Expense estimation for preventive measures from air pollution. X 1000 MNT

Implementati on activity	Duration	Contractor	Contracting organizatio n	Frequency	Detailed cost for activities					Total cost
Air pollution status to be defined by professional organization	Since beginnin g of project activity	General project manager and environment al manager	Authorized professional organizatio n for air quality assessment	Twice a year, in late of June and December	Staff salary	Transportation cost	Measurement & sample cost	for laboratorial analysis		680.0
					400. 0	50,0	150.0	80.0		1360
During the construction period, to organize preventative measures for dusting in the air	Since beginnin g of project activity	Environment al manager appointed by contractor	Contractor executes it by own techniques, technologie s and work force	Once a month in dry season and 6 times a year	Managing officer	Employees' salary 2 people	Transportati on cost	Water norm /25000l*6 time*1.5¥/	Fuel cost /1800¥*150km/	1895.0
					500. 0	800.0	100.0	225.0	270.0	11370.0
Avoid polluting the environment by solid wastes	Since beginnin g of project activity	Contractor's supervisor	Contractor executes it by own techniques, technologie s and work force	To collect and remove solid waste to the dumpsite, once a month (12 times a year)	Transportation cost for removing solid waste from construction			Work cost		1450.0
					1000.0			450.0		17400.0
Avoid making exhalation of lubricants and oil in the air	Since beginnin g of project activity	Contractor's manager in charge of technical safety	Mechanic and drivers of the contractor	To make permanent control on quality of technical maintenance services	Monitoring environmental manager			Work cost / monthly basis/		600.0
					Within a year			50.0		

Total cost	30730.0
------------	---------

The following preventative measures are to be taken to avoid air pollution. That includes:

- To select sampling locations for air pollution measure in the center of the project area and lower part of the wind direction near sludge pond. The professional institution needs to apply genial method to analyze. The analysis is to be done in winter and summer.
- In order to prevent from dust in the air, spray by means of irrigation vehicle in overgrazed land and unpaved roads for construction vehicles during dry seasons in total 6 times (spring, summer and autumn).
- In order to mitigate odor from sludge pond to the environment and air, search potential way and implement. Place the solid wastes generated by treatment in special trash bin or bunker and dispose or remove at dumpsite under the agreement.
- In order to avoid making exhalation from lubricants and oil, permanently monitor safety of employees and vehicles. In case of lubricant and oil leakage, one should immediately remove and clean the soil and comply with waste removal procedure.

7.1.2 Prevention from soil contamination and erosion

Impact code- soil

Every phase of project activities or during collection and disposal of sludge and drywastes from technological phase – wastewater treatment, soil cover might be contaminated based on the survey. Sources of soil contamination are repairs of sewerage, pump stations, treatment plant, maintenance works, earthworks in expansion construction, and vehicle traffic. Even though there was no wastewater leakage and apparent contamination nearby central plant, soil around the area is considered most likely to be contaminated.

Objects affected by impacts

- Soil nearby treatment plant and along pump and pipe
- Field soil where to be constructed expansion
- Transportation route for building materials

Acceptable volume in standard: Standard (MNS5850: 2008)

Table 40 Acceptable volume of heavy metals in project area soil /mg/kg/

Section number	Coordinate	Heavy metal volume mg/kg				
		Cr	Pb	Cd	Ni	Zn
WWTP-1. River bank	49°30'31. 3	15.5	20.1	0.23	7.1	187.8
	105°54'11. 5					
WWTP-2. River bank sediment	49°30'31. 2	7.9	5.5	0.04	4.7	23.5
	105°54'11. 2					
WWTP-3. Extension area	49°30'24. 3	21.7	18.7	0.08	21.5	200.6
	105°55'28					
WWTP-4. WWTP area	49°30'28. 3	73.9	12.3	0.05	12.9	94.8

	105°55'31.3					
WWTP-5. Sludge pond	49°30'33.1	60.3	63.8	0.11	8.1	192.7
	105°55'36.9					
WWTP-6. Mountain slope	49°30'22.9	16.9	15.2	0.07	10.6	68.5
	105°56'02					
Standard (MNS 5850: 2008)		150	100	3	150	300

Based on above table, volume of the heavy metals such as chromium (Cr), plumbum (Pb), cadmium (Cd), nickel (Ni), zinc (Zn) in the soil didn't exceed standard.

Observation and monitoring demand:

It is necessary to make control on roads and routes where machines and techniques pass over. Monitoring on land characteristics, soil quality and occurrence of contamination should be carried out and its reports are to be submitted to relevant offices by the target.

Finance source:

Project implementer has to cover expenses for mitigating negative impacts to environment in annual financial plan and to conduct activities according to the plan. Expense estimation for preventive measures of soil contamination has shown in table 41.

Take samples from pipeline outlet, ravines, sludge pond and wastewater treatment plant area and monitor soil quality.

Table 41 **Expense estimation for preventive measures soil contamination.**
X 1000 MNT

Implementation activity	Duration	Contractor	Contracting organization	Frequency	Detailed cost for activities			Total cost
Soil contamination status to be defined by professional organization	Since beginning of project activity	Project general manager/ environmental manager	Authorized professional organization for soil quality assessment	Twice a year, in March and September	Staff salary	Meal and transportation cost	Soil contamination status to be defined by professional organization	Since beginning of project activity

Central WWP extension project in Darkhan county, Darkhan province

					400.0	50.0		210.0		
Clean the damaged roads during earthwork, pave and rehabilitate the roads	Since beginning of project activity	Contractor's supervisor	Authorized professional organization executes	Annual	Managing officer	Employees' salary 20 people and 5 days	Transportation cost	Fuel cost	Additional cost	7450.0
					250,0	5000.0	1000.0	200.0	1000.0	
Build drain pipes along road, field and other places that potentially impacted by flood	Since beginning of project activity	Contractor's supervisor	Authorized professional organization executes	Annual	Managing salary	Employees salary /4 people, 5 days/	Meal and transportation cost	Fuel cost	Additional cost	3550,0
					250,0	1000.0	1000.0	300,0	1000.0	
					400.0	1000.0	2000.0	3000.0	700.0	
Set board and signs preventing soil erosion in area of expansion construction	Since beginning of project activity	Contractor's supervisor	Contractor executes it by own techniques, technologies and work force	Annual	Specialist's salart			Material		750.0
					50.0			700.0		
Total cost										13070.0

7.1.3 Prevention from water contamination

Impact code- surface and underground water

Water might pollute in the following ways:

- Solid waste, which are disposed in open area may be absorbed to soil through water during the rain and flood, causes pollution flowing into the surface water and leaks underground water.
- Because of no irrigation ditch, work condition complicates and construction work might be afflicted with flood.
- Spillage of lubricants and oil from vehicle may pollute surface and groundwater.

Objects that might be impacted

- Underground water
- Surface water
- Employees

Acceptable level by standard:

Environmental Conservation. Hydrosphere. General requirement for underground water protection from contamination MNS 3342-82

Conservation instruction of water resources from pollution (1st attachment to joint resolution No. 143/A/352 in 1997 by Ministries of Environment and Health and Social Welfare)

Drinking water. Hygienic standard and its monitoring MNS 900-2005

Acceptable maximum level of toxic and poisonous chemicals in water for domestic usage (5th attachment to joint resolution No. 143/A/352 in 1997 by Ministries of Environment and Health and Social Welfare)

Water ambient quality parameters MNS 4586-98

Rules for population's drinking water sources and hygienic region protection (1st attachment to joint resolution No. 167/335/a/171 in 1995 by Ministries of Environment, DPP and Health)

Recording procedure for pollution, drawback and rehabilitation of water resources (2nd attachment to joint resolution No. 167/335/a/171 in 1995 by Ministries of Environment and Health)

Water consumption norm "Identifying payment percent and rate" Government resolution No. 7, 2005

Funding source:

Project implementer needs to include expenses for mitigating negative impacts to environment in annual financial plan and to conduct activities according to the plan. Expense estimation for preventive measures of water contamination has shown in table 42.

