Translation from Mongolian to English

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MONGOLIA
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TERMS OF REFERENCE FOR THE UPDATE AND REVISION OF THE FEASIBILITY STUDY OF "KHERLEN TOONOT" PROJECT

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ABBREVIATIONS

IC	:	Industrial Complex
CNR	:	Construction Norms and Regulations
MET	:	Ministry of Environment and Tourism
EIA	:	Environmental Impact Assessment
GDP	:	Gross Domestic Product
GoM	:	Government of Mongolia
UN	:	United Nations
IMAR	:	Inner Mongolia Autonomous Region
PMU	:	Project Management Unit
FS	:	Feasibility Study
PFS	:	Pre-Feasibility Study
CPS	:	Central Power System
IWRM	:	Integrated Water Resource Management
MMHI	:	Ministry of Mining and Heavy Industry
HPP	:	Hydro Power Plant
EFZ	:	Economic Free Zone
MoE	:	Ministry of Energy
OT	:	Oyu Tolgoi

Content

A. GENERAL INFORMATION

1. Introduction

1.1. Preface

The average air temperature in Mongolia was increased by 2.2 degrees in the last 80 years, which is twice the world average. According to the desertification assessment conducted in 2020, 76.8 percent of Mongolia's total territory or 120.3 million hectares is affected by desertification to some extent, and 22.9 percent or about 30 million hectares are subject to severe or very severe degree of desertification[1].

Due to the effects of global warming, the flow of major rivers in Mongolia decreased significantly, small streams and lakes have dried up, the ecological balance along the banks of the rivers is disturbed and the severe drought has become an extremely distressing issue.

In order to implement the Paris Agreement and to drastically change the policies, goals, methods, and attitudes to fight against climate changes, desertification, water resource scarcity and yellow dust storms and to achieve real results in the future, accumulating water resources, using and protecting surface water is very important and is the basic conditions for sustaining the ecosystem.

Works to to create surface water storage and increase the water supply, to start construction works by developing the feasibility study and design of the project within the framework of the "Blue Horse" project are reflected in the in the Mongolia's national security concept, "Vision-2050" Mongolia's long-term development policy, 2020-2024 action program by the Government, and the "New revival policy".

According to the study results of Kherlen-Toonot projects, which is a part of the projects mentioned above , 79.6% of the factors impacting the Kherlen River ecosystem are relating to climate change. Therefore, in order to support the flow of the Kherlen River and meet the growing needs of the population, livestock, agriculture, mining and energy production, it is necessary to make revisions to the feasibility study of the project to build a multi-purpose water complex for the storage and use of surface water.

From economic and social perspective, it is necessary to meet water demand from short-term renewable water resources, which mainly comprise river water resources. Around 60-70 percent of the average annual flow of rivers in our country flow out across the border and the remaining percent seeps into the soil to fed into underground water or flows into lakes and evaporates.

The update of the feasibility study of "Construction of a multi-purpose water complex and reservoir on the Kherlen River" project and selecting the best option is a work within the framework of the initiative to accumulate the surface water resources that continuously flow-out across the border and store it in a reservoir in times of abundant rainfall and water and feed the river with a constant and ecological flow in times of water shortage or drought and protect many people living along the river and other water users from water resource shortages.

In order to provide for the future water demand in the project area, while considering the potential of the groundwater resources in the region, there is a need to increase the water source in the northern region, which is located far from the South Gobi region.

A project may be technically and economically viable, but the implementation of the project cannot be considered without assessing its environmental and social impacts.

[1] Environmental Baseline Study Report - 2018

1.2. Policy of the Government of Mongolia

The Parliament and the Government of Mongolia pay particular attention to the implementation of the initiative to accumulate the surface water resources and fill reservoirs when in times of abundant rainfall and water, feed the river with a constant and ecological flow in times of water shortage or drought and protect the people living along the river banks and other water users from water resource shortages and included the same in the following policy documents:

1. Objective 6.3 of the long-term policy document for the development of Mongolia "Vision 2050" approved by the Parliament Resolution No. 52 of 2020 states that the shortage of water resources will be prevented, surface water will be accumulated and conditions will be created to meet the demand. Within the scope of the objective, in the 3rd action period for the of 2021-2030, at the natural formations of the land and river riparian will be constructed of floating ponds and underground reservoirs to store precipitation, melted snow and ice water and the construction of multi-purpose reservoirs with flow regulation on large rivers will begin.
2. Goal 6.3 of the five-year development orientation of Mongolia in 2021-2025 approved by Resolution No. 23 of 2020 by the Parliament of Mongolia stipulates that water storage and water supply will be increased, water resources will be protected from pollution and scarcity and integrated management will be implemented and in 6.3.2 of the action plan states on construction of ponds and underground reservoirs to store precipitation, melted snow and ice water in the natural formations of the land and river riparian and start construction of multi-purpose reservoirs with flow adjustment on large rivers;
3. Item 5.1.11 of the “Blue Horse" project for implementation of the 2020-2024 action program by the Government of Mongolia – Develop feasibility study, design and start construction of the Orkhon-Ongi and Kherlen-Toonot projects to increase water supply by creating surface water storage;
4. Section 2.2 Energy Recovery in the New Revival Policy approved by the Parliament under Resolution No. 106 in 2021 stated on development of renewable energy in an appropriate ratio, building water reservoir and pumped storage hydro power plants towards ensuring the reliability and stability of the integrated energy system and it is planned to implement the “Blue Horse” project to accumulate water resources and increase access to water supply in the Gobi region and it is included in the list of development projects to implement the action plan of the "New Revival Policy".
5. Item 3.5.1.7 of Mongolian National Security Concept approved by Resolution No.48 by the Parliament of Mongolia, dated 15 July, 2010 - “Regulate flow of large rivers and construct a reservoir in order to improve usage of surface water in Mongolia”;
6. Item 3.1.3.3 of the “Program for development of Southern Gobi” approved by the Government of Mongolia by its Resolution No. 151 on 16 June 2010 - “regarding to focus on policy of using groundwater, surface water or combined method of using both groundwater and surface water resources and decide water supply alternatives through implementing “Kherlen - Gobi Project”.;
7. Resolution No. 232 dated 17 August 2017 regarding organizing the necessary feasibility study and EIA required for implementingthe "Kherlen River Flow Regulation Project" and resolve financing;

1.3. Reference documents to be used for update of the FS

Laws of Mongolia:

- the Constitution of Mongolia;
- the Law of Mongolia on Water;
- the Urban Development Law;
- the Land law;
- the Law on legal status of towns and villages;
- the Law on Construction;
- the Law on the Utilization of Urban And Rural Settlement's Water Supply And Sewage;
- the Law on Autoroads;
- the Law on Auto transport;
- the Law on Energy;
- the Law on Environmental protection;
- the Law on Disaster Protection;
- the Law on Fire Safety;
- the Law on Establishing protection zone;
- the Law on Environmental Impact Assessment;
- the Law on Specially Protected Areas;
- the Law on Special Protected Area Buffer Zones;
- the Law on Forest;
- the Law on Tourism;
- the Law on the Protection of Cultural Heritage; and
- the Law on Allocation of Land to Mongolian Citizens For Ownership;

Norm and regulations:

- Engineering-Ecological survey for construction (CR 11-102-07)
- Benchmark price on design drawings (CR 81-16-12)
- Benchmark norm on design work for hydraulic construction (CR 81-106-11)
- Resolution No.204, Government of Mongolia, 2009, Construction regulations for construction design development, approval
- Resolution No.151, Government of Mongolia, 2012 Construction regulations for starting, continuing and commissioning construction work
- Basic principles of designing for hydraulic construction (CNR 33-01-03)
- Budget base estimation norms for hydraulic construction (CNR 81-33-10)
- Regulations to budget estimation for construction (CNR 81-95-12)
- Rules on chief engineer (chief architect) of the design drawings for construction (CNR 11-06-03)
- Basic principles for construction engineering survey (CNR 11-07-04)
- Engineering geological work for construction (CNR 11-03-01)
- Basic price for engineering geological survey on the water construction and facilities (CR 81-105-11)
- Organizational management of construction manufacturing (CNR 12-01-09)
- Sample instruction on occupational safety during construction work (CR 12-101-05)
- Geodesy work for contsruction (CNR 11-08-06)
- Landscaping for buildings (CNR 3.01.06-9)
- Excavation and foundation work for construction (CNR 3.02.01-9)
- Hydrotechnical construction and facilities for rivers (CNR 33-03-05)
- Footings for hydraulic construction and facilities (CNR 33-04-09)
- Loads and reactions of hydraulic construction and facilities (CNR 33-05-09)
- Concrete and reinforced concrete structures for hydraulic construction and facilities (CNR 33-06-09)
- Water supply, waste water, external networks and their facilities (CNR 3.05.04-90)

- Planning and installing polymer pipelines for water supply and sewage. Basic principle (CNR 40-102-06)
- Water supply, external networks and facilities (CNR 40-02-06)
- Protection of facilities and building structures from corrosion (CNR 3.04.03-90)
- Earth embankment (CNR 33-07-09)
- Concrete and reinforced concrete ports (CNR 33-08-09)
- Methodological guideline on complete assessment for urban development in urban areas (AD 30-201-09)
- Landscaping for buildings (CNR 3.01.06-90)
- Landscaping and other works (CNR 81-59-05)
- Codes for computing hydrological definitions (CNR 2.01.14-86)
- Earth ports /CNR 33-07-09)
- Designing autoroad bridges and tubes (CNR 32-02-03)
- Planning on urban street and square (CNR 32-04-06)
- Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (MNS AASHTO M 86M : 2005)
- Regulations for developing, approving and expertize apprioval of urban development documents (Decree No.226 by the Minister of Road, Transportation, Construction and Urban Development, 2011)
- Use background image with topographical image clarification based on Engineering network drawing (CR 11-105-06)
- Autoroad planning (CNR 32-01-07)
- Planning on urban street and square (CNR 32-01-04)
- Engineering-ecological survey for construction (CR 11-102-07)
- Regulation of application of benchmark prices of unit capacity of buildings (CR 81-106-16)
- Fire safety of buildings and facilities (CNR 21-01-02)
- Sewage. Outdoor pipelines and facilities (CNR 40-01-14)
- Regulation for electrical installations (CR 43-101-03)
- MNS 5873:2008 Construction drawings. Master plan symbols and working drawings;
- Engineering services - Terminology to describe engineering services for buildings, infrastructure and industrial facilities (MNS EN 16310:2023)
- Other normative documents, norms, regulations and instructions.

International requirements and standards:

- Requirements for feasibility studies of international banks and financial institutions
- International Federation of Consulting Engineers (FIDIC) feasibility study development requirements and standards
- Other international documents, norms, regulations and guidelines.

1.4. Importance and previous studies

The purpose of the research work is to establish a multi-purpose water complex at the selected location of the Kherlen River, to adapt to climate change and to provide water supply options for the the growing water consumption in the long termin the eastern region of South Gobi, to choose optimal and comparative option in terms of engineering solution, financial environmental and social impact.

Feasibility study shall be revised in detail based on previously conducted exploration, research, estimation and calculation materials.

- According to the results of the feasibility study, water resources, technical and technological possibilities, financial and economic conditions, environmental and social impacts are compared to provide water consumption in the Eastern region of South Gobi in a combination of underground water sources in Gobi and surface water sources in the

northern region, or Kherlen River flow regulating and transmitting water to consumers through underground pipelines to the Gobi region

- In order to reduce the desertification that has been intensively occurring in recent years in the entire territory of Mongolia and in the Gobi region, to find engineering solutions by searching for new technical and technological solutions
- Choose the option of using surface water by building a reservoir for water storage with a dam on the Kherlen River with a long-term flow regulation
- Create several environmentally friendly options for the necessary engineering facilities within the framework of the feasibility study, and prepare facility drawings, and decide on their location
- Create a water supply system for the development of pastoral and agricultural areas using energy at a low cost to develop tourism in the region

The following works were carried out on the Kherlen River to increase water supply in the Gobi region:

1. **"Possibility of transporting water between regions and development of Feasibility Study" /Kherlen-Toonot/** within the framework of Sainshand Industrial Complex project, developed by "Monhydroconstruction" LLC in 2014,

2. Pre-Feasibility Study for **"Kherlen-Gobi"** project to improve the ecological capacity of the river by building a water storage reservoir with long-term flow regulation on the Kherlen River, developed by "Prestige Engineering" LLC in 2015.

3. Feasibility Study for "**Gobi Region industrial and mining water supply augmentation"** which was developed by "Prestige Engineering" LLC in 2021**.**

1.4.1. "Possibility of transmitting water between regions and development of feasibility studies" research /Kherlen-Toonot/ within the framework of the Sainshand Industrial Complex project

"Monhydroconstruction" LLC completed the project in 2014 under the order of the Ministry of Industry and Agriculture. Studied the project to build a 2400 m long and 40 m high dam on the Kherlen river in the Delgerkhaan soum area of Khentii province and collect 900 million m3 of surface water and transmit to the Sainshand Industrial Complex through 2 booster pump stations with a 235 km long 800 mm diameter double pipelines. The Construction Development Center of the Ministry of Construction and Urban Development has issued a general opinion on the verification review of design.

