TERRESTRIAL BIODIVERSITY REPORT

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The Vishnugad Pipalkoti Hydroelectric Project (VPHEP) is a run-of-the river hydro power project proposed on River Alaknanda in district Chamoli in Uttarakhand. The project envisages construction of a diversion dam near village Helong (79^{o}29' 30 E and 30^{o}30'50" N). An underground power house is proposed at village Hat (79^{o}24'56" E and 30^{o}25'31"N), 3 km from Pipalkoti. The installed capacity for power generation is 444MW. The present study comprise of Terrestrial Biodiversity Study for the VPHEP.

2.0 PROJECT BACKGROUND

River Alaknanda is a major tributary of river Ganga, originating from the glacial regions of Himalayas. The river has tremendous scope for development of hydro-power, which needs to be harnessed to meet the ever-growing demand for power. At present, various hydropower schemes are in different stages of development on river Alaknanda. Vishnugad Pipalkoti is one of the various hydropower schemes envisaged in this region. The river stretch under the project is about of about 27 km from village Helong to village Birahi. The operation of VPHEP is linked to the upstream projects on Vishnugad (by JP) and of Topovan- Vishnugad (by NTPC). Downstream of this project, further run of the river power project are planned, which will also divert water from Alakananda through headrace tunnel.

3.0 POLICY AND LEGAL ASPECTS OF BIODIVERSITY CONSERVATION

In order to project biodiversity resources of the country Government of India (GOI) is actively involved in various conservation measures such as establishment of National Parks & Sanctuaries, Biosphere Reserve Program, World Heritage Sites, Specific Animal Targeted Project (Project Tiger 1973, Project Elephant 1991-92, Rhinoceros i.e. Sanctuary / National Park in North East and North West India), etc. There are many international treaties/regional treaties concentrate specifically on conservation and use of global biodiversity. Following are some of the international treaties relevant to biodiversity

- Convention on Biological Diversity, (1992)
- Convention Relative to the Preservation of Fauna and Flora in their Natural State. 8th Nov. 1993, London
- International Plant Protection Convention. 6th Dec. 1951, Rome
- Plant Protection Agreement for South East Asia and Pacific Region 27th Feb. 1956, Rome
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat 2nd Feb 1971, Ramsar
- Convention on the conservation of Migratory Species of Wild Animals, 23rd June 1979, Bonn
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, 3rd March 1973, Washington
- International Tropical Timber Agreement 19th Nov. 1983, Geneva

International treaties to which India is a signatory:

- Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS)
- The United Nations Convention on Biological Diversity

There are 97 existing national parks in India covering an area of 38,199.47 km^2 which is 1.16% of the geographical area of the country (National Wildlife Database, June, 2008). Uttarakhand have 6 national parks covering an area of 4,731km^2 which is 8.85% of the geographical area of the state. Two national parks Nanda Devi National Park and Valley of Flowers National Park fall in the Alaknanda basin.

Status of Protected Areas

Location	National Parks	Sanctuaries	Biosphere Reserve	Conservation Reserve	Community Reserve
India	97	508	14	7	2
Uttarakhand	6	6	1	2	0
Alaknanda Basin	2	1	1	0	0
Project Area	0	0	1	0	0

The Project area lies within the transitional zone of Nanda Devi Biosphere Reserve (NDBR).

4.0 BIODIVERSITY ASSESSMENT METHODOLOGY

Flora Assessment: To characterize the vegetation under the project area study was carried out by using Standard Quadrat Method and Random Sampling approach was followed. Quadrat size of 10 x 10 m used for tree species and 5x5m for shrub species and 1× 1m quadrats for herbs & grasses. The properties of vegetation with reference to species composition and functional attributes are expressed on species basis. Frequency, density abundance and Importance Value Index (IVI) were calculated. Diversity was calculated using Shanon – Wiener Index

Shanon – Wiener Index

The number of species and number of individuals in a community is measure of species diversity which depends on stability of the habitat. Vegetation of the study area was assessed by determining Shannon – Wiener diversity index.

$$H = -\Sigma (ni / n) \log_{ln} (ni / n)$$

ni = Number of individuals of each species in the sample

n = Total number of individuals

Faunal assessment: The list of wildlife was obtained from Kedarnath Forest Division Gopeshwar and Badrinath Forest Division Gopeshwar, The domestic animals were listed based on direct observation during field survey.

Public consultation was conducted during survey of the project area to know about various aspects of forest. Information about uses of various plant species by local people as well as sighting of any wildlife species, uses, poaching etc were obtained.

5.0 BIODIVERSITY STATUS

The forests vegetation of the Uttarakhand ranges from tropical dry deciduous forests in the foothills to alpine meadows above timberline. The Comparative Distribution of Forests Types in the State, Alaknanda Basin, Project Influence Area (PIA)-7 km area of project sites, Project Immediate Affected Area (PIAA) - 500 m on either side of project sites and Project Affected Area (PAA) is given below.