Table 42 Cost estimations for preventative measures for water pollution. X 1000, MNT

Implementation activity	Duration	Contractor	Contracting organization	Frequency	Detailed cost for activities		Total cost
Water contamination is to be defined / more than 4 samples from surface water and samples from confluence with Kharaa River	Since beginning of project	Contractor's supervisor, chemical laboratory	Darkhan Us Suvag LLC executes in their laboratory	2 times a month	Specialist's salary	Measurement & sample cost	-
					-	-	

Implement mitigation measures on surface water contamination according to monitoring	Since beginning of project	Environmental manger	Darkhan Us Suvag LLC	Quarterly	Managing salary	Salary fund	Transportation cost	Fuel cost	Other	<u>4000,0</u> 16000,0
					500.0	1500.0	600.0	900.0	500.0	
Place boards and signs to protect water contamination	Since beginning of project	Contractor's supervisor	Contractor executes it in own techniques, technologies and work force	Annual	Specialist's cost	Material		750,0		
					50,0	700,0				
Total cost									16750,0	

7.1.4 Impacts on vegetation

Impact code: Vegetation

The following impacts might arise during infrastructure construction:

- Due to no specialist's instruction, fertile soil layer is mixed, mechanical damages occur and potential soil to grow plant might be decayed in the course of infrastructure construction
- Damage soil and vegetation by road crossing
- Surrounding soil might be contaminated by spillage of lubricants, oil and wastes
- Soil solidents and oxygen drawback can be formed because of decrease of species of rodents, insects and micro organisms in earthsurface

Monitoring

- After the project is completed, carry out monitoring 3 times a year or in spring, summer and autumn whether rehabilitation is being held under the design
- Monitor plant growth process 3 times a year or in spring, summer and autumn
- Harvest crop in lawn area 3 times a year or in spring, summer and autumn
- Examine external factors /such as disposal of dry and liquied waste, overgrazed by human activities and technical operations/ that potentially impact in rehabilitated area
- Fence round the rehabilitated area and green area

Table 43 Cost estimations for preventative measures for water pollution. X 1000, MNT

Implementation activity	Duration	Contractor	Contracting organization	Frequency	Detailed cost for activities	Total cost
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Central WWP extension project in Darkhan county, Darkhan province

Quarterly monitoring cost	At the end of the project activities	General manager and environmental manager of the project	Authorized professional organization and specialist for fauna assessment	2 times a year in May and September	Specialist's salary	Meal and transportation cost	Sample cost for harvest		650,0
					400.0	50,0	200.0	1300.0	
Experiment with another plant if no growth occurs	At the end of the project activities	General manager and environmental manager of the project	Specialized institution for rehabilitation, environmental specialist of the project	A month after seeding	Specialist salary	Transportation cost	Material cost		1000,0
					400.0	100.0	500.0		
Rehabilitation cost	At the end of the project activities	General manager and environmental manager of the project	Specialized institution for rehabilitation, environmental specialist of the project	Once a year or in spring	Employees' cost /3 people 15 days/	Techniques' cost	Material cost	Fuel cost	8050,0
					2250,0	600.0	5000.0	200,0	
Irrigation	In the course of rehabilitation	General manager and environmental manager of the project	Specialized institution for rehabilitation, environmental specialist of the project	2 times a week or 8 times a month, totally 4 months	Employees' cost /1 person in a month\	Transportation cost	Fuel cost		980.0
					400.0	400.0	1,8*100l	37360.0	
Overall cost									41710,0

The total estimated investment in environmental protection is **102260,0 thousand togrogs**.

7.2 Environmental monitoring mechanism

Monitoring mechanism aims to draft environmental monitoring program including pollution monitoring for water, air and soil during the project implementation period, examination methodology to monitor any changes in each environmental component, monitoring period, location of the sampling points, parameters to be identified by the examination, concluding and reporting examination result, prevent from negative impacts to the environment, or in case negative impacts occur propose required measures to eliminate or reduce.

7.2.1 Air Pollution Monitoring

Monitoring demands and parameters

Causing air pollution by dusting and fuel exhalation during the construction building works and causing unsuitable odor to the environment due to no disposal of waste at scheduled time are required to execute monitoring.

Parameters will be monitored such as dust, carbon monoxide /CO/, carbon dioxide / CO₂/, nitrogen dioxide /NO₂/, sulphuric gas /SO₂/, and noise content.

Air test type and form

Air sampling and testing

Monitoring duration

Air sample is to taken and tested it in June and November of every year

Cost of air quality analysis

(It was included in environmental conservation detailed cost)

Monitoring methodology

Controlling procedure of air quality in urban area MNS 17.2.3.16-88

Atmosphere. Basic requirements for sampling MNS 3384-82

Methodology for identification and classification for labor conditions and identification for evaluation criteria MNS 12.100-91

Air and hygienic standards in the work zone MNS 12.013-91

Measurement method for weather at work places MNS 12.054-91

Identification of dust level in the air of work places MNS 12.055-91

Air quality index

General standard MNS 4585-98

Equipment

By using of equipment of specialized organization

Table for outcome records and reports

Analysis needs to be executed by professional organization and reported according to approved form of the organization

Analysis laboratory

Botanical laboratory: Tel-451014, Address: Building of Jukov's Academy of Sciences, 13th khoroo, Bayanzurkh district

Central laboratory of Environment: Tel-341816, Address: Chinggis avenue, Khan-Uul district

Data collection, processing and reporting

Monitoring record and report will be prepared in the approved form of authorized organization and submitted to Environmental Agency by July 15 and December 15 of every year.

7.2.2. Soil contamination and erosion monitoring

Demands for monitoring and parameters

It is necessary to monitor conditions that may cause soil contamination and erosion due to human unintended activities during wastewater treatment construction and trashes generated by the construction work. Soil contamination level is defined by volume of heavy metal.

Monitoring types and forms

Soil samples must be taken from project area and analyzed by comparing results.

Sample point

Samples will be taken from effluence from pipeline outlet, ravine, and treatment plant area and sludge pond.

Monitoring time

April in spring and October in autumn

Monitoring methodology

Environmental Conservation. Soil assessment index and norms in urban area MNS 3297-91

General sampling standards for tests MNS 3298-91

Soil. Procedure for sampling, package, shipment and storage MNS 2305-94

Soil. Identification for soil agrochemical parameters MNS 3310-91

Environmental Conservation. Soil. Description of Hygienic parameters MNS 3985-87

Equipment

By using of equipment of professional institution

Table for outcome records and reports

Analysis needs to be executed by professional organization and reported according to approved form of the organization

Data collection, processing and reporting

Monitoring record and report will be prepared in the approved form of authorized organization and submitted to Environmental Agency by May 15 and November 15 of every year.

7.2.3 Water pollution and consumption monitoring

Monitoring demands and parameters

Underground and surface water can be polluted during construction works so that it should be monitored as follows:

- Non sensation features and physical characteristics (color, odor, taste, transparency, turbidity, suspended solids and temperature)
- Oxygen parameters /dissolved oxygen, chemical oxygen, biochemical oxygen demand/
- Minerals /calcium, magnum, total hardness, vanishing hardness, static hardness, chloride, sulfate, carbonate, hydro carbonate and total minerals/
- Water level

Monitoring time

Spring in every year

Monitoring methodology

Rule of monitoring surface water quality MNS 4047-88

Sampling method for water test and standard methods for chemical tests MNS 3534-83

Water sampling tests MNS 3534-83

Quality indexes of hydrosphere MNS 4586-98

Controlling procedure for surface water quality MNS 4047-88

Procedure for estimation of basic water consumption

Procedure for report preparation on water consumption

Water utilization contract

Equipment

By using of equipment of specialized organization

Table for outcome records and reports

Analysis needs to be executed by professional organization and reported according to approved form of the organization

Data collection, processing and reporting

Monitoring record and report will be prepared in the approved form of authorized organization and submitted to Environmental Agency by May in the particular year.

7.2.4 Noise monitoring

Monitoring demands and parameters

It is likely that noise level generated by construction work may exceed acceptable norms and impact to employees' health, so that noise monitoring should be conducted. Details of monitoring: Regularly monitor noise level

Monitoring time

Every two weeks

Monitoring methodology

Safety operation and hygiene; Environment in workplace; Hygiene standard MNS 4990:2000,

Safety operation and hygiene; General standard to measure light norms at workplaces MNS 4996:2000,

Safety operation and hygiene; General standards to measure noise at workplaces MNS 5003:2000,

Safety operation and hygiene; General standards to measure dust content in the air of workplace MNS 5010:2000

Table for outcome records and reports

Analysis needs to be executed by professional organization and reported under the approved form of the organization

Data collection, processing and reporting

Monitoring record and report will be prepared in the approved form of authorized organization and submitted to Environmental Agency by April 15 and November 15 in the particular year.