As part of the study, the following baseline studies were executed:

a. Topographic map of the dam construction site;
b. Engineering geological survey at the dam construction site;
c. Hydrological calculations performed using multi-year monitoring data of the Kherlen River;
d. Engineering geological survey work along the pipeline route to Sainshand Industrial Complex;
e. Study report;
f. Dam and pipeline technical drawings;
g. Budget for the study works

1.4.2. "Kherlen-Gobi" project to improve the ecological capacity of the river by building a water storage reservoir with long-term flow adjustment on the Kherlen River. Pre-Feasibility Study

"Prestige Engineering" Co., Ltd completed the project under the order by the Water Center. In 2015, The project studied construction of 25 m high dam at the Kherlen River at 20 km west of Kherlenbayan-Ulaan Sum, Khentii Province, accumulating 300-350 million m^3 of surface water and transmitting through 335 km long 600-1400 mm diameter pipelines to Sainshand with 2 booster pump stations. The following baseline studies had been completed. It includes:

a. Collection of previously conducted study materials and conclusions;
b. Water Resources Management Research;
c. Determining water consumption in the project area;
d. To study the hydrology and flow regime of the Kherlen River;
e. Determining the options for the construction of the dam on the Kherlen River and the characteristics of the selected option;
f. A financial and economic analysis is completed
g. Preparing technical drawings of some of the engineering designs;
h. Determine the measures to be taken against desertification and determine their outcome
i. Using the technology to generate hydroelectric power for renewable energy in environmentally friendly way; and
j. Prepare latest up to date map showing Kherlen River reserve.

1.4.3. Feasibility study Gobi region industrial and mining water supply augmentation

The factories and mines in the South Gobi region will be initially supplied from ground water sources and planned water supply pipelines in combination with surface water sources in the northern region to work in the future.

Accordingly, in the first phase, the Feasibility Study for the project "Gobi region industrial and mining water supply augmentation from the ground water sources of Sain-Us, Bor Khoovor, Doloodiin Gobi and Tsagaantsav" was developed.

The water supply system planned along the newly built railway in the South Gobi region was divided into the following 3 parts which was discussed in the study.

1. From ground water source of Sain-Us, Bor Khoovor, Doloodiin Gobi to 2x200,000 m^3 water storage reservoir near Sainshand
2. From Sainshand 2x200,000 m^3 water storage reservoir to Tsagaatsav 2x100,000 m^3 water storage reservoir
3. From Tsagaatsav ground water source, 2x100,000 m^3 water storage reservoir to Tavantolgoi 2x200,000 m^3 water storage reservoir

Within the scope of the project, considered water consumption for the population, agriculture, environment, mining and industries.

The following tasks to be included in the Feasibility Study and calculations to be made. It includes:

- Determine the location of operation boreholes and the capacity of submersible pumps;
- Alignment selection of branch pipelines for water collection from boreholes, selection of pipeline diameter and pipe material;
- Planning water reservoir and determining volume;
- Plan of booster pump station, determine it’s capacity, technical-economic comparison of options;

- Planning and volume determination of water storage reservoirs;
- Survey of main water pipeline route, pipe material selection, technical-economic comparison of alternatives;
- Planning of telemetry control of water transmission pipeline and comparison of alternatives;
- Overhead power line to borewell, booster pump station and substations;

1.5. Areas covered by the project

The project to build a large reservoir with a dam on the Kherlen River to regulate its flow and to accumulate and protect, properly us surface water covers the eastern part of Mongolia which is the economically important Eastern Region and South Gobi Region and most of this area belongs to the natural dry region. In other words, the territory of the project includes 3 soums of Khentii province, 2 soums of Tov province, 3 soums of Gobisumber province, 8 soums of Dornogovi province and 3 soums of Umnogovi province.

Newly discovered and strategically important large deposits of of Mongolia are located in the Gobi region in the eastern part of Mongolia and mining, oil and energy industries are being built in this region for use, extraction and processing. For instance, Oyu Tolgoi and Tavan Tolgoi extraction and concentration plants were admitted into operation and in the future, major projects such as Tavan Tologi power plant, oil refinery, copper smelter, coke and steel plants are planned to be put into operation in stages. Therefore, there is a need to meet the growing water demand in the region with minimal negative impact on the environment. The construction of a water storage reservoir at the Kherlen River, flow regulation and water supply through pipelines will not only solve water supply to the growing cities, population, agriculture, and nature conservation in the Gobi region, as well as the water supply for a large mining industry, will also solve problems aimed at reviving green areas, new water source problem for implementing the “Billion Trees National Movement”,problem for reducing the impact of human activities on the environment and problems relating to environmental reclamation.

1.6. Scope of the project

Within the framework of the project, based on the study materials, the following research works will be carried out by comparing location for the dam and the alignment for construction of long-distance transmission pipelines and choosing the most efficient alternative in terms of economy, society and ecology.

The scope of the general work includes the following works and will be based on engineering solutions, methods, new optimal alternatives, detailed drawings, budgets, methods, economic calculations, methods of further use, optimal legal environment and actual calculation of benefits in many aspects.

1. Multipurpose water complex
    - Dam;
    - Water intake structure;
    - Spillwaty structure;
    - Water discharge pipeline;
    - Bottom outlet;
    - Fish passage, protection facility;
    - Facility to pass the river flow during construction;
    - Hydro power station;
    - Water storage area; and

- Collecting, storing, settling rainwater and flood water at a certain distance and connecting it to the pond by water intake pipes.

2. Pipeline for water transmission to long distance
    - Booster pump station, reservoir;
    - Overhead power line;
    - Information communication line;
    - Road; and
    - Map for establishing the resource.

1. Economic study
2. Environmental impact assessment
3. Consists of other relevant study works.

Figure 1.1 Kherlen-Gobi project area

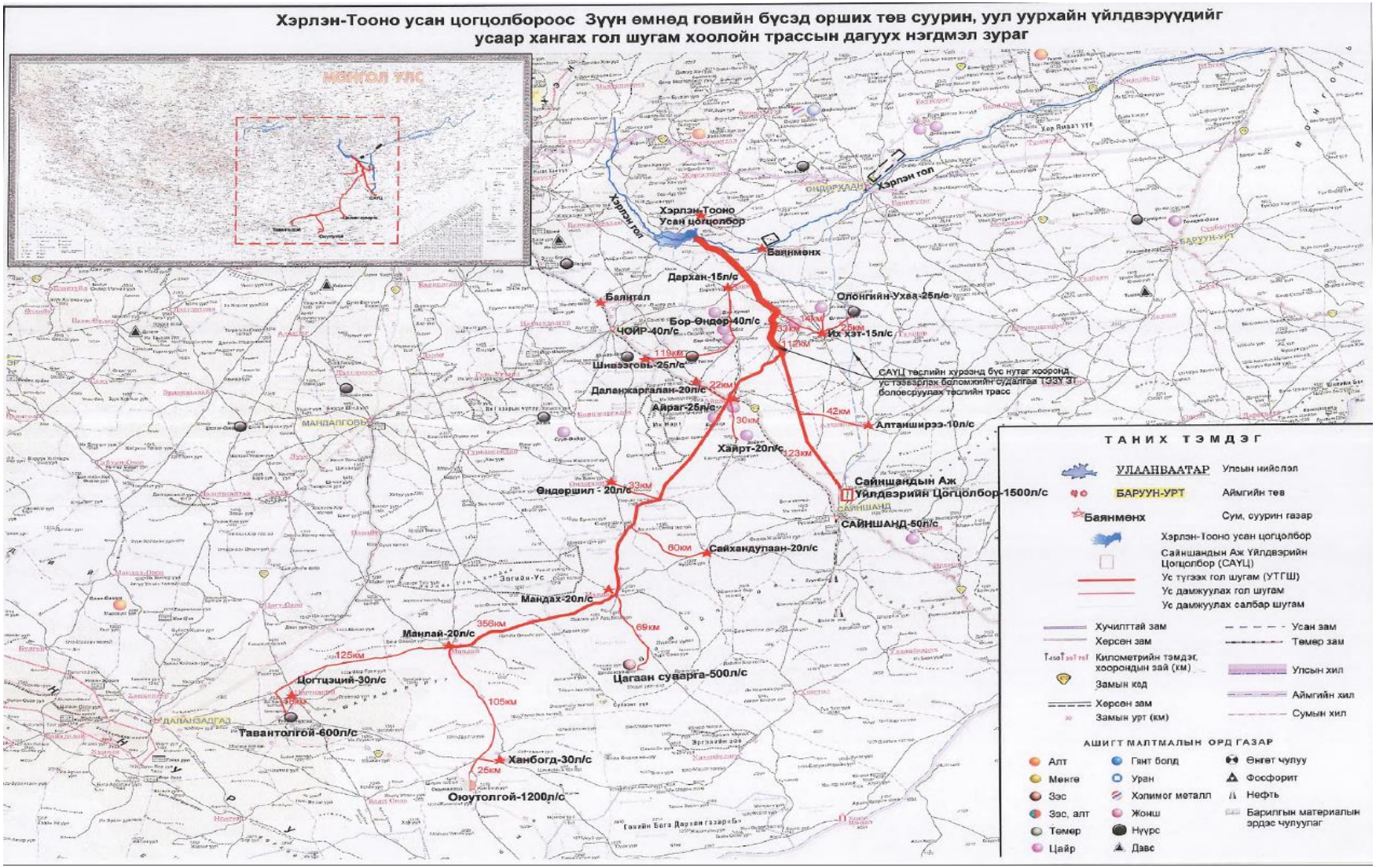

Figure 1.2 Main water supply pipeline alignment from Kherlen-Toonot water complex

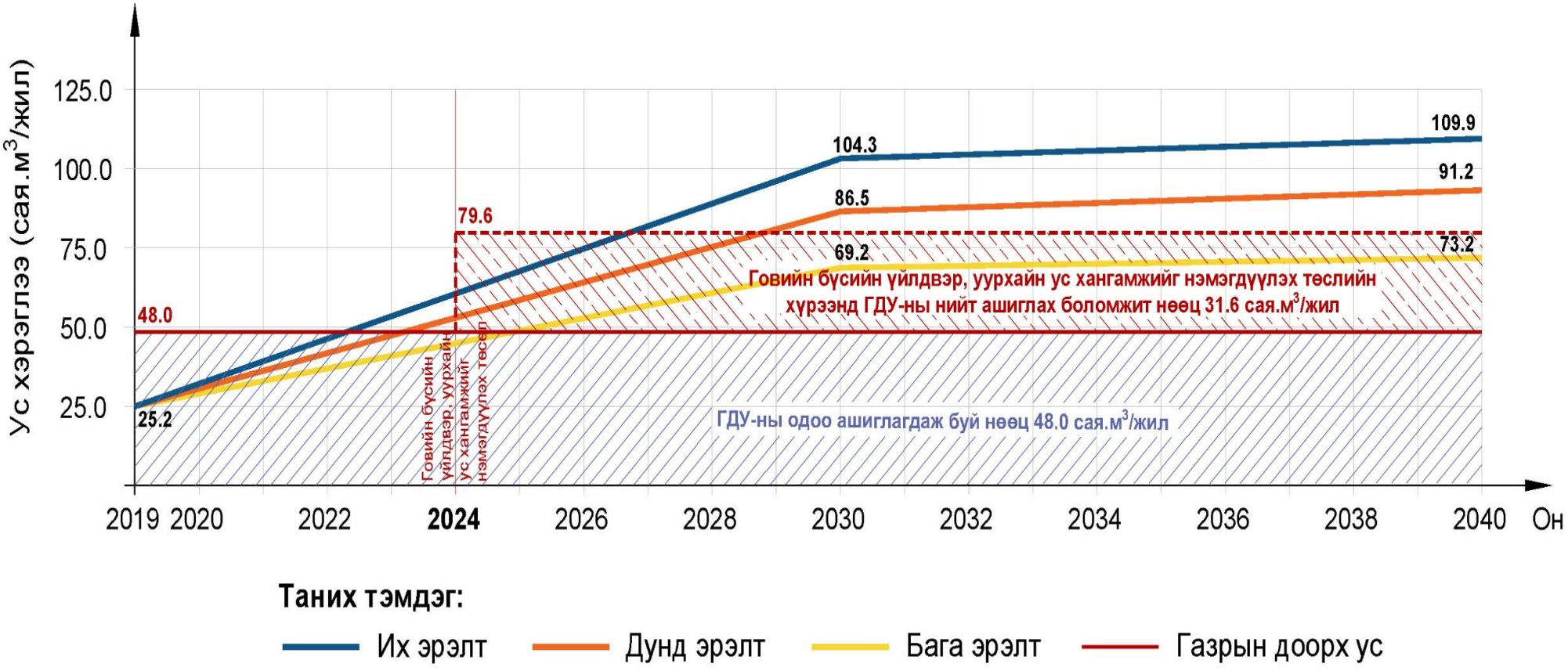

Figure 1.3 Ratio between water demand in the Gobi Region and usage of groundwater resource

