**PROJECT DESCRIPTION**

**Naugad Hydropower Project**

## Location

The proposed Naugad Khola Hydropower Project area lies within Naugad Rural Municipality ward no 5 (former Sipti and Dhuligada Village Development Committee) of Darchula District, Sudurpachshim Province of Nepal. All the components of the Project lie within Naugad Rural Municipality. The locations for diversion weir axis at Naugad Khola lie confluence of Naugad Khola and Hopari Khola.

Geographically, the proposed site of Naugad Khola Hydropower Project lies within the longitudes from 80⁰ 39' 25"E to 80⁰ 41' 23"E and latitudes from 29⁰ 44' 15"N to 29⁰ 46' 04"N. Location map of the Project area in Nepal map is shown in Figure 2.1.

The proposed powerhouse site is located on the Left bank of Naugad Khola at near to Hopari village. Elevation of the rivers in the proposed headwork’s and powerhouse area is 1251 masl and 1051 masl, respectively. The proposed penstock alignment follows the left bank of Naugad Khola.

## Physical Features

Naugad Khola is perennial Rivers originating from the middle mountains, the highest peak within the catchment area being at 4000 masl in Bramaha Lake. Naugad Khola, within the Project area, flows from North to South direction. The altitude of the river in the Project area varies from 1251 masl to 1051 masl. The average gradient of the river course in the Project area is more than 10%.

Naugad catchments are mainly covered and moderate to dense mixed forest, whereas Rocky Mountains prevail in the higher altitudes. Agricultural fields on terraces and scattered settlements dominate the area below 2,000 m. Within the reach of the proposed components of the Project, the forest area dominates with few scattered settlements and agricultural terraces. The fan-shaped catchments drain towards the South direction. The river, after Naugad Khola confluence flows towards the north to south direction up to the confluence with Chameliya River. The maximum length of the catchment at the proposed Naugad intake sites is about 15 km. Based on the topographical maps; there is no lake within the basin.

The headworks site is located about 10 to 20m downstream of the confluence of Naugad Khola and Hopari Khola. The gravel trap, desander, and forebay are placed on the flood plain of Naugad Khola along its left bank. The proposed headrace water conveyance system is proposed to be MS pipe option. The powerhouse site is located at near to Chyuri Bagar village on the flood plain of Naugad Khola along its Left bank.

The topography is generally favorable for implementation of hydropower project. The power evacuated from the Project will be connected through a 15 km long single-circuit 33 kV transmission line to proposed Balanch sub-station located in Darchula district.

## Accessibility

Gokuleshwor, the road head point of Dhangadi to Darchula route is linked by a 260 km long black-topped road. From Gokuleshwor to Sukha Khola is Approximately 10 km long black-topped after Sukha Khola to Hopari is approximately 15 km earthen road connected to proposed intake and powerhouse point. The proposed Project’s headworks area is at the Naugad village along the Left bank of Naugad Khola. The headworks, powerhouse, and other major project components can be accessible by about 25 km long existing fair-weather road.

Gokuleshwor is accessible by regular passenger-bus-service from Kathmandu, Dhangadi and Attariya. The road has no obstruction throughout the year. However during the winter season, if snowfall arise road will be obstructed.

## Infrastructure

Gokuleshwor, at about 25 km from the Project area, is the nearest market place Gokuleshwor offering almost all the infrastructures needed by the Project. It has a regular transportation service connected with Kathmandu, Attariya and Dhangadi has a market where almost all the goods for daily life as well as for local construction works can be bought. Electricity and landline telephone services are currently unavailable in the Project area, whereas GSM and CDMA telephones are available for communication in the Project area.

## Project Components

### Headworks

The headworks design is basically governed by the type of River, quantity of flow of water and sediment, type of scheme, etc. For Naugad Khola Hydropower project the headworks layout has been fixed considering quantity of flow of water and sediment in the River, required design discharge, existing topography, geological conditions and optimum utilization of space needed. Besides this the location of headworks has been proposed at the downstream point of confluence of Hopari and Naugad Khola. Following basic principles are considered for design of the headworks for NHP.

* The structures will divert necessary flow into the system.
* Bed load entry to intake is negligible and mostly passed through under-sluice.
* Structures will be safe from any hazardous floods and excess flood in the River will be safely passed to downstream over uncontrolled free flow spillway.

### Settling Basin

Settling basin chambers are fed with discharge from one approach canal. The alignment of the basins has been chosen such that openings are stable during and after construction. Settling basin is designed to trap the silt sand of size equal to or bigger than 0.2 mm.