7.2.5 Medical monitoring

Monitoring demands and parameters

Noise and dust levels generated by construction work may exceed norms at work places, which in turn impact health of construction workers. Therefore, monitoring for employees' health should be done constantly.

Monitoring time

All employees need to be involved in medical examination once a year.

Monitoring methodology

Complex medical examination diagnostics

Table for outcome records and reports

Analysis needs to be executed by professional organization and reported under the approved form of the organization

Data collection, processing and reporting

Monitoring record and report will be prepared in the approved form of authorized organization and submitted to Environmental Agency by October in the particular year.

7.2.6. Other issue

- Additional requirements from administrative institutions of the province regarding to activities must be promptly met.
- Constant cooperation with environmental and professional inspection organizations on enforcement of laws on environmental protection.
- In case of change of project activities, appropriate and additional clarifications to environmental plan and environmental monitoring program need to be submitted to Ministry of Environment and Green Development.

Analysis and report:

An officer in charge of environmental issues must write down monitoring report on the special notebook and give evaluation and conclusion. As a result of monitoring report, there is a negative impact to the environment, one must immediately inform to "Environ" LLC and related professional institution in order to conduct research.

7.3 Grievance Redress Mechanism

Project implementation unit will provide simply and effective Grievance Redress Mechanism which is sufficient for impact receptor individuals and organizations.

Project implementation unit will establish and implement easily and effective Grievance Redress Mechanism which is sufficient for impact receptor individuals and organizations at the first stage of the project.

To design structure and organization, Grievance Redress Mechanism must comply with following principles, including:

- Every complaint and request from industrial employees and residents in the territory of project implementation must be received and informed back on its accept. Transparent system needs to be established.
- Define whether every complaint and request includes in project scope and whether it is reasonable
- Research complaint issue, data collection of identical complaint experience, whether it is available to solve within the project scope; if it is available to be solved, discussion with others on which solutions are appropriate
- Methods to resolve with/without independent advisory and third party
 - Under the internal rules or approved ethics and indicators, complaint response has to be given within the project management, as well as in case that complaint was not solved, opportunity submitting to governing body of the project will be provided.
 - To find out solution based on mutual discussion between plaintiff and project implementer
 - In case that parties can't make decision based on mutual agreement, complaints will be resolved rooted in lateral body
- Establish monitoring system to monitor complaint solution and measure and verify whether it was informed back.
- Distribute information on taking/taken measures according to complaints of residents, industrial employees and workers in the territory of project site; collect residents' vote on structure and organization for receiving complaint and resolving.
- Even though complaints from impact receptors that are elders, women, children with low income, no land property and who are living in the territory without land license should be drawn special attention and generally discussed in consulting meeting.
- If impact receptors- individual and organization don't have good satisfaction for decision, he/she has a right to submit to Mongolian Court.

7.3 Implementation schedule of Environmental Management Plan

Duration of EMP corresponds with total project implementation period.

Baseline data and condition in environmental detailed impact assessment and measures, parameters and expected results in environmental protection plan will be included when developing materials for tender to select contractor.

After the contractor was selected, agreement needs to be covered with provisions of environmental protection plan as well as a copy of environmental protection plan will be given to the contractor.

The contractor is legally binded to implement environmental protection plan, while on the duty for project execution. The contractor is obliged to renew EMP annually based on the monitoring results as well as on the results of corrective actions to reduce the negative impacts and submit the renewed EMP to implementing agency.

To implement environmental protection plan, the contractor needs to cooperate with environmental office, Darkhan county in Darkhan Uul province and issue report on plan implementation at fixed time.

The project team will supervise over plan implementation.

CHAPTER 8. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

Public consultation and information disclosure processes were taken two times at two levels during the assessment period.

Firstly, the social experts within the framework of Feasibility study team organized a public opinion survey on water supply and wastewater treatment issues among residents in Darkhan City. The survey has been organized during 22-27 January 2014. Area based sampling method was employed in selecting 100 households from apartment residents and 100 households from ger district of Darkhan City.

The survey covered the following issues:

- Socio-economic status of survey covered households
- Current situation and consumers satisfaction with the current water supply and waste water treatment services and
- Needs for improvement of water supply and wastewater treatment services

The survey results have been reflected in a separate chapter as “households socio-economic survey” within the feasibility study report.

If shortly describe the findings, the minimum standard of living in Darkhan-Uul aimag was pegged at 117,500 tugrugs (abided 1 April 2012) per capita per month. With the average size of the household at 4, the minimum standard of living (MSL) per household on a monthly basis is 470,000 tugrugs or 5,640,000 per year. Using this as basis for poverty threshold, the households in the Darkhan city may be categorized into poor and non-poor, where those households with income falling below the threshold are considered poor. The results denote that the poverty incidence in the Darkhan city is 26.5%, where the poor earn an average monthly income of 3,642,642 tugrugs, way below the MSL in Darkhan-Uul aimag. For ger area households, poverty incidence is 44.0%, while it is 9.0% for apartment area households

Residents don't have knowledge and information about the water supply and sanitation service of the Darkhan city and have not realized there are problems. One quarter of Darkhan city resident don't know what organization provide water supply and sanitation service to them. Almost half of ger area residents don't know what organization provide water supply and sanitation service to them. Also apartment residents don't realize that sanitation service in Darkhan city is problematic as other stakeholders expected such as Darkhan Us Suvag JSC, Apartment Owners Association and City Mayor's Office. Residents of Darkhan city named poor sanitation service in eighth place among 12 selected environmental and social infrastructure issues and 61.0 percent of respondents answered this issue is existed in their living area. 70.0 percent of ger area respondents said this issue is existed in their living area, while 52.0 percent of apartment residents said this issue is existed in their living area. No one of ger area residents is satisfied with current sanitation situation. 80.0 percent of apartment area residents satisfied with current sanitation situation.

Residents of Darkhan city named pollution of the Kharaa River in the second place after air pollution among selected environmental and social infrastructure issues and

83.3 percent of respondents answered this issue is existed in their living area. Six out of ten respondents or 64.1 percent of respondents supported re-use of grey water. 40.8 percent of respondents mentioned that we have to re-use treated grey water for toilet flushing.

The survey shows, ger area households really want have improved sanitation service and condition It is also shown that apartment area households not aware that sanitation service is problematic in Darkhan city.

Secondly, Public consultation and information dissemination was taken place during the data collection process for detailed environmental impact assessment in February –March 2014. At this stage, public consultation was focused more on potential population segments under project expected influence. Two criteria have been considered in selecting the target populations:

1. Select and interview those households, whose geographical location is below the dominant wind direction of the proposed wastewater extension project location and current wastewater treatment plant and who exposed constantly or timely to nuisance associated with specific smell from wastewater treatment process
2. Select and interview those households, whose location is around or nearby a pipeline outlet, which is releasing treated water to nature. Livestock of these households daily feed water from this source and whose livelihoods are directly and indirectly impacted by the treated water quality around the years.

Information dissemination and public consultation started with meeting with Mr. Azjargal, Darkhan soum governor, Mr. Batzul, soum environmental inspector. As per suggestion by governor, we met bagh governors and speakers of bagh citizen representatives meeting (Ms. Tuya, governor of 3rd bagh and Ms. Tungalag, local bagh speaker), inhabitants of which have been affected by the nearby water treatment plant for many years since the current treatment plant started operating.

The study team is thankful for these peoples' support in successful organizing the public consultation and survey event.



Figure 38 Meeting with Mr. Azjargal B., Darkhan soum governor

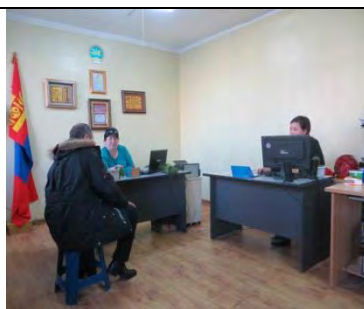


Figure 39 Meeting with Ms. Tuya D, 3rd bagh governor, Ms. Tungalag, local meeting speaker, Ms. Munkhtsetseg, social worker of 3rd bagh of Darkhan soum



Figure 40 Mr. Batzul, soum environmental inspector

Interview of local citizens on wastewater plant and its extension have taken place in 26-27 of February and 10-11 March 2014 covering 100 households living nearby WWTP.