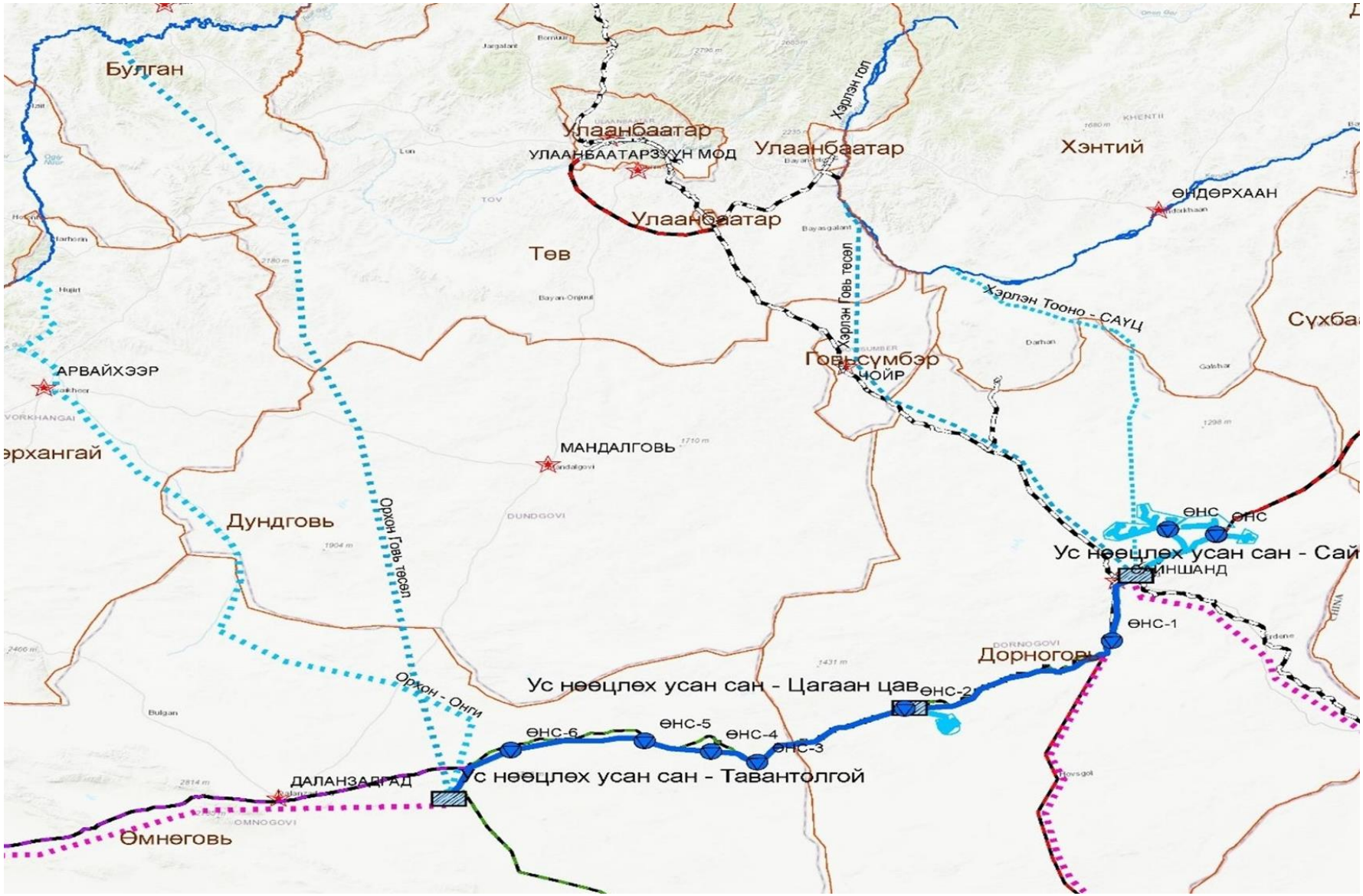

Figure 1.4 Possibility to supply water from the rivers in the Khangai region to the Gobi region

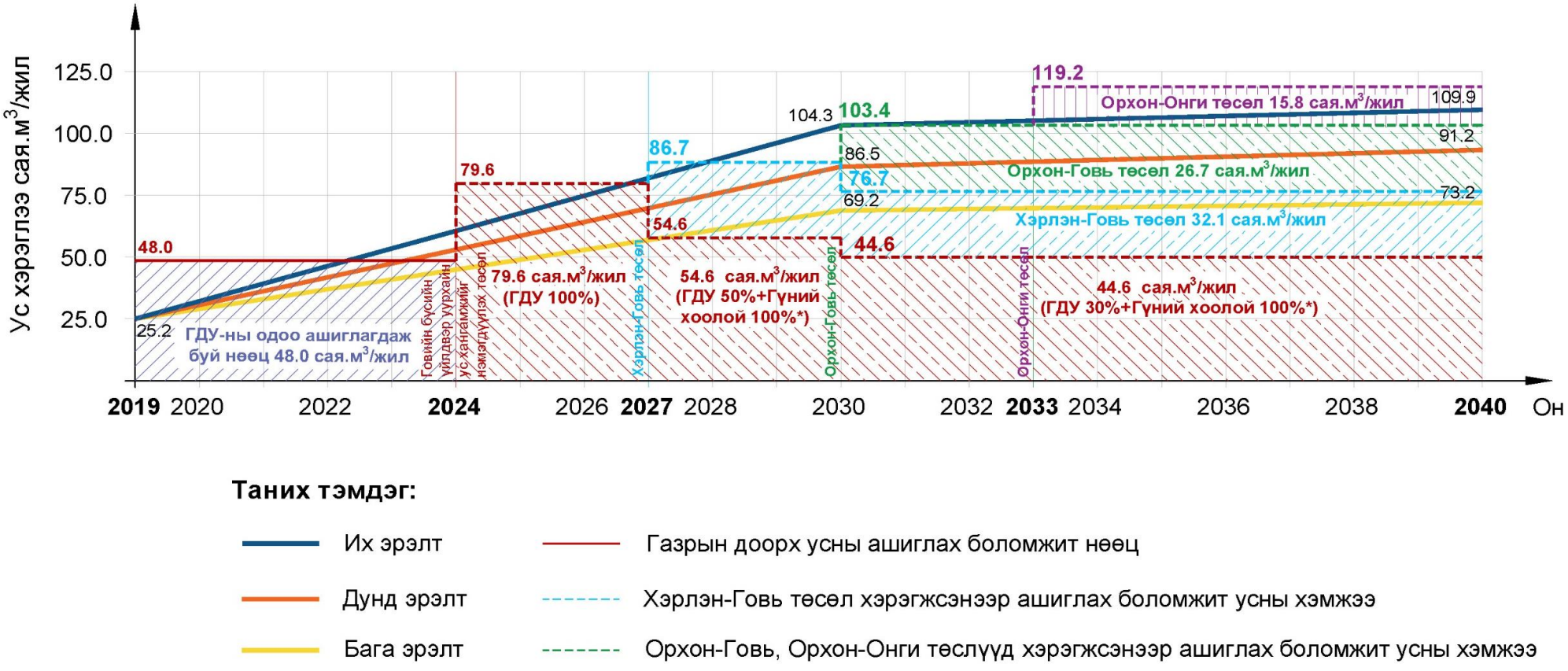

Figure 1.5 Water demand in the Gobi region and possibility to use dual source of groundwater and surface water

2. Updating Feasibility study

2.1. Purpose of study

The main goal of the research work to revise the Feasibility Study and to develop a d technical drawing for construction of water storage reservoir on the Kherlen River with flow regulation for water supply to the population, livestock, agriculture, industries and mines in the Gobi region by transmitting water from the reservoir to a long distance is to conduct analysis on possible alternatives for implementation in terms of engineering, technology, finance and economy. The research work meets the following requirements:

- Perform an analysis of all relevant technical, economic, financial issues to high professional standards;
- Prepare technical and economic analysis and technical drawings and develop a draft workplan;
- Calculate required funding for each stages of the project and to determine feasibility of the project upon combining Technical, Economic, Environmental and Social Impact Assessments;
- Provide optimal solution on investment efficiency for combined approach of surface water and ground water in order to meet long term water consumption demand ;
- Determine the stages of implementation of the plan to transfer water from the reservoir over long distances and provide water to the population, livestock, agriculture, industry, and mines in the Gobi region; and
- Clarify the measures to be taken against desertification and determine the significance of its results.

The feasibility study must be carried out in compliance with Mongolian laws, the CNRs that are in effect and relevant international regulations, and the outcome of the Feasibility Study will be that, in terms of quality, it shall be acceptable internationally and be sufficient for financing decisions.

The Consultant can be a domestic or a foreign company with relevant working experience in the fields of investigation and study for developing a dam, reservoir and water pipeline in Mongolia and must have a Special Permission dealing with various stages of engineering design, if necessary, such companies can associate.

The consultant should coordinate with the government's policy program to reduce desertification and calculate its effectiveness.

The project feasibility, in consideration of the environmental and social factors, will be determined using the outcome of the feasibility study. In this process, the views of the stakeholders, civil society and non-governmental organizations on the proposed project will be considered and will be used as basis for making a decision.

A feasibility study is a preparation for evaluating the economic and financial status of a proposed project. Here, considering the issues in a comprehensive and serious manner, the analysis will be developed for the non-quantifiable indicators and develop cost and benefits.

2.2. Stages of study, works and tasks

The feasibility study of the project to construct a multi-purpose water complex on the Kherlen River will be carried out in accordance with Mongolian and international standards, rules and regulations and the consulting service will have the following components:

1. Feasibility study: Based on the financial challenges identified in the economic and financial studies, the scenario selected as the best scenario in the preliminary phase study will be further refined:

a. Define final technical design criteria for all components;
b. Finalize facility locations and land use requirements;
c. Finalize technical data gathering (geology, engineering geology, topographic, etc.);
d. Coordinate and agree with major users on interfacing and implementation timing;
e. Finalize technical inputs to the financing plan;
f. Perform engineering calculations for all project components and produce Preliminary design;
g. Establish requirements for Final Design; and
h. Produce Implementation Plan and Schedule representing all major stakeholder interests.

2. Economics and Finance Study:

a. Identify and quantify all factors necessary to assess the financial viability of the selected alternative, including financial, economic, legal, political, and environmental/social ;
b. Develop financial and economic models to identify sensitivities and analyze risks;
c. Develop recommendations for a financing plan; and
d. Identification of financial constraints on the implementation to be considered in the Final FS.

3. Environmental and Social Impact Assessments with Public Consultations Plan. The objectives of this task are, based on the results of Feasibility Study, develop Environmental Impact Assessment towards final decision on implementation of the project component:

a. Flow regulating facility and reservoir;
b. Water transmission pipeline and pump station;
c. Overhead power line; and
d. Road construction.

EIA covers the following components:

a. Analysis of legal and policy issues;
b. Assessment of basic conditions;
c. Environmental impact assessment;
d. Physical/Cultural Heritage;
e. Resettlement, relocation;
f. Indigenous people;
g. Environmental Management Plan; and
h. Public participation and consultation.

An Engineering Investigation of the Feasibility Study must be carried out efficiently and at a highly professional level based on previous and subsequent studies that are required for the proposed Project. To achieve the optimal results of the project, adopt the principle of obtaining the innovative and advanced software, operating procedures and obtain the best data information, latest experience.

The Consultant’s services will be concluded upon completing the Feasibility Study in accordance with relevant international regulations and requirements and Government of Mongolia and handing over the work performance to the Client after discussions and approvals.

Detailed requirements for each task are described in the following sections.

B. TASKS IN THE STUDY PHASES

3. Feasibility Study

3.1. Introduction

Based on the results of the Preliminary Feasibility Study, the study of the Feasibility stage consists of the following main components. It includes:

- To calculate the long-term water consumption in the region where the project will be implemented
- Define final technical design criteria for all components of the Feasibility Study.
- Finalize facility locations and land use requirements;
- Finalize technical data gathering of topographic, geotechnical, engineering geological survey and investigation;
- Coordinate and agree with major users on interfacing and implementation timing;
- Develop a plan and stages for surface water and ground water use;
- Finalize technical inputs to the financing plan;
- Perform feasibility study engineering calculations for all project components and produce preliminary technical drawings and budget;
- Establish requirements for Final Design; and
- Produce an Implementation Plan and Schedule representing all major stakeholder interests.

At least 2 Sub-Dams will be selected at the proposed location of dam which are evaluated at the Prefeasibility Study and selection of the main dam should be done by a comparison method by taking into account the riverbank, the height and width of the dam, thickness of stream alluvium and type of base stone and structure and size of the hydrotechnical building and facilities shall be selected under method of comparison.

Include summarization, selection, design requirements, preliminary plan, cost and implementation schedule of alternatives performed under this study. A Feasibility Study shall be carried out for the alternative selected from the alternatives identified during the Prefeasibility Study Phase.

3.2. Engineering and Technical Study

To conduct detailed engineering and technical study on the damsite, water reservoir area, and water transmission pipeline which were selected during preliminary study.

The engineering and technical study to be executed under the Feasibility Study shall be compliant with the Construction Law of Mongolia, the CNR that are in effect, and the relevant standards.

3.2.1. Engineering survey and investigation

As part of the technical and economic feasibility study, a comprehensive engineering survey and investigation to be conducted at the site of the water storage reservoir with a dam, along the water pipeline route, and other planned sites for building and structures. An engineering survey investigation should be conducted confirming safety environment conditions for the population, appropriate structure and strength of buildings and facilities, study area for survey and investigation and evaluate natural and man-made conditions.