### Headrace Pipe/Canal

Pipe option has been recommended for headrace. The cross section of the Headrace pipe will be circular in shape. It has been fixed considering the practical approach.

### Forebay/Surge Tank

A forebay partly underground, but exposed to surface at top is provided to protect the horizontal penstock pipe from the effect of water hammer caused by sudden change in flow condition. A forebay:

* provides a free reservoir surface close to the discharge regulation mechanism,
* supplies the additional water required by the turbine during load demand until the water velocity in canal/pipe has accelerated to the new steady state value,
* stores water during load rejection until the canal velocity has been retarded to the new steady state value, and
* protects the penstock against detrimental effects of water hammer.

### Powerhouse and Tailrace

The powerhouse will accommodate generating facilities including two Francis turbines. Considering the topography, utilization of maximum head and structural stability, the powerhouse will be surface concrete structure. Tailrace canal is designed as free flow canal but will be open culvert in shape.

### Hydro mechanical Equipment's

Hydraulic gates will be provided at different locations of headwork, settling basins, Canal inlet, and tailrace for regulation of discharge, maintenance of the structures and emergency purpose. Hydraulic gates will be fixed wheel, sliding and/or flap type. Vertical lift fixed wheel and slide type of gates are proposed according to their function and purpose. Penstock pipe of 1.25 m diameter has been proposed however for the wall thickness detailed design will be covered by feasibility study.

### Electromechanical Equipment's

Two sets of horizontal shaft, Francis turbines are proposed for the net head and design discharge of 190 m and 4.67 m3/s with rated output of 5MW. The Francis Turbine is fitted with guide vanes that control the water. This will help to prevent the Over-speed of the generator. The alternator is proposed as two set of 5.5mVA coupled with each turbine with appropriate size of control panel. When the grid is restored back or the plant has to be run in isolated mode the guide vanes shall open to require size for the water to strike the runner. The details of electromechanical equipment's will covered by feasibility study.

## Environmental and Social Aspects

### Environmental Aspect

The project area lies in the Api Nampa Conservation Area therefore Environmental Impact Assessment (EIA) study shall be carried out as per governments prevailing Acts and Rules. The EIA study will quantify the base level environmental parameters their magnitude and extent of environmental impacts with proposed mitigation measures. The broad categorization of impacts includes Geo physical, Biological, Cultural and Socio economic parameters.

### Geo-Physical Parameters

Landscape changes, will accelerate the landslides and instability of the land in the project area. During the construction phase the noises, dust, soil erosion, downstream sedimentation, geological hazards and changes in water quality are pre dominant impacts on physical environment. Similarly, the stockpiling of construction materials, disposal of soil and spoiled materials, quarry site operation and stone crushers plants and alteration in drainage pattern are also impacts significantly. Therefore, EIA study will quantify these impacts and suggest the mitigation plans, with proper monitoring plans. The Geo physical impacts are more concentric on construction phase and a few will continued during the operation phase also.

Proposed Naugad Khola Hydropower Project site is safe in terms of soil stability, access road reaches to the both powerhouse and intake points, and proposed water conveyance system is pipe system so, it is expected little impacts on the environment during preliminary study.

### Biological Parameters

Loss of Forest, Flora and fauna, disturbance in the movement of wild animals, use of forest product by construction workers, extinct of Fishes and other aquatic life are main environmental impacts. Therefore, EIA study will quantify these magnitude and extent of impacts and suggest the mitigation plans, with proper monitoring plans. The impact of biologic environmental parameter affects both in construction and operation phases of projects.

There is not dense forest area in the proposed Naugad Khola Hydropower Project structure's locations, so loss of forest is expected minimum as per the preliminary study but impact on aquatic life mainly extinct of fishes in the Naugad rivers upstream seems more dominant.

### Socio Economic and Cultural Parameters

Population displacement and resettlement, loss of assets due to the land acquisition, pressure in social services like health post, schools etc. during the construction phases, damages and drying of irrigation canals and dependent livelihood effects, damages of cultural and religious sites are the major socio economic and cultural parameters. The EIA study will quantify the magnitude and extent of impacts on these parameters.

There are not the cases of population displacement, as per the preliminary study, however the loss of cultivable land is expected around 20 hector in the pipe alignment, intake site and powerhouse sites. In addition, there are 2 irrigation canals in the right bank of river which will remain dry due to the project and this will case the losses of agriculture based livelihood of peoples. No religious and cultural importance area. The detailed feasibility study along with EIA study will quantify the exact losses of private land and processes of land acquisition as per the prevailing law of the land.