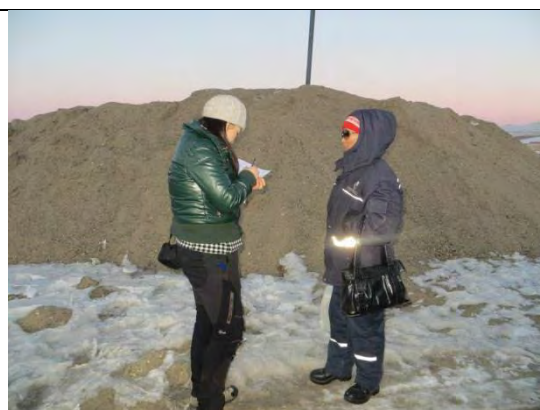


Figure 41 Interview process of local inhabitants living nearby Darkhan's WWTP

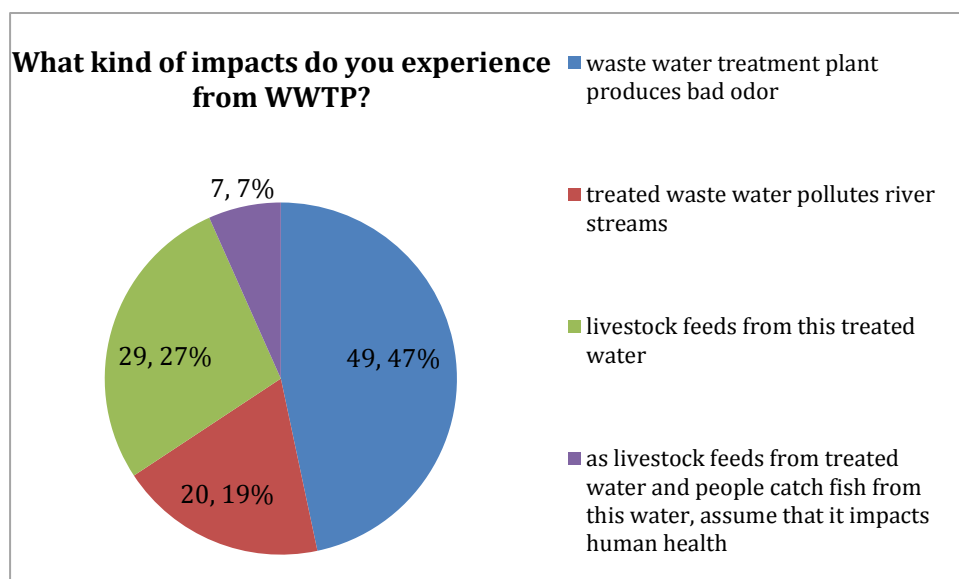
The content of questionnaire survey are as follows:

General information of respondents: name, sex, business type, and constant address.

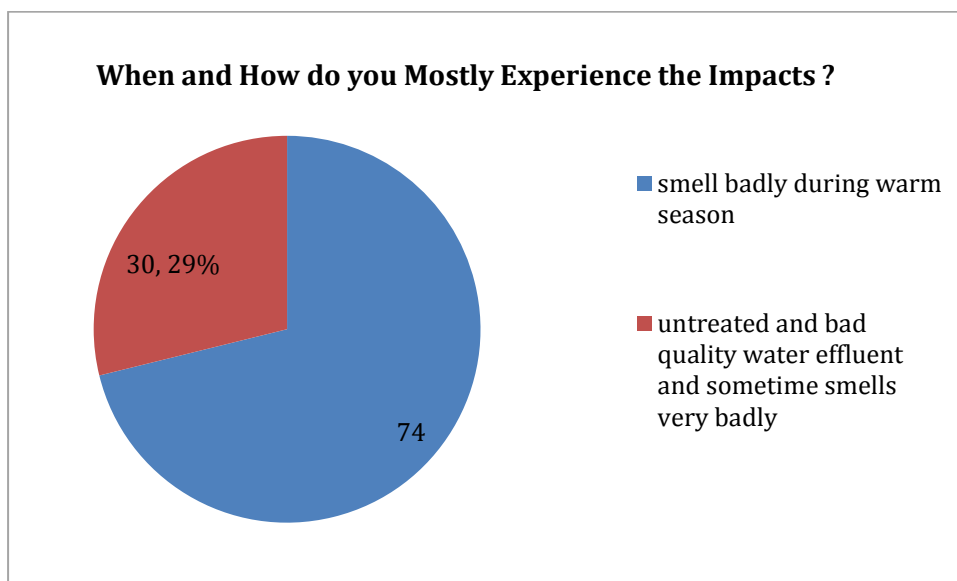
1. What kinds of impacts from current wastewater treatment plant have you experiencing (for example, human health problem, air, water and soil pollution and contamination, flora and fauna depletion etc)? Can you name the positive and negative impacts?
2. When, where and how you feel impacts more/less and or to what extent?
3. What do you think what kind of measures should be taken by whom and when to reduce/eliminate those negative impacts?
4. What any other opinions and comments do you have to reduce/eliminate the impacts?

Herewith, the results of survey have been described:

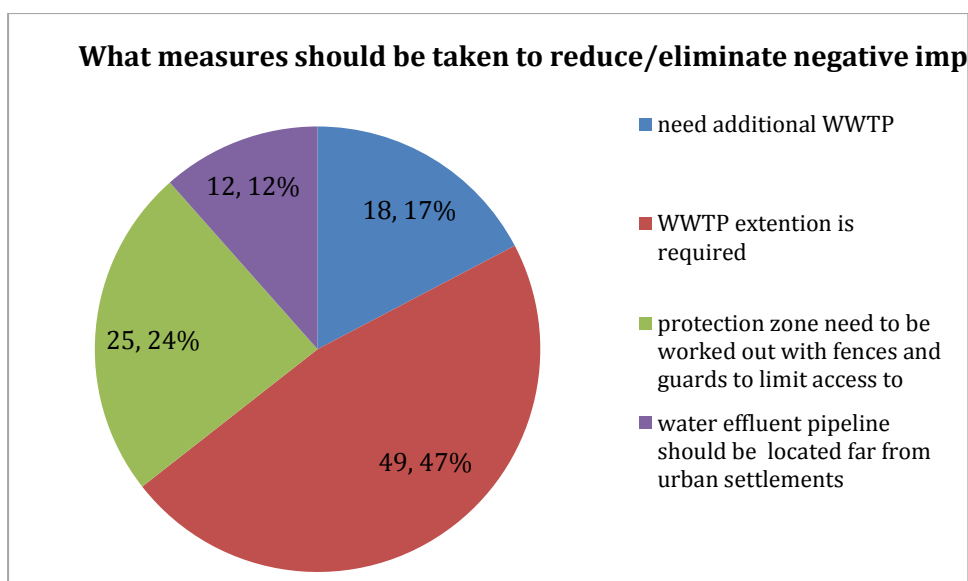
Graphic 1 Responses on First Question. Total respondents-104 persons



Graphic 2 Responses on Second Question. Total respondents-104 persons



Graphic 3 Responses on Third Question. Total respondents-104 persons



If summarize the results of survey respondents, smell produced from waste water treatments processes is the most impact factor for the communities living nearby. 74 respondents answered that bad odor produced from sludge increases with warm season and it gets really bad whenever there is wind.

Most of respondents do worry about the quality of treated water. Some of them are doubtful that it comes in compliance with the national standard on effluent released to nature. Therefore people worry that consumption of effluent by livestock as well catching of fish in the river water that polluted by effluent may impact indirectly and negatively people's health.

Regarding the impact reduction measures, 64 % respondents replied that there is need either to build a new facility or extend current WWTP capacity.

As results of responses show, there is a strong need to reduce impacts from WWTP on river water quality and air quality. Public survey results have been utilized in the impact assessment processes by all Environs' experts and the results have been applied for developing impact reduction/elimination measures as well as in environmental monitoring plan within the DEIA report.