After the completion of each engineering field survey, the consultant shall restore the surveyed area to a condition appropriate for its intended use. If the consultant is from a foreign country, he will work with a Mongolian partner who has a special license to conduct engineering studies.

The Consultant should return the areas to their original state upon completion of site engineering surveys and investigations. The Consultant shall cooperate with a licensed Mongolian partner to perform engineering investigations.

3.2.2. Engineering Geodesy (Topographic) Survey and Mapping

The main purpose of this study is to develop mapping and combine results from the processing for each building and facility area. Collect and summarize topographical data relating to the project area, aerial photographs, previous studies and reports. In doing so, it is necessary to cooperate with Mongolian authorities and companies with special licenses.

Engineering geodesy works for the Feasibility study shall include the followings:

- Conduct site survey for the proposed building facilities and area,
- Expand geodesy reference network and if necessary, establish geodesy network of special purpose,
- Produce an elevation tie to the geodesy network,
- Develop geodesy mapping for the reservoir, dam embankment, other hydro-technical buildings and facilities and along the water transmission pipeline corridor,
- Produce new digital image, photo geodesy mapping and update,
- Include the water measurement temporary station, hydrometric measurement, engineering geological measurement, drillings points to the geodesy mapping
- For conducting survey works follow the proposed route of the water transmission pipeline and document the multi-options-on a preliminary basis--and locate the alignments,
- In preparing a map of the area covered by the dam area and reservoir, mark the area for settlements, agricultural fields, pastures, roads, power lines, etc.
- A detailed survey of movable and immovable property, fields, buildings and unique natural formations will be carried out in the area covered by the study area, and
- Include the active road to the mapping and prepare a cross section and longitudinal section where it crosses the water transmission pipeline, power line, communication line, fiber-optic cable and other pipelines to the geodesy map, include crossings together with alignment for the buildings and facilities,

The Consultant shall perform topo-geodesy mapping work with appropriate scale and accuracy using GIS software and AutoCAD software.

- Develop a geodesy map of 1: 10 000 scales with elevation accuracy not less than 5 meters for the water catchment area of the reservoir
- Develop a geodesy map of 1:1000 scales with elevation accuracy not less than 1 meters for the dam embankment and hydro-technical building and structure
- For the transmission main pipeline develop a map of 1: 25 000 scales with level accuracy not less than 5 meter, up to 200 m wide corridor,

- Develop a geodesy map of 1:5000 scales with elevation accuracy not less than 1÷5 meters at the area for the booster pump station and reservoir.
- Satellite data processing shall be made using GIS software.

Geodesy mapping shall include building and facilities including water reservoir with a dam, other components of the reservoir complex, construction camps, material storage areas, pump stations, water treating facility, water transmission pipeline, overhead power line, road and storage technology

Show map that indicates the large water consumers, their elevation, water pipeline segments length, pump station, water reservoir and their capacity. The current water supply system of operating industry, mining in the project implementation area shall be included to the map.

All results from the survey and investigation including estimations, schemes and mapping shall be included to the Topographic report .

3.2.3. Micro Climate Change Impact Assessment

The Consultant shall prepare a summary of climate change, global warming and river stream conditions as a result of regulating the flow of Kherlen River and constructing a water reservoir.

The Consultant shall conduct an evaluation on microclimate, monitoring of flow due to flood.

Conduct a general study on the region's climatic conditions/meteorology comparing with neighboring country – People's Republic of China; evaluate the feasibility of change in the river stream regime; identify appropriate methodology for regulating the most feasible flow regime of river; and study interdependence of various changes.

3.2.4. Hydrological Studies

Conduct additional studies required for the Feasibility Study on meteorology and hydrology in addition to the preliminary study and develop a revised study report accordingly.

Based on the collected data and information, the hydrological assessment studies will be conducted in the following areas:

- Determine size of the water area for the dam;
- Estimating the reservoir level of the dam over a long period;
- To conduct research on the movement of sediments in the Kherlen River;
- Analyze the connection between groundwater and surface water in the dam reservoir area;
- To study the amount of water evaporation;
- Determining the ice cover and temperature changes of the Kherlen River;
- Determine flow probability by 0.01%, 0.1% 1%, 5%, 25%, 50%, 75% at the dam area;
- If necessary, determine the flow rate by placing a temporary control system near the dam area.

The consultant will develop an estimate of water balances, the future trend of flows and the impact of climate and human activities on them. Select a comprehensive calculation model for the basin and the results are presented and evaluated under several conditions.

The issue of how the project will affect the ecosystem of the Kherlen River is important. Therefore, identify flow regime at different characteristic periods of the Kherlen River and determine how they are in harmony with the living organisms, animals and plant species in the riverbed, floodplain

and river basin and on this basis, it is important to develop an ecological/environmental flow calculation in the selected area for the dam.

Based on the results of the work, the basic parameters of the calculation for construction of the dam will be determined and the flow regulation calculation will be performed.

3.2.5. Geology, Geophysics, Hydrogeology, Engineering -Geological Survey and investigation

During the engineering geological survey and investigation, the Consultant shall summarize processes and prepare conclusions on information and quantified indicators from the previously conducted geological, hydro-geological, engineering geological and list them by name and type, scope, duration for execution, study method and methodology and their results.

Physical geography, climate, geology, geomorphology structure, engineering geological phenomenon, activity, physics, geology and techno genesis conditions should be identified by the Consultant during this stage of work.

This part of engineering geological works for feasibility study shall include:

- Collect data and information of engineering geology previously conducted for the areas of the proposed Project and process them
- Process aerial and satellite imagery and the best processed geological mapping
- Overall study
- Alignment study
- Geophysical study
- Drilling, excavation work
- Study of soil in the areas and tests performed
- Study and test to identify seepage characteristics of soil of the area for proposed the dam and cracks of basic rock
- Hydrogeology study
- Determine the depth and thickness of soil permafrost
- Study of sand and aggregates to be used for the construction of the dam, road and other hydro-technical buildings, facilities
- Process results from investigation and testing
- Process and develop technical report.

Since the Project covers a large amount of territory, the Consultant should study the engineering geological condition, engineering geological phenomenon, boundaries and intensity of geological process of the environment. Identify origin of Quaternary deposit systems, their type and distribution boundaries, fractures and boundary of rock soil cracks, ground and soil water distribution, location and their replenishment accumulation zones.

Within the overall study and alignment study the Consultant shall visit the site and establish a program for surveys and investigations in the event there is no existing data and information is available on the area of the Project and develop program for survey and investigation with method, methodology and detailed description of quantify.

The Geophysical survey and investigation shall cover the dam area and reservoir to be constructed at the Kherlen River. Under this study, the Consultant shall identify depth of rock soil and permafrost soil and their boundaries, thickness and fracture, crack boundaries. Establish the level of soil water and deep water in the river valley and flow direction. Also, Consultant shall conduct a geophysical study for seismology and earthquake zoning. The Consultant shall select

method and methodology appropriate for the geophysical study and conduct a drilling survey to verify results.

Within the hydrogeology study at the reservoir area the Consultant shall establish quantitative indicators of soil water and deep water as well as water chemical content, rusting and mordant quality per each water strata and include recommendations on soil water regime change, methods to protect from flooding, methods of observation for the regime and methods to take measurements during the operation period. Consultant shall show locations along the water transmission pipeline to identify soil water near to ground surface and show in the report. Where necessary, Consultant shall establish hydro-geological monitoring boreholes to facilitate underground water regime (monthly, quarterly and annually) and develop conclusions.

The Consultant shall identify engineering geological conditions at the Project area, areas for Project buildings and facilities (water reservoir, dam, water outflow structure, water transmission pipeline, booster pump station etc.). Develop geological mapping and reports for the Project area and areas for Project building and facilities.

Conduct geological assessment of existing data, maps and aerial maps categorized by zones. Prepare geological maps and geological cross sections and seismic-tectonic drawings categorized by zones.

Survey and investigate geology, geophysics and engineering geology connected to the topographic mapping. Conduct engineering –geological survey investigation following the selected line and profile.

Engineering –geological surveys and investigations shall include soil and rock soil drilling, kern sampling, digging channel, cast in place test and gallery at the embankment area, site test, laboratory tests and their reports and determine soil and rock strata.

Engineering geological assessment shall be conducted for the following components.

- Water reservoir (water proofing of the reservoir, any water loss and slope stabilization etc.,)
- Embankment
- Other hydro-technical buildings and facilities.
- Sub station
- Construction material quarry and borrow pit site
- Infrastructure at the dam area
- Water transmission pipeline
- Booster pump station at reservoir
- Water treatment facility
- Road

Consultant shall carry out drilling at the dam area and take necessary complete samples at each alternatives for selecting the dam area, the outcome of this work will be the basis for selecting the dam area. For the water cumulating reservoir area, drill 0.2÷0.4 numbers of boreholes within a 1 km square area.

Drill 2-3 boreholes at each of the selected alternative areas for the dam. Depth of boreholes need to penetrate base rock and conduct pumping and cast in place work to determine rock cracks, depth of boreholes should penetrate up to 20 m in the base rock.

Engineering geological drilling shall be conducted at each 1 km along the transmission main pipeline and the depth of drilling is 1-2 m below depth of pipeline installation. It is allowed to increase or decrease distance for drilling depending on engineering geological condition.

Drill 2-3 boreholes at the proposed area for pump station, reservoir and other buildings and facilities. Drill boreholes of 5-6 m deep at each 3 km along the proposed power supply line and road. Sample not less than 30 percent of drilling and digging and test them at a laboratory. Determine base rock depth cracks and their locations at the proposed area for the dam. The Consultant shall determine difficult engineering geological conditions or risks and develop explanation.

Conduct sampling and site testing during the planned period of surveys and investigations. The selected sample and kern from drilling shall be tested at a laboratory to determine soil characteristics, quality and analyze to confirm suitability for foundations or use for construction material. Collect the sorted kerns from drilling and store in a safe location.

Upon receiving the results from the engineering geology, develop engineering geological mapping of 1: 5000 for the dam area, 1: 10 000 for the reservoir area, 1: 25 000 for the water transmission pipeline alignment and cross and longitudinal sections of necessary amount and attach them to the report.

Include results from the survey and investigation and estimations from the geology, geophysics, hydrogeology and engineering geology to the Study Report.

3.2.6. Seismicity Study

Summarize quality and quantity data used in the previously conducted seismic study analyzing by name and type of works, coverage, executed timeframe, methodology and result and provide a conclusion.

Conduct a detailed seismic study at the site of the proposed dam, reservoir at the Kherlen River and site surveys and investigations for determining cracks in the base rock, length of cracks, vertical and longitudinal transferring and types of damage. Identify physic and mechanic characteristics, age of rocks and conduct laboratory tests.

Develop zoning maps for the reservoir and dam areas in accordance with the results in the report Reservoir. Determine seismicity zones along the water transmission area.

The Consultant shall assess seismic impacts and describe seismicity for the region and assess seismic risks. Determine seismic impact zones, seismic sources, the estimated maximum earthquake, the anticipated maximum earthquake during Project operation, the estimated earthquake speed, earthquake grades for construction of water reservoir etc.,

Review the current seismic network in the region, Project area and offer suggestions for improving monitoring seismic activity in the Project region and area.

3.2.7. Construction Material Survey and Investigation

Carry out studies for clay, sand, gravel and rock materials necessary for construction of the dam, hydro-technical building and facility. Also include study of gravel and sand deposits to be used for concrete production. The Construction Material Survey and Investigation should provide necessary information on resources, natural resources map, quantity, quality and geological conditions including; sampling, sampling locations, road map, road map for construction materials and the locations of construction sites

In addition, identify resources of cement, steel, wooden material and; foreign and local material procurement sources. Consultant must follow norms, standards and regulation requirements of the Mineral Resources Authority in Mongolia based on regulation for protection of nature and environment and usage of natural resources for earth material investigation. Conduct study for water to be used for construction

Attach all scopes of work including; investigations, surveys, results and estimations undertaken in the report on construction materials.

3.2.8. Technical condition

It includes:

- All permits for infrastructure engineering building and facility
- Land permit
- Road permit
- Permits relating to environment
- Legal permission
- Utilization permit
- Permission by the Water Authority
- Permits from relevant state and local administrative organizations

3.3 Technical calculations and solutions of the Feasibility Study

3.3.1 Flow Regulation of Kherlen River, Hydro-Technical Buildings and Facilities

Develop technical solutions for the dam, reservoir, hydro-technical building and facilities to be constructed at the Kherlen River. Select the most optimum location for construction of the proposed reservoir, dam which include study and evaluation of alternatives relating to type of dam embankment, water intake, flood overflow and ecological flow passage structure, water complex facilities during construction or operation etc.,

In order to use surface water at long distance by transmitting method Consultant should list the requirements for selection of dam and reservoir area considering conditions to bring water closer to the customers, to have less loading for pump station, capable to store necessary amount of water, with good stability and durability and select the area for construction of dam embankment to have the minimum area for reservoir possible with maximum water volume capacity, minimum length of dam embankment and lowest cost..

3.3.2 Alternatives and selection of Technical Specifications for Reservoir

Calculate topographical indicators for the proposed reservoir to be constructed at the Kherlen River and identify the basic indicators of the reservoir based on water economy. Upon the results from water economy Consultant shall calculate water regulation and identify reservoir volume and other important parameters. Also calculate the minimum level of the reservoir, static and dynamic levels, the maximum level and the surcharged maximum reservoir level.