Appendices

Appendix 1 A copy of General Environmental Impact Assessment issued by the Ministry of Environment and Green Development in Mongolian


**МОНГОЛ УЛСЫН
БАЙГАЛЬ ОРЧИН,
НОГООН ХӨГЖЛИЙН ЯАМ**
15160 Улаанбаатар хот, Чингэлтэй дүүрэг,
Нэгдсэн Үндэстний гудамж 5/2, Засгийн газрын II байр
Утас: 26-19-66, Факс: (976-51) 26-61-71, 26-62-86,
E-mail: contact@mne.gov.mn, http://www.mne.mn

2014.08.14 № 6/2014
талай _____ -ны № _____ -т

БАРИЛГА ХОТ БАЙГУУЛАЛТЫН ЯАМАНД

Дархан-Уул аймгийн Дархан сумын нутаг дэвсгэрт төв цэвэрлэх байгууламжийг шинэчлэх, өргөтгөх төсөлд "Байгаль орчинд нөлөөлөх байдлын үнэлгээний тухай хууль-ийн дагуу ерөнхий үнэлгээ хийв.

Ерөнхий үнэлгээний дүгнэлтээр уг төсөлд байгаль орчинд нөлөөлөх байдлын нарийвчилсан үнэлгээ хийлгэх шаардлагатай гэж үзэв.

Ерөнхий үнэлгээний дүгнэлтийг хавсаргав.


ЕРӨНХИЙ ШИИЖЭЭ  Д.ЭНХБАТ

01125

БАЙГАЛЬ ОРЧИН, НОГООН ХӨГЖЛИЙН ЯАМ

БАЙГАЛЬ ОРЧНЫ НӨЛӨӨЛЛИЙН
ЕРӨНХИЙ ҮНЭЛГЭЭНИЙ ДҮГНЭЛТ

2014 оны 02 дугаар
сарын 11-ний өдөр

Улаанбаатар хот

Төслийн дугаар

2013/B007

ТӨСЛИЙН ТОВЧ ТОДОРХОЙЛОЛТ

Төслийн нэр

Төв цэвэрлэх байгууламжийг өргөтгөх

Байршил

Дархан Уул аймгийн Дархан сумын нутагт "Дархан ус суваг" ХХК-ын төв цэвэрлэх байгууламжийн өргөтгөл шинэчлэл

Төсөл хэрэгжүүлэгч

Азийн хөгжлийн банкны хөнгөлттэй зээлийн техник туслалцааны санхүүжилтээр "Барилга хот байгуулалтын яам" "Дархан ус суваг" ХХК

Төсөл хэрэгжүүлэгчийн хаяг "Хот байгуулалтын салбарын Мон-2301" төсөл

Төслийн хүчин чадал, товч
тодорхойлолт

Дархан хотын шинэчилэн сайжруулсан бохир усны дэд бүтцийг бий болгох замаар бохир усны цэвэрлэгээний хүчин чадлыг сайжруулна. Үүнд: шинээр цэвэрлэх байгууламж барих, бохир усны системийн 3 элементийг сольж шинэчлэх, хуучин Дархан болон аж үйлдвэрийн бүсийн хоёрдогч насосны станцуудад их засвар, шинэчлэл хийх ажлууд орно. Төслийн хүчин чадал нь 20,000 м³ хоног байх ба ачаалал ихэссэн тохиолдолд модулын өргөтгөл хийх боломжтой, бохир усны цэвэрлэгээний систем нь одоогийн шугам хоолой болон насосны станцын их засвар, шинэ урьдчилсан цэвэрлэгээний идэвхит лагийн систем, шаталсан агааржуулалттай биореакторын системээс бүрдэнэ. Биологийн үе шатууд нь тэнцвэржүүлэх сав, азотгүйжүүлэх шүүлтүүр, азотжуулах сав, туналтын сав, ариутгах биореактер, нарийн шүүлтүүр зэргээс бүрдэхээр төсөлд тусгасан байна.

Дархан Уул аймгийн Дархан сумын нутагт “Дархан ус суваг” ХХК-ын “Төв цэвэрлэх байгууламжийг шинэчлэх, өргөтгөх” төсөлд “Байгаль орчинд нөлөөлөх байдлын үнэлгээний тухай” хуулийн дагуу ерөнхий үнэлгээ хийж, уг төсөлд байгаль орчны нөлөөллийн нарийвчилсан үнэлгээ хийлгэх шаардлагатай гэж үзлээ.

НАРИЙВЧИЛСАН ҮНЭЛГЭЭ ХИЙЛГЭХ ҮНДЭСЛЭЛ

1. Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагааны үед байгаль орчинд учруулж болзошгүй сөрөг нөлөөллийг нарийвчилан тогтоох судалгааны ажлын эхний үе шатанд тухайн орчны байгаль орчны төлөв байдлын үнэлгээг нарийвчлан хийх;

2. Байгаль орчны төлөв байдлын үнэлгээгээр тогтоогдсон тухайн орчны байгалийн нөөцөд төслийн үйл ажиллагаанаас шууд болон шууд бусаар нөлөөлөх сөрөг нөлөөллийг нарийвчлан тогтоож, түүнийг арилгах, бууруулах, урьдчилан сэргийлэх арга хэмжээг тусгасан Байгаль орчны менежментийн төлөвлөгөөг боловсруулж, байгаль орчныг хамгаалах, аливаа бохирдлыг бууруулах, нөхөн сэргээх үйл ажиллагааг хэрэгжүүлэх хугацаа, хариуцах ажилтан, шаардагдах зардлыг нарийвчлан боловсруулах;

3 Төслийн хүрээнд баригдах барилга байгууламж, хаягдлын сан, бохир ус зайлуулах байгууламж, ус дамжуулах шугам, агуулах, лаг хатаах талбай зэргээс байгаль орчинд үзүүлэх сөрөг нөлөөллийг тухайн дамжлага, цех, объект тус бүрт ялган үнэлж тогтоох

4. Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагаа болон ажиллагсдын ахуйн хэрэгцээний цэвэр усны хэмжээг нарийвчлан тооцож түүнийг хангах эх үүсвэрийг тогтоох;

5 Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагаанаас тухайн газрын гүний усны нөөцөд нөлөөлөл үзүүлэх эсэхийг хянах;

6. Ажилчдын суурин, үйл ажиллагааны явцад гарах ахуйн болон үйлдвэрлэлийн хог хаягдал болон ашиглагдаж байгаа тоног төхөөрөмж, шатах тослох материалаас гарах тусгай ангиллын хог хаягдлыг хүний эрүүл мэнд, байгаль орчинд халгүй аргаар цуглуулах, ангилан ялгах, дахин ашиглах, устгах, зайлуулах аргыг нарийвчлан тооцож, төслийн үйл ажиллагааны салшгүй нэг хэсэг болгон хог хаягдлыг байгаль орчинд сөрөг нөлөөлөлгүйгээр устгах, зайлуулах талаар зөвлөмж боловсруулах;

7. Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагаанаас агаар, хөрсөн орчинд үүсэх бохирдлыг нарийвчлан тооцож түүнийг арилгах, бууруулах талаар зөвлөмж боловсруулж, байгаль орчны бохирдол багатай техник, технологийн сонголт хийх,

8. Төсөл хэрэгжих газар нутагт амьдарч буй иргэд, сумын удирдлагуудтай нягт хамтран ажиллах, төслийн үйл ажиллагааны цар хүрээ, байгаль орчинд халгүй

аргаар нийгэм, одийн засаг, орон нутгийн хөгжилд үзүүлэх давуу болон сул талыг дэлгэрэнгүй танилцуулж, тэдний саналыг албан ёсоор авах;

9. 2012 оны 5 дугаар сард батлагдсан Байгаль орчныг хамгаалах тухай хууль болон Байгаль орчны сайдын 2010 оны 137 дугаар тушаалаар батлагдсан "Байгаль орчны хохирлын үнэлгээ, нөхөн төлбөр тооцох аргачлал"-ын дагуу үйлдвэрийн үйл ажиллагаанаас ургамал, хөрс, ус, амьтан, агаар орчинд учруулах хохирлыг байгалийн бүрэлдэлт тус бүрээр тогтоож, улмаар тухайн газрыг эвдрэлд оруулснаар учирч болох хохирлыг урьдчилан тооцож нийлбэр үнэлгээ гарган төслийг хэрэгжүүлэх байгаль орчны хариуцлагын болон эдийн засгийн үндэслэлийг тодруулж дүгнэлт гаргах;

10. Төв цэвэрлэх байгууламжийг өргөтгөх барилга байгууламж, тоног төхөөрөмжийг суурилуулах ажлыг гүйцэтгэх болон төсөл хэрэгжүүлэх явцад гарч болзошгүй ослын үнэлгээ хийлгэх, барилгын түр талбай, ажилчдын байр, ашиглах техник хэрэгсэл, тоног төхөөрөмжөөс байгаль орчинд үзүүлэх нөлөөллийг үнэлж, гүүнийг багасгах арга хэмжээ, зөвлөмжийг боловсруулах

11. Төв цэвэрлэх байгууламжийг өргөтгөх ажилчдын байр, үйлдвэрийн барилга, үйлчилгээний барилга байгууламж эдэлбэр газрын боломжит газруудад тухайн бүс нутгийн онцлогт тохирсон ногоон байгууламж, мод бүхий зурвас тарих, ногоон байгууламжийн схем зургийг хийж тайланд хавсаргах;

12. Байгаль орчинд нөлөөлөх байдлын ерөнхий үнэлгээ хийлгэхээр хүсэлт гаргасан Барилга хот байгуулалтын яам"-ны 2014 оны 01 дүгээр сарын 23-ны өдрийн 8/232 тоот албан хүсэлт.