Consultant shall calculate reservoir evaporation and seepage. Calculate a lower impoundment embankment at the dam. Evaluate ice and icing regimes at the lower impoundment. This shall include calculation of Spring melt water and precipitation flooding and their passage through the dam embankment. Calculate timing and conditions the first filling and estimate the rate and volume of accumulation of sediments.

Study the potential alternatives for dam structural requirements and size and the final selection under the technical solution shall be done based on the Feasibility study comparison.

It shall include viewing of the options, selection process, technical requirement for design and preliminary planning, cost estimates and implementation schedule.

3.3.3 Identification of Type and Structure of Hydro -Technical Building and Facilities

The Consultant shall identify type, structure and basic sizing of the dam embankment and other required hydro-technical building and facilities to be built at the Kherlen River.

Selection of type, structure and main size for hydro-technical building and facilities shall include the followings:

1. Dam
2. Water intake building
3. Spillway
4. Water Discharge Pipeline
5. Bottom outlet
6. Fish passage, protection structure
7. Facility to pass the river flow during construction
8. Hydro power station and its building and facilities
9. Booster pump station and reservoir
10. Long distance transmission pipeline
11. Reservoir

Consultant shall determine, in detail, the structure of the main body of the dam, size and calculation of the seepage, settling and stabilization of the main body. Calculate connection of the dam embankment to the river bottom or bedrock under the channel and calculate required prevention measures against seepage through foundation or bedrock and plan the necessary structures.

Study possibility to build hydropower station and evaluate its importance and determine whether it is appropriate.

Plan buildings and facilities necessary for dam passage of river ecological flow and water intake structure from where water is to be transmitted through pipeline, booster pump station. Consider options for the water intake structure and recommend the optimum solution for reliable operation in Mongolian conditions.

The study shall include configuration of all required facilities including waste traps, fish protection, lifting mechanism and lower impoundment structures. Develop a plan for the temporary facilities necessary during the construction of the dam embankment, including upper and lower temporary embankment impoundments, river flow passage and other necessary components.

Consultant shall include views of the options, selection process, technical requirements for design, preliminary planning, cost estimates and implementation schedule. Preliminary Expenditure Proposal must be prepared for capital investment, operations and maintenance

expenditures, list of structure based on the lots/packages, construction works, and handing over of structure.

3.3.4 Hydraulic Study

Consultant shall study flood routing of the probable maximum flood through the reservoir to establish the discharge capacity of the spillway, operating rule of the reservoir, and water levels downstream impoundment of the dam/spillway.

The Consultant shall provide the testing, criteria and model, methodology, used in the flood routing.

The spillway capacity must be available at all times to discharge the design/probable maximum flood during first and final stage of the dam.

Back water studies to determine maximum water level at full reservoir level and its location, and maximum distance from the axis of the dam.

Reservoir sedimentation studies include methodologies, sediment characteristics, sediment volume, sediment accumulation profile in the reservoir, profile/elevation of sediment at the upstream pool of the dam, determination of reduction of the dead and useful reservoir, live storage, surface volume depending on water level, water volume curve as a function of time of 50 years after commencing the operation of the reservoir.

Identify specifications for ground level/height F(H) and volume V(H) of reservoir based on the above said studies.

Carry out complementary studies and investigations necessary for the Feasibility study following the corresponding scope of work under Preliminary Study, and revise and update them, and present the report. The updated calculations shall be used to dimension and optimize the hydraulic structures such as coffer dams, dam, spillway, bottom outlets, and river diversion during construction, waterways, etc.

All the scope of works including estimations and conclusions must be included in the Hydraulic Study Report.

3.3.5 Reservoir Operation and its modeling

During the Feasibility study the following works shall be done for each Project alternative. The Consultant shall develop reservoir modeling referring on latest hydrological observation data: Estimate the operating reservoir levels (minimum, normal and maximum). Develop flow curve at the downstream pool.

The reservoir operation and simulation studies for the power and energy analysis shall be presented in a report along with the model, methodology, criteria and data used and the analysis of the results.

The Consultant will provide simulation of analysis of possible operating regimes of reservoir over 50-60 years, using internationally accepted latest software. These scenarios will be described in terms of economic, financial, environmental and social impacts.

The Consultant shall prepare a phased reservoir filling schedule in accordance with the construction stages. These scenarios should be assessed in terms at stages of economic, financial, environmental and social impacts studies.

The Consultant shall review, in the light of international experience, possible institutional arrangements (e.g., a reservoir management commission with multi-country representation) for monitoring reservoir operation and regimes for ensuring compliance with the prescribed operating regime. The options should be described in terms of strengths and weaknesses. The Consultant shall identify preferred institutional arrangements both in respect of initial filling schedule and in respect of the regular operation of reservoir and develop a recommendation.

Reservoir Model and Flow Regulation Model:

Prior to determining Reservoir Model, the following information should be for the chosen dam.

- Monthly and annual average flow of the river;
- Dead storage volume and dead storage volume level of reservoir
- Active volume and active volume level of reservoir
- The maximum volume and the maximum level of reservoir
- Available volume capacity of the reservoir
- Water Loss (seapage, evaporation, ice creation)
- Capacity of water transmission pipeline

Modern and internationally accepted models must be used for designing the reservoir. The purpose of model is to i) identify impacts on water resource and regime of the Kherlen River due to the construction of reservoir Complex over the Kherlen River; and ii) analyze the filling progress

The model should consist of the following components.

- Incoming flow (Hydrologic data from stations)
- Proposed reservoir
- Water Supply Information (amount of water to charge)
- Low flow (amount of ecological flow)
- Estimation of flow to come to the ending point
- Estimation and duration of filling

3.3.6 Operation Alternatives of Reservoir Complex and Selection of an Optimum Alternative

Develop operating regimes for the operation of reservoir, hydro-technical building and facilities. The reservoir shall be used to supply water to various types of customers for domestic use, industries, agriculture, ecological enhancement, flow regulation for maintaining downstream river ecology and environment and tourism.

Based on results from the flow regulation calculations, Consultant shall develop graphics for the dispatches and estimate time correlation between the supply to the customers from the reservoir and manufacturing of power, ecological flow at downstream and water level in the reservoir. This shall include; reducing water supply fluctuation, keeping reservoir above the minimum guaranteed level during the time of low water and water accumulation possibilities during the times of high water.

Plan measuring instruments and equipment for monitoring dam embankment setting, transferring, seepage and sedimentation situation and plan a constant station for climate and hydro-metering.

Regarding the water intake structure, Consultant shall calculate the design criteria to accommodate the estimated design flow of the Project and as well as future water demand increase.

Prepare list of required investment, operation and main maintenance expense and details on preliminary basis.

3.3.7 Basic engineering design

The Consultant shall carry out basic engineering design. Develop design criteria and layout drawings.

The determination of selected alternative layout and design shall go hand-in-hand, and include various dam types, height/reservoir capacity, mode of operation of the power plant with respect to base load and peaking, reservoir and flow management, environmental mitigation, volume level in the reservoir to absorb floods, and the construction of dam demand installed capacity in stages.

Based on the results of the basic designs and the various cost elements derived, an optimization of the layout and of its various components shall be carried out.

Project definition design shall be carried out and drawings prepared based on field investigations and optimizations performed. Optimizations shall include, among others, reservoir size, dam height, development stages, spillway design capacity and size, waterways (intake type and size, headrace pressure tunnel length and cross-sectional area, surge chamber, pressure shaft, penstocks, valves, major mechanical (turbine capacity and number of turbines), electrical equipment (generators, transformers), gross and net operating heads, powerhouse cavern, tailrace, etc.

Design and drawings of the building and structures shall include all components of a reservoir, spillway structure, intake structure, bottom outlets tunnels, penstocks, river diversion during construction, power station, installed capacity and number and size of generating units, electrical and mechanical equipment etc.,

The design and drawings of the water transmission pipeline for long distance water conveyance shall cover pump stations, their types and size, capacity, water transmission pipeline, reservoir, water storage reservoir, water outlet structure (to be located at 10km).

Layouts and design shall include, but not limited to the following:

- Dam, spillway (cranes, gates, etc.), including optimization of the spillway (number of upstream and downstream pool, type and size of gate, etc.) and to reflect measures to be taken on regular use and protection from natural risks;
- Waterways: Intake with trash racks, log stops, gates, hoists, sediment traps; facilities for ecological discharge from the reservoir; Head race pressure tunnel, rock and sand traps; and Surge chamber and pressure shaft, valves and fish protection structures etc.
- Tailrace: draft tubes, gates surge arrangements, tailrace tunnel, gates, cranes, etc. Powerhouse; civil works, mechanical equipment such as: turbines, governors, cooling system ventilation, drainage, cranes, etc.; electrical equipment such as generators, transformers, switch gear, auxiliary power supply, power cables, control cables, communication, protection and control equipment, switchyard, control room and dispatcher equipment etc.
- Fish breading facility
- Water Transmission Pipeline:
  - Water purification and disinfection facilities
  - Booster Pump Station (planning, location and capacity)
  - Water Outlet (able to run in cold weather)

- Reservoir

3.3.8 Stability Analysis

The structural analysis is intended to determine the integrity of the dam and structures under standard loadings and other loadings. These include water accumulating reservoir, maximum water level at the lower impoundment, internal pressures, foundation soil displacement, stockpile material, sedimentation, earthquakes, etc.,

For type of dam considered/selected, the corresponding stability analysis shall be performed.

The Engineering design shall be presented in a report, including findings, design memoranda, calculations, analysis, and optimization of Project components.

3.4 Hydraulic calculation for the water transmission pipeline

Hydraulic calculation of the pipeline shall be developed for each option and Consultant shall conduct calculations for selection of the number of pump stations, their capacity, location, and other criteria. Pipeline diameter, sectional length, material selection shall be identified in connection with hydraulic surge (water hammer) calculations. Based on this calculation, the Consultant shall develop an optimization option for surge protection and plan necessary measures and recommends for equipment.

Incorporate Mongolian and cold climate conditions in the technical and economic criteria to select pipe material and diameter. In order words, select the most beneficial pipe diameter for economy during the operating life of the project.

3.4.1 Pipe material selection

Consultant shall provide recommendations for pipe, and it should include factors such as: physical indicators, usage and condition for transportation, installation and operating conditions of the pipe. Select pipe of modern technology, corrosion resistance, high pressure capacity, and low hydraulic resistance.

Incorporate Mongolian and cold climate conditions for calculations of depth of pipeline installation and sizing. Also, calculate earthwork quantities for pipeline installation and develop method for assembly and installation of the pipeline.

Develop a preliminary plan for investment that includes: technical specifications of the pipeline to transmit water over long distances supported by studies conducted to evaluate design requirements, construction and operating cost, and implementation schedule.

Show overview of these options, selection, design requirements and preliminary planning, budget expense and implementation schedule. Prepare the required preliminary investment and construction and commissioning costs.

3.4.2 Booster pump station solution

Selection of the locations of booster pump stations and their capacity shall be identified by economically beneficial indicators with comparison of total investment for pipeline and pump station operating cost. Calculate the booster pump station location and its capacity based on the option selected, with the most optimum pipe diameters.

Select pump type, quantity and capacity to be used at pump stations and include both duty cycle and reserve pumps.

Plan water tanks at the suction side of each pump station with purpose to stabilize hydraulic conditions of pump stations and pipeline. The size of water tanks shall be calculated taking into account minimizing the risk of damage to the pipeline and required time for repair and maintenance. The structure and material of water tanks should be selected accounting for the cold climatic conditions and technological requirements of Mongolia.

Plan diesel standby power generation at each pump station to assure and provide reliable operation.

Configuration and size of pump stations shall be recommended depending on the equipment and instruments and proposed location. The recommended building structure shall be the most appropriate for Mongolian conditions. Each pump station shall have appropriate working conditions for the operators and have a security fence and guard house. Pump station operation shall be fully automatic with possibility to operate manually when necessary.

Show overview of these options, selection, design requirements and preliminary planning, budget expense and implementation schedule and prepare the required investment and construction and commissioning costs on preliminary basis.

3.4.3 Water Treatment and Disinfection Facility

Water from the reservoir at the Kherlen River transmitted through pipeline for supply for human consumption shall be treated and disinfected to meet potable water standards. It is necessary to consider the modern method and technology for selecting disinfecting method and methodology.

Selecting location, capacity of water treatment, disinfecting facilities shall be made upon comparing potential options.

Present overviews of these options, technological conclusions, design requirements and preliminary planning, budget expense and implementation schedule.

3.4.4 Reservoir

The reservoir must be planned to ensure continuous water supply up to the end of the main water transmission pipeline and distribution pipelines to large consumers of the region. Alternatives should be made for the structure, size and location of the reservoir.

3.4.5 Infrastructure

Study current and future infrastructure planning of road, electric lines and communication lines, fiber-optic cable. Consultant shall identify current conditions and future trends and evaluate working conditions of interdependence between the proposed hydropower station and central power system.

Consultant should determine perliminary designs for year-round access to project sites by roads, and the location and requirements for offices, workshops, housing facilities, electric power, recreation areas and temporary installations, construction camps, contractor’s equipment, and borrow pit areas for construction material, and establish the infrastructure that will has to be solved for the Project.