БУСАД АСУУДАЛ

1. Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагаатай холбогдуулан орон нутгийн засаг захиргааны болон Мэргэжлийн хяналтын ерөнхий газар, Онцгой байдлын газар болон холбогдох бусад байгууллагуудаас тавигдах нэмэлт шаардлагыг цаг тухайд нь ханган биелүүлж байх;

2. Байгаль орчинд нөлөөлөх байдлын нэрийвчилсэн үнэлгээ хийлгэхэд шаардлагатай материалуудыг төсөл хэрэгжүүлэгчийн зүгээс бүрэн бүрдүүлж өгч байх;

3. Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагаа явуулахтай холбогдох асуудлаарх Монгол Улсын болон Олон Улсын хууль тогтоомж, дүрэм, журам, норм, стандарт, заавар зөвлөмжийг үйл ажиллагаандаа мөрдлөг болгон ажиллах;

4. Ерөнхий үнэлгээний дүгнэлт, ажлын чиглэл нөхцөлөөс өөр үйл ажиллагаа явуулах болон төслийг өргөтгөх, шинэ тоног төхөөрөмж, технологи нэвтрүүлэх тухай бүрт Ерөнхий үнэлгээнд хамрагдаж шийдвэр гаргуулж байх.

ЕРӨНХИЙ ҮНЭЛГЭЭ ХИЙСЭН

БАЙГАЛЬ ОРЧИН, НОГООН ХӨГЖЛИЙН
ЯАМНЫ ШИНЖЭЭЧ



С.БАЯРЦЭЦЭГ

БАЙГАЛЬ ОРЧИН, НОГООН ХӨГЖЛИЙН ЯАМ

Улаанбаатар хот

**Байгаль орчны нөлөөллийн
нарийвчилсан үнэлгээ хийх чиглэл-хуваарь**

Ажлын агуулга	Хугацаа	Тайлбар
1. Төсөл хэрэгжих нутаг дэвсгэрийн байгаль орчны өнөөгийн төлөв байдлыг харуулсан дүрс бичлэг хийх, фото зураг, топозураг M1:10000, геологийн зураг зүсэлтийн хамт M1:10000, авч тайланд хавсаргах, төслийн газарзүйн байрлалын зургийг 1:2000 масштабтайгаар хийх, газарзүйн байрлалын өгөгдлийн мета мэдээллүүдийг тайланд тусгах.	БОНБНУ-ний эхний үе шатанд	Мэргэжлийн байгууллага
2. Нарийвчилсан үнэлгээ хийлгэх асуудлаар эрх бүхий аж ахуйн нэгжтэй тохиролцож гэрээ байгуулах	-	Төсөл хэрэгжүүлэгч
3. Төв цэвэрлэх байгууламжийг өргөтгөх нөлөөллийн бүсийг хамруулж байгаль орчны төлөв байдлын судалгаа хийх, нөөцийг бүрэн ашиглах, олборлолтод өртсөн талбайг бүрэн нөхөн сэргээх, орчны бохирдлоос урьдчилан сэргийлэх болон болон байгаль орчныг хамгаалах талаар авах арга хэмжээг тодорхойлох чиглэлээр дараах нэмэлт судалгааг хийж дүгнэлт гаргах. <u>А.Усны асуудлаар</u> - Төв цэвэрлэх байгууламжийг өргөтгөх барилга байгууламж барих үед хур борооны их үерийн өнгөрөлтийг тооцож, нөлөөллийг үнэлэх, барилга байгууламжийн ажилд нөлөөлөх байдлыг үнэлж тогтоох -Төсөл хэрэгжүүлэх явцад шаардагдах усны хэрэглээ, ашиглалтыг нарийвчлан тооцож эх үүсвэрийг түүнтэй уялдуулан нарийвчлан тогтоож, эрх бүхий мэргэжлийн байгууллагаар георогеологийн иж бүрэн судалгаа хийлгэж Усны газраар дүгнэлт гаргуулах -Төслийн хүрээнд баригдах барилга байгууламж, цахилгаан станцын технологи болон ахуйн зориулалтаар ашиглагдах усны хэрэглээг нарийвчлан тооцож, үйлдвэрлэлийн үйл ажиллагаанаас гарах хаягдал бохир усыг байгаль орчинд халгүй аргаар зайлуулах зөвлөмжийг боловсруулах -Бохир ус цэвэрлэх байгууламжийн явцад болон усан сангаас уурших, алдагдах усны хэмжээг нарийвчлан тооцож дүгнэлт гаргах <u>Б. Хөрсний асуудлаар</u> - Газрын элэгдэл эвдрэлийн өнөөгийн байдлыг тодорхойлж зураглал үйлдэх, дүрс бичлэг хийх; - Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагааны явцад	Нарийвчилсан үнэлгээний явцад	Төсөл хэрэгжүүлэгч Мэргэжлийн байгууллага

<p>өртөж эвдэрсэн хөрсөнд үзүүлэх сөрөг нөлөөлөл түүнийг багасгах арилгах, нөхөн сэргээх арга хэмжээ шаардагдах хөрөнгө зардлыг тодорхойлж тайланд тусгах;</p> <p>- Олон салаа зам гаргах, хөрс бохирдуулах эвдрэхээс сэргийлэх арга хэмжээ, зөвлөмжийг боловсруулж, эвдэрсэн хөрсийг нөхөн сэргээх, түүнд шаардагдах хөрөнгө зардлыг нарийвчлан тодорхойлох;</p> <p>- Газрын эвдрэлийг нөхөн сэргээх арга замыг тодорхой төлөвлөгөөний дагуу хийх, түүнд шаардагдах хөрөнгө зардлыг төлөвлөх;</p> <p>- Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагаанаас үүсэж болзошгүй хөрсний бохирдлоос сэргийлэх талаар хийх ажлуудыг төлөвлөн, хэрэгжүүлэх.</p> <p><u>В. Агаар, цаг уурын асуудлаар</u></p> <p>- Тухайн орчны цаг агаарын өөрчлөлтийг тодорхойлж, түүнээс Цахилгаан станцын техник, тоног төхөөрөмж, технологи болон үйлдвэрлэлийн хэвийн үйл ажиллагаанд учруулж болзошгүй нөлөөллийг тогтоох</p> <p>- Төв цэвэрлэх байгууламжийг өргөтгөх үед агаарт хаягдах бохирдуулагч бодисын төрөл, хэмжээг урьдчилан тооцож, түүнийг бууруулах бодисын төрөл, хэмжээг урьдчилан тооцож түүний бууруулах дэвшилтэт арга технологийг нэвтрүүлэх</p> <p><u>Г. Ой, ургамал, амьтны асуудлаар</u></p> <p>- Төв цэвэрлэх байгууламжийг өргөтгөх үйл ажиллагааны явцад ургамал, амьтанд үзүүлэх сөрөг нөлөөллийг тогтоож, тэдгээрийг бууруулах, арилгах арга хэмжээ шаардагдах хөрөнгө зардлыг тодорхойлох.</p> <p>- Эвдэрсэн газрын ургамалжуулалтын арга хэмжээг тухайн газарт байгалийн аясаар цаашид хөрс ургамлан бүрхэвч тогтвортойгоор бүрдэх нөхцөл бий болгох.</p> <p>- Бохир ус дамжуулах чадвар, байж болох ачаалалтай уялдуулан барьж байгуулах үеийн болон ашиглалтын үед гарч болзошгүй саатал, доголдол аваар ослын түвшинг тодорхойлж түүнээс үүдэн гарч болзошгүй нөлөөллийг үнэлэх</p>		
<p>4. Цэвэрлэх байгууламжийн талбайд газрын төлөв байдлын чанарын улсын хянан баталгааг тогтоосон хугацаанд эрх бүхий байгууллагаар хийлгэж байх</p>	Тухай бүрт	Төсөл хэрэгжүүлэгч
<p>Төв цэвэрлэх байгууламжийн хэрэгцээнд ашиглагдаж буй химийн бодис тус бүрээр эрсдлийн үнэлгээ хийх</p>		Мэргэжлийн байгууллага
<p>5. Байгаль орчныг хамгаалах тухай хуулийн 10¹ дүгээр зүйлд заасны дагуу Байгаль орчны аудитыг 2 жил тутамд хийлгэж байх.</p>	Төслийн үйл ажиллагааны үед 2 жил тутамд	Мэргэжлийн байгууллага тай хамтран