3.4.6 Hydro-mechanic and electro-mechanic equipment design

The type and number of turbines to be installed in the HPP and the generator capacity should be calculated optimally. Cost, efficiency, reliability, availability and means of transportation must be considered when choosing a turbine.

Turbines shall be provided with adequate water drainage, and must be cavitation-free, icing-free, and have space for maintenance.

Optimal selection of the general layout, dam height, dam type and installed capacity of the HPP shall be done and the generator shall be studied based on the number and capacity of the turbines. Capacity of the standby generator that would be connected to the internal electric system of the station must be defined.

Study the connector between turbines and generators. When selecting generator, it is preferred if the supplier for turbine, generator and other equipment is the same.

Look into control valves that could shut-off where necessary for the water transmission pressure pipe and turbine equipment. In order to protect the electro-mechanical equipment, the time of shutting-off of the main valve of the water transmission pressure pipe must be determined, and the hydraulic hammer in the water transmission pressure pipe shall be calculated.

Water intake and bottom outlet of the water transmission pipeline shall be determined, and water discharge chamber and their valves shall be included. Number and size of the valves shall be defined in order to do the structure calculation. Determine type and size of the crane for moving the Lift valve.

Determine the location of the turbines, power transmission line, HPP building, office for station employees, resting houses and their components.

Main charachteristics of a HPP, such as installed capacity, production, load coefficient of the HPP must be detailed in the FS.

3.4.7 Energy Demand for the Project and Planning of Power Supply

Consultant shall determine anticipated electric power required for operation of the Project. Calculate the number of electrical equipment items to be planned at the dam and other hydrotechnical facilities. There should be a listing of all major electrical loads for operation, such as: lighting and heating etc., Consultant shall calculate power demand for each pump station, including pumping equipment, and other necessary functions.

Power demand for water complex facilities at the Kherlen River, booster pumps to be located nearby and internal hydropower station use shall be provided from the power generated at the hydropower station. Consider options to connect the booster pump stations located far from the Kherlen River to nearby local energy networks. It is necessary to select power line capacity due to distance to be connected to the energy system and plan capacity of transformer sub-stations.

Show a connection scheme of each facility using electricity with control panels and power panels. Show overview of the locations, technological solutions, design requirements and preliminary planning, budget expense and implementation schedule.

3.4.8 Technical Specification of the Hydro–Power Station

Capacity of hydropower station shall be calculated upon results from water surge calculations at the dam embankment. Consultant shall select the most optimum capacity to produce energy.

Calculate type, capacity and number of the turbine generators at the Hydro Power Station by taking into account cooling water, filtering system, pressure and air system and operating

conditions of the turbine. Calculate building structure and size of the Hydro power station and also the subsidiary equipment. Include technical solution including basic scheme of the Hydro power station, booster substation, their basic equipment, capacity of power transmitting line, alignment and cross section of the line.

Show a scheme for installation of the system, electrical equipment scheme, design requirements and preliminary budget for investment, preliminary plan and implementation schedule.

3.4.9 Power line from the Hydro Power Station and its connectivity to the Central Electricity System

Study power line to transmit power from the Hydro Power Station and its capacity and location.

Determine work regime of the proposed Hydro Power Station, develop options for connection to the Central Electricity System and cooperation. Estimate energy system regime calculation through potential alternatives and make an analysis and conclusion. Also carry out static stability calculation for the energy system.

3.4.10 Road planning and planning norms

- “Design of a road” RMCNR 22-004-2016
- “Road climate and geotechnical condition” RCGC 2.01.01-2004
- “Design of a bridge and pipe on a road” CNR 32.02.03
- “Planning a construction in seismic region” CNR 22.01.01*/2006
- “Geodetic work” CNR 3.01.03-88;

Consultant shall develop requirements and planning of roads for the Project facilities that will be needed during construction and operations and conduct an evaluation. Develop alternatives of a road system required during construction of dam embankment and other hydro technical facilities at the Kherlen River and recommend the best option to connect to the closest railway point. Develop a plan for transport of oversize and overweight equipment to the construction sites, during construction and operations. Identify bridges and/or flood protection culverts at necessary locations. Consider possibilities to use the road during construction period for operation and if necessary plan a new road for operation.

Study road routes for transporting construction materials. If necessary, Consultant shall plan an alignment and location selection for roads to be used during the construction period as well as operation period for difficult to access places.

Plan a temporary road necessary during construction of water transmission pipeline and booster pump stations for transporting equipment and materials in accordance with Mongolian Construction Norms and regulations, standards and appropriate environment regulations. Plan a road along the transmission main to be utilized during operations and road over passes.

Show overview of the alternatives of a road to be utilized during construction and operations, design requirements and preliminary planning, budget expense and implementation schedule.

3.4.11 Communication, Data and Telemetry Control

Consultant shall identify communication and data systems, an automatic control system necessary for the Project. The Water Complex on Kherlen River and all booster pump stations shall be connected by communication system to a central control center at all times. Study and evaluate communication system alternatives and recommend the most reliable system.

Dam facility and booster pump station operation shall be regulated by automatic regime with manual operation option that is regulated from the central system. Automatic control of the water transmission pipeline shall be planned to be controlled through telemetry system. A modern method of remote identification of water transmission pipeline damage shall be inlcuded.

Show location scheme, technological selection, design requirements and preliminary planning, budget expense and implementation schedule. Study modern methods needed to diagnose damage of the water transmission pipeline from a far distance.

3.4.12 Project Operation Organization

Estimate management structure and number of employees of the operating organization and requirements for their working environment and living accommodations.

Provide recommendations for the location of the central control and administration center. Plan work places for the operating organization that meet functional requirements and include necessary furniture, vehicles, mechanisms, equipment and instruments, and estimate the required investment and define job descriptions for key personnel for each site.

Plan buildings and facilities for the organization, operation, employee accomodations and security purpose for operation of the reservoir, dam and other hydraulic facilities. Include necessary facility planning for tourism purposes.

Plan measures to involve local communities during operation of the buildings and facilities, such as presentation to the local administrations and communities and for recruiting and training local workers.

3.4.13 Bill of Quantity

Consultant shall estimate a detailed Bill of Quantity for civil works and equipment of the various components of the Project, taking into account that they may be used in bidding documents.

The basic design of the selected dam will be finalized and approved. Technical and drawing specifications will be prepared by developing the design at the feasibility study level. The design and layout shall include all parts of the construction works (roads, communication, earthworks and site work, diversion works, dam, station, workers' housing, booster pump stations, transmission pipelines) and electro-mechanical and hydro-mechanical equipment (turbines , electric motors, switches, substations, network connections).

The implementation schedule for each stage of the construction work will be developed, the design of the river course structure will be prepared, and the dimensions of the structure will be calculated and the design will be evaluated.

Prepare an estimate of bill of quantity, including the sources used, drawings and descriptions.

3.4.14 Procurement Planning

Prepare a procurement strategy for the contract lots/packages for civil works, pipeline and for the electrical and mechanical equipment, accompanied by the justification thereof.

Pre-evaluation shall be done for major contracts for civil works, pipeline and electrical and mechanical equipment, into account the technical conditions provided. Procurement planning should be done for each stage, as required. Develop a separate report for procurement criteria, alternative analysis, justification for the selected alternative and procurement planning.

3.4.15 Safety Policy of Dam

The World Bank Policy on Dam Safety should be observed, required documents produced and procedures undertaken regularly under BP4.37. Quality assurance and guarantee, operation and maintenance for construction shall be in accordance to the OP 4.37 and BP 4.37 of World Bank.

A Qualified expert should determine and assess that the Project construction and facilities would of no significant adverse impacts to peoples' lives and assets, and include specific measures in the EIA plan.

3.4.16 Health and Safety at Work Place

The objective of this task is to define mitigation and action plan to minimize health and safety risks to permanent and temporary employees of Contractors during the construction phase, to the staff during the operational phase.

Thus, the Consultant shall prepare an Occupational Health and Safety Plan as a mechanism to reduce health and safety risks to the workers. This plan should pinclude daily safety requirements, present the actions to be taken, identify the organizations responsible for the action and specify the costs for the program.

3.4.17 Implementation Schedule

Prepare an implementation schedule and graph based on the procurement strategy so that a cash flow projection calculation can be developed for consideration in the economic and financial analysis. This schedule shall define the preconstruction activities, including access and transportation routes and methods, locations of borrow pit areas for construction materials, construction methodologies, construction equipment, construction labor force requirements, construction camps and site infrastructure, office facilities, ecological requirements and population resettlement activities. The critical activities and the critical path of activities shall be illustrated in the schedule.

Develop construction schedule for a dam defining its phases and for each stage.

4 Financial and economic study

4.1 Introduction

The purpose of this task is to provide detailed economic and financial assessment for the selected alternative. The Consultants will:

- Evaluate in detail the selected alternative's economic and financial issues, including water demand dynamics, water and energy tariff structures, risks, and timing variables;
- Estimate the economic cost of domestic and cross-boundary externalities (environmental, social, political); and
- Conduct a detailed assessment of whether the project creates more net benefits to the economy than other mutually exclusive options for the use of the resources in question in accordance with requirements of the Economic Evaluation of Investment Operations.

Donor organizations, investors, state authorities and monitoring authorities are interested in the economic benefits of a project. Therefore, economic and financial analyses have been performed to identify the economic basis of the project.

A Financial and Economic Study has its own significant characteristics as it illustrates direct and indirect results that can be expressed in quantitative and qualitative data, and contains broader

issues in detail based on actual data. Hence, the Consultant's Financial and Economic Study and Analysis will be a significantly important and an independent part of the Feasibility Study in terms of detailed study and actual results.

The Consultant must not necessarily express all the results of study in currency terms only. However, the Consultant shall strive to identify the quantitative results of vital information as much as possible. Specially, regarding direct expenses such as the dam and reservoir, pipelines, pump station study, field surveys, design and construction works that are directly relating to project activity, must be included in the Economic and Financial Study. Nevertheless, to present the project benefits as a whole, the Consultant shall discuss in the sub-section of the Economic and Financial Study how expected benefits of project will positively impact development of tourism, food and agricultural industries and the mining sector. Not only quantitative benefits but also indirect social, economic and environmental qualitative benefits of "Construction of water storage reservoir with flow regulation on Kherlen River" project will be analyzed.

4.2 Financial and Economic risks of the Project

This task shall cover the coordination of project participants, preliminary estimations of the project investment and expenditure, and the determination of economic and financial benefits.

Should the major water construction projects fail to achieve its Cost-Benefit targets, there will be potential negative impact on the Mongolian economy. Therefore, financial and economic study should be carried out by estimating cost, schedule, and economic efficiency of the project to determine whether the project can be implemented or not, and a certain results can be achieved.

In addition to expertise in Economics and Finance in a Natural Resources context, the Natural Resource Economist must also have extensive knowledge of the design and management of major projects gained through hands-on experience.

4.3 Main studies

Water supply project is greatly different from other projects as it contain social characteristics and aspects. It is erroneous to assess water supply projects only from economic standpoint such as cost-recovery, revenue and project benefits . Therefore, the Economic, Social and Financial Assessment must be done simultaneously and preparing final assessment should be based on the social assessment , so to ensure issue of national security, public health and sustainable development.

4.3.1 Comparison of outcomes for implementing and not implementing the project

Comparing studies between "with-project" and "without-project" will be another method to identify benefits of the Project. Economic benefits of each project alternative will be analyzed by using financial and economic models. Other possible alternative of using water resources for different purpose - "without-project" alternative shall also be examined to maintain and protect the natural environment. According to worldwide requirements on protecting natural environments, it is viewed that protecting the natural environment could bring more benefits than implementing any project. Hence, implementing a project from one side and without implementing project from another side must be considered. Therefore, it is important to consider all possible alternatives for protecting the environment and assuring the wellbeing of society and developing other sectors of the economy instead of regulating the flow of river and transferring water. In the case of "with-project" alternative, all possible alternatives of water resources must be considered as well.

Aim of “Construction of multi-purpose water complex on Kherlen River” is to satisfy future water demand trends of the Southern Gobi Region and to ensure sustainable development of the ecosystem surrounding the Kherlen River Basin with assistance of a dam, water reservoir, hydropower station, a water transmission pipeline, water outlets, and reservoir complex to be constructed over the Kherlen River- one of the largest rivers in Mongolia.

Therefore, comparison analysis on how the Project would impact the environment, society, economy and public health will be conducted from various points of view. This comparison analysis will be a part of the Feasibility Study. In the case of postponing or not implementing the project, scenarios would be considered, including:

- Kherlen River’s ecosystem, desertification and dryness in the Gobi Region will be changed and increased;
- Shortage of water, water quality related issues, demographical issues such as health, sickness and death will be changed; and
- Future and current water consumptions of mining industries in the Gobi Region, utilizations of groundwater resources and water tariffs will be identified through economic indicators.

Predefined Study on future harms and risks as a result of “without-project” will be conducted.

4.3.2 Laws, Regulations and Water Tariff

Review of, and consistence with, the applicable international conventions, domestic laws and policy documents, treaties and bilateral agreements is a basis of successful implementation of any project, therefore, it is emerging to scrutinize international conventions, domestic legislations and other policy documents which are directly applicable to a particular project.

Within the framework of legal issues, it is required to review all effective international conventions, treaties, and bilateral agreements which Mongolia is a party to and domestic laws, policy documents, legal programs and other documents essential for the implementation of the project.

The tentative list of the applicable and effective international conventions, bilateral agreements, domestic laws, policy papers essential for the project implementation, has been endorsed to the Report, however, this list shall not be treated as an exhaustive list for legal review purpose. In other words, if there is any new circumstances and legal documents emerged during preparation stage of the feasibility study for the project, such circumstances and legal documents must be covered adequately in the feasibility study report.

Legal review helps to reveal the external and the internal legal factors that may affect the project implementation, and its cause or justification, to provide an answer to some public misunderstanding about the project from legal point of view, to correctly evaluate potential external and internal risks and its factors for the implementation of the project, to envisage decisive countermeasures against such risks, and to ensure in establishing legal preconditions for successful implementation of the project.

Water use payment shall be calculated in accordance with the Law on Payment for Use of Natural Resources adopted in 2012 as revised; and Government Resolution #326 of 2013, #416 of 2022 concerning Determination and Exemption of Water Use Payment. In financial and economic calculations, all effective laws and regulations, taxes and tariffs of Mongolia shall be complied.

It is recommended to assess the project from perspective of whether the project is eligible for an international recognition within framework of international programs, such as Man and the

Biosphere sponsored by UNESCO, and the World Heritage Convention due to its significance and extents; and if it is determined as eligible, then to recommend how to accomplish such recognition in the international level and its implication in environmental and social impacts of the project, to determine possible impacts for the project's international significance and configuration and financing for the project.

4.3.3 Management Alternatives for Assets of the Project

Within the framework of this objective, it is required to study issues concerning the ownership of assets created by the project. The consultant shall study the current or newly emerging experiences in the world with respect of ownership rights for assets created by a project, and/or joint ownership by several parties or countries and issue a recommendation in that respect. Recommendations must be made for the involvement of the stakeholders especially the government.

It is required to submit proposal or recommendation in respect of implementation of the project through 'Build-Operate-Transfer' concession type pursuant to the Concession Law of Mongolia by project implementing consortium comprising of foreign and local entities, with involvement or financing of international organizations or international investors, define the terms to use and maintain the water related construction, relationship with other water users or consumers, rights and duties of project implementing entity, transfer of the assets into state or local property at the end of the term.

4.3.4 Estimations of Water Consumption and Water Tariff

Issues relating to the estimations of water consumptions in the region are discussed in engineering and technical study section of this TOR. The Natural Resource Economist shall responsible for this task.

Every water consumer will use water for different purposes. Therefore, different water tariffs have to be applied within the estimations. Water Tariffs will be fixed differently on the basis of water transmission cost, consumers' ability and social characteristics. Tariffs for water services should be recommended as a result of estimating the cost of water services to identify the difference between fixed rate and actual cost.

4.3.5 Project Cost Estimation

Sources of Project financing for the selected alternative along with targeted weights for each will be identified and ranked in the context of current conditions in the global financial market for investment in Mongolia.

Market-based, realistic Weighted Average Cost of Capital (WACC) estimates for alternate financing scenarios and alternate project structures will be analysed. Project alternatives will be identified and alternate financing scenarios will be computed.

Despite the capital investment required for Engineering Structure, the ecological, social and financing costs necessary for environmental and social study should be estimated in the CAPEX.

4.3.6 Estimates of Rvenue and Operating Expenses

Develop financial and economic estimation for the project selected alternative, inclusive of, but not limited to the following:

- OPEX,
- Depreciation
- Interest Expense
- Labor Costs
- Worker's Compensation
- Social and Health Insurance Taxes
- Other Taxes
- Fee on Use of Water Resources
- Land Utilization
- Insurance Cost
- Environmental and Social Costs
- Other operational costs
- Resettlement cost

The estimations of variable costs must be done for each of the components in the study.

Water sales will be the source of revenue. The revenue will also come from different tariffs described in the Sub-Clause 4.3.5 of this TOR. Electricity generation from the Hydropower Station to be constructed over the Kherlen River will also be a source of revenue.

4.3.7 Direct and indirect benefits

Estimate the direct benefits in the following sectors upon implementation of the project, such as:

- Water supply for population
- Animal husbandry, agriculture;
- Power supply;
- Water supply for industries;
- Extension of job placements, creating new jobs and increased income for citizens;
- Tourism;
- Water supply for mining exploration and processing;
- Impact on the state and local economic and budget; and
- Benefit against desertification.

Economic indirect benefits of the Project must be analyzed. Indirect benefits, such as, continuous mining operation, GDP growth rate due to it, production by small and medium enterprises along the pipeline will be included.

Indirect benefits of the Project are attractive to stakeholders, investors and financing organization and the Consultant shall clearly show in detail these indirect benefits, even though it cannot be quantified or measured by monetary amount. In addition, the Consultant shall determine the indirect benefits of the Project according to the interests and activities of stakeholders, investors

and financing organization to give an opportunity to look at multiple points of view of indirect benefits including:

- Impact on ecosystem of the Kherlen River and other project territory;
- Impact against the desertification and drying;
- Change in the quality and amount of potable and domestic water and its' impact;
- Impact on population and their health;
- Changes in the culture and life quality for the population in the region; and
- Tourism, intangible benefits of the development of city and settlement area.

The Consultant shall summarize the direct and indirect benefits of the Project for comparison or for use separately.

4.3.8 Potential Risks in the Environmental and Social Sectors

Negative Environmental Impact Assessment shall be described in economic terms. Principles of retaining conditions to live and engage in traditional livestock industry activities for a long period of time must be served. Potential impacts on water wells and herders' wells shall be monitored and assessed to identify whether or not groundwater resources are affected.

Social criteria considers the percentage of population engaged with main domestic industry and changes in number of people engaged. In case of significant decrease in engagement of traditional industry, a socioeconomic impact assessment is to be conducted to assess changes in household income, unemployment, involuntary resettlement and burden/pressure faced by indigenous people due to the changes in type of main industry.

Environmental Impact Assessment has to be done according to the Environmental impact assessment rules approved by the Government of Mongolia Resolution 58 of February 08, 2023.

4.3.9 Socioeconomic Study of Project

General analysis and conclusions should be made for the socioeconomic situations of the Project region.

Water Demand Analysis shall be performed based on the population growth and regional economic development trends.

An analysis of business profits and losses in the project area will be made and a conclusion will be drawn. Although mining development has variety of benefits and creates multilateral business opportunities, natural resources have their own capacity and limitation about which must be taken into account. Protecting the natural conditions for pastoral cattle breeding supports the sustainable development goal to have the ability to retain natural resources for future generations. Therefore, constructing a groundwater system (for mining purposes) within this ecological boundary will give opportunity for the local population to live and continue with their pastoral cattle breeding for many years to come. In other words, one consumer's rights should not affect to another consumer's rights.

Social benefits of project should be described through economic assessment. The indirect and direct benefits will be expressed by:

- Increased percentage and sufficiency of water for population;
- Water Quality Improvement;
- Changes in distance of water intake;
- Changes in Water Tariff;
- Reductions of unproductive social expense;
- Number of job places;
- Increase of Household Income;
- Improvement of pastureland generation;
- Reduction of land degradation and desertification;
- Decrease of livestock mortality; and
- Decrease of livestock stillbirth rate.

GDP growth forecasts shall be made and analyzed. It should describe the GDP if the project is not implemented. Although there is a probability of GDP growth if the Sainshand Industrial Complex, Shivee-Ovoo, and Zamyn-Uud Economic Free Zone start working at full capacity, the Consultant should illustrate changes in the GDP rate in the event of mining industry suspension due to the insufficiency of water. The study should also include direct and indirect trends and forecasts, including:

- State budget;
- Province budget;
- Profits to local government; and
- Local citizens' household income.

4.3.10 Evaluation of risks in a form of comparison

The Feasibility Study for the Project shall evaluate possible economic and financial risks of alternatives. Potential risks shall be described, taking into account the level of infrastructure development, economic capacity and political situation of Mongolia.

There should be a clearly described action plan to eliminate and prevent possible financial and economic risks. The amount of any risk shall be calculated from the loss of time, wasteful expenses, the resources to compensate for it, and the risk that may arise from the delay in the implementation of the project.

Financial and Economic Risk Assessment must be summarized together with the Environmental and Social Risk Assessment and Action Plan should be made to reduce the risks.

4.3.11 Project benefit estimation

The Consultant shall employ the following principles to estimate project benefits:

- All expenditures required for indirect and direct benefits of the Project must be estimated in detail with sufficient justification;
- Income and revenue should be computed using financial and economic parameters and methodologies; and
- Add value to the estimations including figures, diagrams and schemes. These expressions should be acceptable and clear to read, understand and use by the interested parties.

The Consultant must compute the following estimations using known traditional or new developed methodologies:

- Individual estimations of drawings, investigations and surveys, construction activities and operations expenditure; and
- Income and Revenue Estimations ;

Investment benefit estimation shall be estimated for each of the alternative via their implementation stages.

4.3.12 Financial and economic analysis

The Consultant shall consider the following factors in the Financial and Economic Analysis:

- Current price, base-price, NPV and payback evaluation;
- Capital, depth and payment ratio, payment conditions, circulating asset;
- Sensitivity Analysis – electricity rates, increase in CAPEX, delay of construction work
- Financial and Political Factors - inflation, exchange rate, exchange rate difference,
- interest fee and payment risks.

Evaluate comparisons of alternatives on “before-after” the project basis. Project beneficiaries of all sectors must be included in the Financial and Economic Analysis.

Develop Financial Model for the project, inclusive of the following:

- Sales
- Cost of goods sold
- Gross Profit
- OPEX
- Earnings before interest and tax
- Pretax Income
- Income Tax
- Net Income
- CAPEX
- Long-term Debt Borrowing
- Long-term Debt Repayment
- Environmental Costs
- Free Cash Flow
- Discount Multiple
- Present value of Cash Flows

The Consultant shall determine financing type and sources including:

- Identify possible financing scenarios together with the components of the Project to determine interest level;
- Identify possible investors and assess how to cooperate with them during the Project implementing phases.

Compute Internal rate of return (IRR) and Compute Net Present Value (NPV) of the selected alternative.

Project Economic Basis will be determined by not only economic benefits but also by the result of social, economic and ecological benefit assessment so that economic benefit can be determined by summary of assessment.

C. DELIVERABLES BY THE CONSULTANT

4. Work results

5.1 Introduction

The Feasibility Study and Detailed Environmental and Social Assessment shall be performed simultaneously under separate agreement. The Feasibility Study shall include engineering, technical, financial, economic, legal and institutional studies used for developing the project concept and justifications for its implementation. The Environmental and Social Assessment will discuss and find solutions to the environmental and social impacts of the proposed project. Results from these two works will establish the basis for decisions on implementation of the project.

5.2 Deliverables

Deliverables of this FS is described in this section.

The Feasibility Study shall be discussed and approved by the experts of “Construction Development Center” of Ministry of Construction and Development, and “Water Resource Committee” under the Ministry of Environment and Tourism in accordance with the current Mongolian Law on “Construction” and Regulation on “Design for construction and its expertise approval” which was approved by the Resolution No.108 of 2019.

5.2.1 Reporting

Inception report: A brief report to the PMU to present the work plan for the Final Feasibility Stage updated by the findings of the previous studies.

Draft Final report: Submitted for review by the PMU, present the results of all technical, environmental/social and economic/financial work done for this stage.

Executive summary: should provide a clear presentation concerning the scope and objectives of the proposed Project, assess its technical, environmental and social feasibility under current conditions, indicate state and public consultations undertaken and their outcome, and include an evaluation of costs and potential sources and mechanisms for funding the Project. In addition to text, the Executive Summary should contain tables, figures and/or maps as needed.

Final report: The Final Study should provide complete details of all work performed, analyses made, and justification of options and recommendations proposed. This report will build upon the reports completed previously and integrate comments received from the PMU, including issues raised and discussed at review meetings, as well as written comments.

The Final Report should be delivered to PMU and disclosed to the public by posting it on the Project website and making it available at appropriate locations in printed form. In addition, a master hard copy and master soft electronic copy appropriate for reproduction purposes should be provided to the PMU to meet any future needs for reprinting.

5.2.2 Finance and economic study

The Draft report: should focus on findings, conclusions, and recommended actions supported by summaries of the data collected and citations for any references used in interpreting those data. Liberal use of tables, maps, and graphics to present summaries of data and analyses is strongly encouraged. Unpublished documents that are not readily available should also be

assembled into an annex. The report will be submitted to the PMU and will be posted on the project's website for public viewing and in a printable form.

The PMU will organize review meetings. Main sections of the Finance and Economy Study that require extensive re-writing and editing should be re-submitted for verification to the PMU. If the corrections made to the report are received and approved in writing by the PMU, the Consultant will submit the final report.

Executive summary: should provide a clear presentation concerning the scope and objectives of the proposed Project, assess its technical, environmental and social feasibility under current conditions, indicate state and public consultations undertaken and their outcome, and include an evaluation of costs and potential sources and mechanisms for funding the Project. In addition to text, the Executive Summary should contain tables, figures and/or maps as needed.