6. Байгалийн гамшгаас үүдэн гарч болзошгүй ослын үнэлгээ хийж ослос сэргийлэх, түүнийг багасгах арилгах арга хэмжээг тодорхойлж тайланд тусгах	Нарийвчилсан үнэлгээний явцад	Мэргэжлийн байгууллага
7. Нарийвчилсан үнэлгээний тайланд төсөл хэрэгжих нутаг дэвсгэрийн захиргаа, иргэдийн нийтийн хурлын санал, дүгнэлтийг авч, хурлын тэмдэглэлийг тайланд хавсаргах	Нарийвчилсан үнэлгээний явцад	Мэргэжлийн байгууллага
8. "Байгаль орчинд нөлөөлөх байдлын үнэлгээний тухай" хуулийн дагуу хуулийн 8.4-т заасан агуулга болон тус ерөнхий үнэлгээний дүгнэлтэд тусгагдсан асуудлыг багтаан боловсруулсан нөлөөллийн нарийвчилсан үнэлгээний тайланг Байгаль орчин, ногоон хөгжлийн яаманд ирүүлж шүүмж хийлгэн шийдвэр гаргуулан 4 хувь бэлтгэж БОНХЯ, холбогдох сумын Засаг дарга, төсөл хэрэгжүүлэгч болон үнэлгээ хийсэн мэргэжлийн байгууллагад тус бүр 1 хувийг хүлээлгэн өгөх	2014 оны 3-р улиралд багтаан	Төсөл хэрэгжүүлэгч Мэргэжлийн байгууллага

Заавал хэрэгжүүлэх шаардлагатай дээр дурьдсан арга хэмжээг цаг хугацаанд нь ханган биелүүлээгүй тохиолдолд ерөнхий үнэлгээний дүгнэлтийг хүчингүй болгож "Байгаль орчинд нөлөөлөх байдлын үнэлгээний тухай" хуулийн дагуу хариуцлага ноогдуулах болно.

Ерөнхий үнэлгээний дүгнэлт, нарийвчилсан үнэлгээний чиглэл хуваарийг тогтоосон:

БАЙГАЛЬ ОРЧИН, НОГООН ХӨГЖЛИЙН ЯАМНЫ ШИНЖЭЭЧ

С. БАЯРЦЭЦЭГ

Ерөнхий үнэлгээний дүгнэлт, нарийвчилсан үнэлгээ хийх чиглэл, хуваарийг хүлээн зөвшөөрч хэрэгжүүлэх үүрэг хүлээсэн:

БХБЯАМНЫ ОРОН СУУЦ, НИЙТИЙН АЖ АХУЙН БОДЛОГЫН ХЭРЭГЖИЛТИЙГ ЗОХИЦУУЛАХ ГАЗРЫН ДАРГА

Р.ЭРДЭНЭЦЭЦЭГ

Appendix 2 Copies of lab sampling results on water quality and bacteriology



УС СУВГИЙН УДИРДАХ ГАЗАР
УСНЫ ТӨВ ЛАБОРАТОРИ
WATER SUPPLY & SEWERAGE AUTHORITY
CENTRAL WATER LABORATORY
БЗД, 5-р хороо, УСУГ, ЗУХА-ны байр
Утас: 77117714; 77117717



C-083

ИТГЭМЖЛЭГДСЭН ЛАБОРАТОРИЙН СОРИЛТЫН ДҮНГИЙН ХУУДАС
/TEST REPORTS OF ACCREDITED LABORATORY/

Хэвлэсэн огноо /Printed date/: 2014 оны 03-р сарын 04

Дугаар No.: 14/269, химийн хэсэг /chemical section/

Хуудас /page/ 1/2

Протоколын дугаар /Protocol number/	Бүтээгдэхүүний стандартын дугаар /ISO number/	Сорьцын тодорхойлолт /Sample specification/
32	MNS 4943 : 2011	Хүрээлэн буй орчинд нийлүүлэх цэвэршүүлсэн бохир ус /Effluent treated wastewater/

Захиалагчийн нэр /Customer name/: "Дархан хотын цэвэрлэх байгууламж"

Сорьцын нэр /Sample name/: Б-560 – ЦБ-д орж буй ус

Б-561 – 1-р тунгаагуурын дараах ус

Б-562 – 2-р тунгаагуурын дараах ус

Б-563 – гүйцэд цэвэрлэгээний дараах гарч буй ус

Сорьц авч ирсэн хүний нэр /Sample relinquished by/: Р.Сайжаа

Сорьцын хэмжээ /Sample volume/	Сорьц авсан огноо /Sampling date/	Хүлээн авсан огноо /Sample receiving date/	Шинжилсэн огноо /Analysing date/
Тус бүр 1.5 л	2014/02/27	2014/02/27	2014/02/27-2014/03/04

Шинжилгээний дүн /Results/:

д/д	Шинжилгээний аргачлал /Standard method/	Шинжилсэн үзүүлэлт /Parameters/	Хэмжих нэгж /Unit/	Б-560	Б-561	Б-562	ЗДА /PL/	Б-563
1	MNS ISO 10523:2001	Усны орчин pH /pH value/		8.44	8	7.82	6 - 9	8.09
2	MNS ISO 4810:1999	Цахилгаан дамжуулах чанар /Electrical conductivity/	μS/cm μS/cm	896	1082	1219		1148
3	MNS ISO 11923:2001	Умбуур бодис /Suspended solids/	мг/л; mg/L	486	96	9.8	50	5.8
4	MNS ISO 6060:2001	Химийн хэрэгцээт хүчилтөрөгч /Chemical oxygen demand; COD-Cr/	мгO ₂ /л; mgO ₂ /L	607.7	409	85.4	50	99
5	MNS ISO 5815:2001	Биохимийн хэрэгцээт хүчилтөрөгч /Biochemical oxygen demand; BOD ₅ /	мгO ₂ /л; mgO ₂ /L	249	195	14.5	20	13.5
6	MNS ISO 6777:2001	Нитрит /Nitrite/	мгNO ₂ /л; mgNO ₂ /L	0.03	0.03	12.1		15.3
7	MNS ISO 7890-3:2001	Нитрат /Nitrate/	мгNO ₃ /л; mgNO ₃ /L	0.2	0	1.92		0.95
8	MNS 4428:1997	Аммонийн азот /Ammonium nitrogen/	мгNH ₄ -N/л; mgNH ₄ -N/L	65	54.3	29.4	6	25
9	MNS ISO 6878:2001	Нийт фосфор /Total phosphorus/	мгPO ₄ -P/л; mgPO ₄ -P/L	7.61	4.09	0.86	0.3	1.98
10	MNS ISO 5663:2001	Кьелдалийн азот /Kjeldahl nitrogen/	мг/л; mg/L	92.19	40.33	37.27		34.47

Товчилсон үг: ЗДА-Зөвшөөрөгдөх дээд агууламж /Abbreviation: PL- Permissible limit/

Энэхүү сорилтын дүн нь тухайн сорьцын хувьд хүчинтэй /This result is valid only for this sample/

Шинжилгээ гүйцэтгэсэн /Analysed by/:

Химич /Chemist/

Химич /Chemist/

Химич /Chemist/

Х. Соёл-Эрдэнэ

Б. Чулуунчимэг

Г. Болдбаатар

Шинжилгээний дүнг нэгтгэсэн /Integrated by/:

Техникийн ажилтан /Technical engineer/

Хянаж баталгаажуулсан /Checked by/:

Химич-чанарын менежер /Chemical quality manager/

Ц. Удвал

Ц. Болормая

Лабораторийн зөвшөөрөлгүйгээр хуулбарлахыг хориглоно /Do not copy without permission from the laboratory/



C-083

УС СУВГИЙН УДИРДАХ ГАЗАР
УСНЫ ТӨВ ЛАБОРАТОРИ
WATER SUPPLY & SEWERAGE AUTHORITY
CENTRAL WATER LABORATORY
БЗД, 5-р хороо, УСУГ, ЗУХА-ны байр
Утас: 77117714; 77117717



ИТГЭМЖЛЭГДСЭН ЛАБОРАТОРИЙН СОРИЛТЫН ДҮНГИЙН ХУУДАС
(TEST REPORTS OF ACCREDITED LABORATORY)

Хэвлэсэн огноо /Printed date/: 2014 оны 03-р сарын 04

Дугаар No.:14/269, бактериологийн хэсэг /bacteriological section/

Хуудас /page/ 2/2

Протоколын дугаар /Protocol number/	Бүтээгдэхүүний стандартын дугаар /ISO number/	Сорьцын тодорхойлолт /Sample specification/
32	MNS 4943 : 2011	Хүрээлэн буй орчинд нийлүүлэх цэвэршүүлсэн бохир ус /Effluent treated wastewater/

Захиалагчийн нэр /Customer name/: "Дархан хотын цэвэрлэх байгууламж"

Сорьцын нэр /Sample name/: Б-560 – ЦБ-д орж буй ус

Б-561 – 1-р тунгаагуурын дараах ус

Б-562 – 2-р тунгаагуурын дараах ус

Б-563 – гүйцэд цэвэрлэгээний дараах гарч буй ус

Сорьц авч ирсэн хүний нэр /Sample relinquished by/: Р.Сайжаа

Сорьцын хэмжээ /Sample volume/	Сорьц авсан огноо /Sampling date/	Хүлээн авсан огноо /Sample receiving date/	Шинжилсэн огноо /Analysing date/
Тус бүр 0.5 л	2014/02/27	2014/02/27	2014/02/27-2014/03/04

Шинжилгээний дүн /Results:

Д / д	Шинжилгээний аргачлал /Standard method/	Шинжилсэн үзүүлэлт /Parameters/	Б-560	Б-561	Б-562	ЗДА /PL/	Б-563
1	MNS 5668:2008	1 мл усан дахь нийт нянгийн тоо /Total bacterial count in 1 ml/	174*10 ⁴	112*10 ⁴	32*10 ³		21*10 ³
2		Коли титр /Coli-titr/	0.00004	0.00004	0.0004		0.043
3		Коли индекс /Coli-index/	23800000	23800000	2300000		23000
4		1 мл усан дахь гэдэсний бүлгийн нян /Coliform organisms in 1 ml/	илрэв	илрэв	илрэв		илрэв
5		1 мл усан дахь гэдэсний бүлгийн эмгэгтөрөгч нянгийн тоо /Pathogenic bacteria in 1 ml/	илрээгүй	илрээгүй	илрээгүй	илрэхгүй	илрээгүй
6		1 мл усан дахь энтерококк /Enterococcus in 1ml/	илрэв	илрэв	илрэв		илрэв
7		1 мл усан дахь перфрингенс /Clostridium perfringens in 1 ml/	10 ⁻³ илрэв	10 ⁻³ илрэв	10 ⁻² илрэв		10 ⁻¹ илрэв

Товчилсон үг: ЗДА-Зөвшөөрөгдөх дээд агууламж /Abbreviation: PL- Permissible limit/
Энэхүү сорилтын дүн нь тухайн сорьцын хувьд хүчинтэй /This result is valid only for this sample

Шинжилгээ гүйцэтгэсэн /Analysed by/:

Бактериологич /Bacteriologist/

Шинжилгээний дүнг нэгтгэсэн /Integrated by/:

Техникийн ажилтан /Technical engineer/

Хянаж баталгаажуулсан /Checked by/:

Бактериологич-чанарын менежер /Bacteriological quality manager/

Лабораторийн зөвшөөрөлгүйгээр хуулбарлахыг хориглоно /Do not copy without permission from the laboratory/



О. Төмөртогтох

Ц. Удвал

Д. Оюунсүрэн

Appendix 3 Soil lab results

ШУА-ийн Газарзүйн хүрээлэн

Хөрс судлалын лаборатори

Хөрсний задлан шинжилгээний дүн

Захиалагч: "Энвайрон" ХХК

Дээж авсан газар: Дархан-Уул аймаг, Цэвэрлэх байгууламж

2014.03.06

Хөрсний химийн үндсэн шинж

Зүсэлтийн дугаар	pH _{н.о} (1:5)	CaCO ₃ %	Ялзмаг %	EC _{2.5} dS/m	Хөдөлгөөнт, мг/100г	
					P ₂ O ₅	K ₂ O
№1 Голын татам	8.73	0.00	2.073	0.628	1.85	16.2
№2 Хурдас	8.60	0.00	0.310	0.230	0.14	7.2
№3 Өргөтгөл барих талбай	8.40	0.00	6.537	2.512	2.38	31.4
№4 УБ-н дотоод талбай	8.36	0.00	2.488	0.195	1.954	16.2
№5 Лагын талбай	7.59	0.00	6.688	0.399	4.26	42.7
№6 Цэвэр газар уулын энгэр	7.95	12.72	2.270	0.840	1.86	30.8



Хөрс судлалын лабораторийн эрхлэгч: доктор (Ph.D).....О.Батхишиг

ШУА-ийн Газарзүйн хүрээлэн

Хөрс судлалын лаборатори

Хөрсний задлан шинжилгээний дүн

Захиалагч:

"Энвайрон" ХХК

Дээж авсан газар:

Дархан-Уул аймаг, Цэвэрлэх байгууламж

Хөрсний механик бүрэлдэхүүн

2014.03.06

Зүсэлтийн дугаар	Ширхэгийн хэмжээ, % (мм-ээр)		
	Элс (2-0.05мм)	Тоос (0.05-0.002мм)	Шавар (< 0.002мм)
№1 Голын татам	55.7	37.6	6.7
№2 Хурдас	74.7	20.3	4.9
№3 Өргөтгөл барих талбай	26.4	56.3	17.2
№4 УБ-н дотоод талбай	30.8	53.3	15.9
№5 Лагын талбай	52.8	37.0	10.2
№6 Цэвэр газар уулын энгэр	33.8	50.9	15.3



Хөрс судлалын лабораторийн эрхлэгч: доктор (Ph.D).....О.Батхишиг

ШУА-ийн Газарзүйн хүрээлэн

Хөрс судлалын лаборатори

Хөрсний задлан шинжилгээний дүн

Захиалагч: "Энвайрон" ХХК

Дээж авсан газар: Дархан-Уул аймаг, Цэвэрлэх байгууламж

Задлан шинжилгээний арга: Атомын Шингээлтийн Спектрометр

2014.03.06

Хөрсөн дэх хүнд металлын агууламж

Зүсэлтийн дугаар	Хүнд металлын агууламж мг/кг				
	Cr	Pb	Cd	Ni	Zn
№1 Голын татам	15.5	20.1	0.23	7.1	187.8
№2 Хурдас	7.9	5.5	0.04	4.7	23.5
№3 Өргөтгөл барих талбай	21.7	18.7	0.08	21.5	200.6
№4 УБ-н дотоод талбай	73.9	12.3	0.05	12.9	94.8
№5 Лагын талбай	60.3	63.8	0.11	8.1	192.7
№6 Цэвэр газар уулын энгэр	16.9	15.2	0.07	10.6	68.5
Стандарт (MNS 5850 : 2008)	150	100	3	150	300



Хөрс судлалын лабораторийн эрхлэгч: доктор (Ph.D.) О.Батхишиг

Appendix 4 Public survey results in Mongolian

STUDY TEAM FOR DEIA REPORT

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3. Narangarav T., soil specialist
4. Ayaugul Kh., translator
5. Prof Saijaa N., Hygienic expert
6. Dr. Suran, Flora study expert
7. Ms. Baasanjav, Aquatic biologist
8. Alimaa M., air quality expert
9. Otgonbat T., Surface water sampling and analysis
10. Purev G., Fauna expert

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