Final Report for Financial and Economic Study: Finance and Economy Study shall be developed as Final Report as per schedule. The Final Study should provide complete details of all work performed, analyses made, and justification of options and recommendations proposed. This report will build upon the reports completed previously and integrate comments received from the PMU, including issues raised and discussed at review meetings, as well as written comments.

6. Management of Feasibility study

6.1. Roles and responsibilities

Roles and Responsibilities of Project Management Unit: The Project Management Unit (PMU) is responsible for providing managerial guidance and monitoring progress of the Feasibility Study. The PMU shall monitor the fulfillments of the Consultant and shall receive the reports on the Project from the Consultant for review and approval by related organizations. The PMU shall monitor the activities of the Consultant all times and shall report to the Client.

Roles and Responsibilities of the Client: The Client for the Project is the Water Authority. The Client shall perform the monitoring with assistance of PMU, review and discuss the reports on Project phases and shall grant necessary approvals when required.

Roles and Responsibilities of the Consultant: To ensure fulfillment of Feasibility Study within a timeframe, the Consultant will be fully responsible for regulating their activities under transparent and united management. The Consultant shall be responsible for ensuring work interrelations, exchanging official information and organizing meetings with Consultant's management and other key and non-key experts. In addition, the Consultant will submit work fulfillments and will hand over reports to the PMU and the Client in compliance with Work Schedule for discussion and approval after including their recommendations.

6.2. Consultant time schedule

The work of the Consultant will be supervised by the Client, Water Authority – a Government implementation agency, through PMU, which will be the focal point for coordination with all other ministries, agencies and any other international institutions. It will also provide liaison and contacts with the academic and applied research institutions, Civil Society Organizations and Nongovernmental Organizations.

The following Tables 6.1 – 6.3 present the description and the duration of the production of the reports. The Consultant Teams for the Feasibility study and the Environmental and social assessment should begin work upon contract signature. The Consultants Team should submit a detailed workplan and schedule with critical milestones with allowance for PMU and external reviews.

The Consultant must provide monthly progress reports in writing during the implementation of the Project to avoid unexpected problems and to resolve problems in a timely manner. The inception reports, monthly progress reports and any other reports must be prepared in English and Mongolian. The Inception Report shall include the work plan and schedule and be include main concept and contents of the report.

The general drafts and final reports will be prepared in both English and Mongolian. The Draft Final Reports must be printed in Mongolian and English and be presented to the Client, Erdes Oyu Tolgoi LLC, MMHI, MET, MoE, local government, and to the Public Representatives for comments.

Table 6.1: Milestone plan for Feasibility study stages

No.	Objective	Month
1	Submit Inception report and detailed work program for Feasibility Study	1
2	Compile, review, and evaluate existing/ongoing studies	2
3	Submit 1st stage work report	2
4	Submit 2nd stage work draft report	2
5	Review by the Client and PMU and receive their comments	1.5
6	Submit draft feasibility study report	3
7	Obtain an expertise approval	2
8	Receive comments from PMU and get it approved by the Client	2
9	Submit pre-feasibility study report	5

Table 6.2: Milestone Plan for Finance, Economy Study

No.	Objective	Month
1	Submit Inception report	2
2	Participate in Workshop	1
3	Submit Program for consultation and communication with state and public jointly with other Consultants	1.5
4	Submit annotated outline of finance, economy study	2
5	Submit result report of the 1 stage works	3
6	Submit draft finance, economy study	6
7	Review by the Client and PMU and receive their comments	2
8	Submit Draft Final Report	8
9	Receive comments from PMU and get it approved by the Client	2
10	Submit final finance, economy study report	10

Table 6.3: Milestone Plan for Final Feasibility Study

No.	Objective	Month
1	Submit work program for Final Feasibility stage	0.5
2	Compile, review, and evaluate prior task outputs	1
3	Submit 1st stage work report	0.5
4	Submit 2nd stage work draft report	0.5
5	Review by the Client and PMU and receive their comments	1
6	Submit Draft Final Report	2
7	Obtain an expertise approval	0.5
8	Receive comments from PMU and get it approved by the Client	0.5
9	Submit Final Feasibility Report and Preliminary Design	5

Follow the above time schedule for producing the reports. The Consultant shall start work upon signing a contract.

6.3. Ownership and control of information, data and documents

All information and data, all intellectual property rights, ownership, licensing provided to the Consultant Team shall be used only for this Study and assessment. Documents, information and data generated by the Consultant Team shall not be disclosed without the expressed written consent of the PMU.

7. Requirements for the Consultant Team

The Consulting Team should be a consulting firm or a consortium experienced internationally in performing work on projects similar in size and complexity. The international Consulting Team awarded this service shall form joint venture with an experienced Mongolian organizations and company with this project.

Consultant Team will develop definition of the identity and biography of specialists to be involved in specific positions within the Consultant Team. Identities of Consultant Team leader and his Deputy will be named, as well as the key staffs and special experts required to work for a short period.

The Consultant Team must confirm that all specialists are available to work during the Project implementation period.

Table 7.1: Key staffs inputs for Feasibility study

Key staffs			
International	Person /month	**National**	Person /month
Team Leader	18	Deputy team leader	18
Financial and economic study team leader	6	Deputy leader of financial and economic study team	6
Technical and engineering study team leader	6	Deputy leader of technical and engineering study team	12
Natural resource economist	4	Natural resource economist	3
Financial specialist	2	Financial specialist	3
Legal specialist	1	Legal specialist	6

Hydrogeological engineer	2	Hydrogeological engineer	18
Hydrologist	3	Hydrologist	18
Hydraulic engineer	3	Hydraulic engineer	18
Water supply and pipeline engineer	3	Water supply and pipeline engineer	8
Water reservoir planning engineer	3	Reservoir engineer	6
Dam design engineer	3	Geodetic engineer	4
Geologist	4	Geologist	4
		Ichthyologist	3
		Soil scientist	3
		Construction engineer	6
		Road engineer	4
		Mechanic and line engineer	4
		Electric engineer	6
		Automation engineer	6
		GIS specialist	3
		AutoCAD operator	18
TOTAL			

Minimum qualification requirements of Consultant Team specialists for Feasibility study are presented below:

Team leader:

- Have a minimum of 20 years of work experience in his field of expertise and at least 10 years of work experience in hydro engineering, nature resource management, strategical resource management, and planning. The team leader must have project management experience regarding feasibility studies projects;
- Demonstrate the capability to coordinate efficiently multi-dimensional project implementation including participating related individuals and companies;
- Experienced in managing similar projects together with interacting with government, civil society and the public;
- Have the qualifications to consult Project staff and specialists;
- Have knowledge of project finance, economics, hydraulic engineering, related techniques and technology, environment, social and organization development, practical experience of implementation;
- A Master’s degree or higher qualifications in related field;
- Fluent oral and writing skills in English;
- Proficient in all of PC based software applications;
- Have sound organizational skills and experienced in a timely manner often under severe time pressures; and
- Has demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of projects;

The Leader of Financial and Economic Study Team

- Have a minimum of 10 years work experience in finance, economics, and nature resource economic management;
- Experienced in working in his field in developing countries. It is competitive advantage if have an experience of management and coordination in similar project in Mongolia;
- Have work experience in management projects or bigger investment projects (budgets of at least 1 billion US. Dollars);
- Experienced in performing similar projects and interacting with government, civil society and the public;
- Demonstrate the capability to coordinate efficiently multi-directional project implementation including participating related parties;
- Have the qualifications to consult Project staff and specialists;
- A Master's degree or higher qualifications in finance and economics;
- Have sound organizational skills and able to deliver assignments in a timely manner often under severe time pressures;
- Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project;
- Strong inter-personnel skills and a commitment to work within a team-oriented project
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications;

The Leader of Technical and Engineering Study Team

- Should have a minimum of 10 years project management experience in hydraulic engineering, hydro dam planning and water transmission pipelines. It is competative advantage if have a experience of management and coordination in similar project in Mongolia;
- Experienced in working on above field in developing countries;
- Experienced in similar or larger projects as an administrator or in a leading management role;
- Experienced with similar projects interacting with government, civil society and public;
- Have demonstrated capability to coordinate efficiently multi-directional project implementation including related participants;
- Qualified to consult and manage project staff;
- A Master's degree in hydraulic engineering;
- Possess sound organizational skills and able to deliver assignments in a timely manner often under severe time pressures;
- Has demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project;
- Have strong inter-personnel skills and a commitment to work in a team-oriented project;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications;

Financial specialist

- Should have a minimum of 10 years work experience in projects related fields in developing countries and Mongolia;

- Ability to estimate, assess and prepare financial analysis of investment in natural resource and infrastructure development projects;
- Experienced with financial analysis implemented by World bank and International Financial corporation in developing countries;
- Ability to analyze and compare alternates;
- Qualified to consult and manage project staff;
- A Master's of higher degree in finance;
- Demonstrated initiative in developing practical approaches that improve efficiency and
- effectiveness of the project;
- Strong inter-personnel skills and commitment to work in a team-oriented project;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications and financial programs.

Legal specialist

- Should have a minimum of 10 years work experience in his profession;
- Accustomed to working on projects developing warm legal environment on developing countries resource management;
- Legal specialist should have experience relating to instructions and requirements of the project and experienced with international organizations, natural resource management policy and law in developing countries;
- Experienced in managing situations typical of developing countries have wide range interests;
- A Master's or higher degree in law;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications.

Hydro-Dam and Reservoir Planning Engineer

- Should have a minimum of 10 years relevant professional work experience ;
- Experienced working for planning and assessment on larger water infrastructure projects. It is competitive advantage if have an experience in similar project in Mongolia;
- Experienced with dam and reservoir projects implemented by World bank and International Financial Corporation in developing countries;
- Professional skill to prepare engineering calculations and method alternates;
- Experienced in implementing projects in cold region countries;
- Have a degree in hydraulic structure engineering;
- Possess a wide array of experience assessing negative impacts of hydrology, river, water resource management, water infrastructure, climatic change and mitigation plan;
- Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project;
- Fluent oral and writing skills in English;Proficient in all of PC based software applications.

Hydraulic Engineer

- Should have a minimum of 10 years work experience in their profession;
- Experienced with water infrastructure projects;

- Experienced with projects implemented in Mongolia or Cold region;
- A Master's or higher degree in hydraulic structure engineering;
- Possess a wide array of experience with hydraulic estimation and testing of hydraulic modeling structure of various types of hydro structure;
- Professional skill to conduct engineering calculations and select method alternates;
- Demonstrated initiative in developing practical approaches that improve efficiency and
- effectiveness of the project;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications.

Water Transmission Pipeline and Reservoir Planning Engineer

- Should have a minimum of 10 years work experience in his profession;
- Experienced in similar large water transmission pipeline projects. It is competative advantage if have a work experience in similar project in Mongolia;
- An experienced professional in hydraulic structure or water supply engineering. A Master's or higher degree;
- Possess a wide array of experience with water transmission pipeline planning and project planning for pump stations and other structures;
- Has project experience implemented in cold region;
- Professional skill to conduct engineering calculations and alternates of method;
- Demonstrated initiative in developing practical approaches that improve efficiency and
- effectiveness of the project;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications.

Hydrologist

- A Master's or higher degree in hydrology. Should have a minimum of 10 years work
- experience;
- Experienced with projects implemented in Mongolia;
- Professional process skills and work experience in estimation modeling;
- Demonstrated initiative in developing practical approaches that improve efficiency and
- effectiveness of the project;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications;

Hydrogeological Engineer

- A Master's or higher degree in hydrogeology;
- Should have a minimum of 10 years work experience of groundwater investigation in Mongolia or similar dry land region. It is competitive advantage if have a work experience in similar project in Mongolia;
- Possess professional skill to process information and work experience in estimation modeling;
- Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project;

- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications.

Ichthyologist

- Have a Master's or higher degree in ichthyology;
- Should have a minimum of 10 years work experience;
- It is competative advantage if have a work experience in similar project in Mongolia;
- Work experience in biodiversity study, aquatic and fish study in similar region;
- Work experience with planning of fish breeding in water pond;
- Professional skills to process information with work experience in estimation modeling;
- Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based applications;

Geological Engineer

- The specialist shall be a Geological Engineer;
- Should have master or higher degree in geology, should have a minimum of 10 years work experience in their profession;
- Experienced in geological survey and investigation for hydraulic projects implemented in the dry region, in Mongolia or similar region and have not less than 10 years experience.
- Information on the development of professional skills and have experience working on computational modeling;
- Demonstrated initiative in developing practical approaches that improve efficiency and effectiveness of the project; and
- Fluent in English, proficient in all of PC based software applications.

Geodetic engineer

- Should have master or higher degree in geodesy;
- Experienced in geodetic survey and investigation for hydraulic projects implemented in the dry region, in Mongolia or similar region, and have more than 10 years of experience;
- Should have experience working with data processing and modeling;
- Demonstrated skills in developing practical approaches that improve efficiency and effectiveness of the project and prioritize tasks;
- Fluent oral and writing skills in English; and
- Proficient in all of PC based software applications;

The Consultant may suggests its' team operation in another formation or may add required specialists who are not listed above. The comprehensive team shall include other required specialists for investigation, HPP, electrical, roads, construction, structure detail, training, environment and social work;

To properly accomplish the work required by this TOR, the Consultant will be required to have a project office in Ulaanbaatar for the duration of the Feasibility Study.