Comparative Distribution of Forest Types

S. No	Forest Type	Uttarakhand	Alaknanda Basin	PIA	PIAA	PAA
1	Moist Alpine Scrub	+	+	-	-	-
2	Sub- Alpine Forests	+	+	-	-	-
3	Himalayan Dry Temperate Forests	+	+	+	-	-
4	Himalayan Moist Temperate Forests	+	+	+	-	-
5	Sub-tropical Pine Forests	+	+	+	+	+
6	Tropical Dry Deciduous Forests	+	-	-	-	-
7	Tropical Deciduous Forests	+	-	-	-	-
8	Littoral & Swamp Forests	+	-	-	-	-

Biodiversity of Alaknanda River Basin

The Alaknanda River is the major tributary of the river Ganga. The Alaknanda originates at a height of 3641 meters below Balakun peak 16 km upstream from Badrinath form the two glaciers of Bhagirath Kharak and Satopanth.

The unique geographical location climate and topography along with latitudinal variation of the area has endowed the Alaknanda basin with highly luxuriant and diverse flora. The following major forest types have been identified:

i. Himalayan Sub tropical Pine (between 900 – 2000m)
ii. Temperate Forest (between 2000-2800).
iii. Sub alpine Forest (between 2800-3800m).
iv. Alpines land (above tree line between 3800-4500m).
v. Alpine meadows (above tree line in above 3800-4500m).

Nanda Devi Biosphere Reserve (NDBR)

The project site is located in the transitional zone of NDBR. The territory of Nanda Devi Biosphere reserve starts from Patal Ganga. The transitional zone in project area is approximately 5km from dam site to Patalganga. The land use pattern of this zone comprises of forests, agricultural land, waste land, settlements, cultivable waste land and orchards. The National Highway NH-58 is located on the left side of the Alaknanda river in the project area and is a pilgrim route.

Nanda Devi Biosphere Reserve (30° 05'-31° 02'N Latitude, 79^{0}12'-80^{0}19'E Longitude) is located in the northern part of west Himalaya and comprises of parts of Chamoli district

in Garhwal, Bageshwar and Pithoragarh districts in Kumaun in the Uttarakhand State. It belongs to Himalayan Highland Biogeographic Zonation of India and among the World Heritage Sites. In order to undertake complementary activities of biodiversity conservation and development of sustainable management aspects, Biosphere Reserves are demarcated into three inter-related zones.

Core zone: The core zone is defined as absolutely undisturbed zone. It must contain suitable habitat for numerous plant and animal species, including higher order predators and may contain centres of endemism. The core zones also contain places of exceptional scientific interest**. A core zone secures legal protection** and management and research activities that do not affect natural processes and wildlife are allowed. In NDBR strict conservation measures are taken to preserve the core zone and no human activity except regulated tourism is allowed inside the core zone. Regular patrolling activity and monitoring activity is taken up in side the core zone The Core Zone of NDBR comprise of:

1. Nanda Devi National - total area 624.6 km^2
2. Valley of Flower National Park - total area of 87.5 km^2

The Valley of flowers is a trek of about 16 km from Govindghat which is about 25 km from Joshimath. The Nanda Devi National Park is situated at a distance of 25 km from Joshimath, the territory starts at a distance of 9 km trek from the Village Lata. The core zone of NDBR harbors high diversity of species, alpine communities, rare, endangered, native and endemic species of both flora and fauna. The core area has 17 species of mammals such as Snow leopard *(Panthera uncia).* Leopard *(P. pardus),* Himalayan black bear *(Selenarctos thibetanus),* Himalayan brown bear *(Ursus aretos),* Himalayan musk deer *(Moschus chrysogaster)* Blue sheep *(Pseudois nayaur),* Himalayan tahr *(Hemitragus jemlahicus),* etc. many species of birds such as Monal pheasant *(Lophophorous impejanus),* Himalayan snow cock *(Tetraogallus himalayensis),* Koklas pheasant *(Pucrasia macrolopha),* Snow pigeon *(Columba leuconota),* Himalayan golden eagle *(Aquila chrysaetos),* Himalayan griffon *(Gyps himalayensis),* Lammergeier *(Gypaetus barbatus),* etc. (Tak 1997) and 19 species of butterflies such as Common yellow swallowtail *(Papilio machaon).* Common blue apollo *(Parnasshis hardwickei),* Bath white *(Pontia daplidice),* Painted lady *(Cynthia cardui),* etc**.**

Buffer Zone: The buffer zone adjoins or surrounds the core zone. In the NDBR the whole buffer zone has mainly three types of lands. Vegetation in the buffer zone comprises of temperate, subalpine and alpine types. It supports over 800 species of plants including fungi, lichens and bryophytes and 520 species of fauna. Over 23 forest communities and over 62 alpine communities have been recorded from the buffer zone of the reserve. 254 species of plants in Pindari area and 193 species in Lata-Tolma-Malari area are used by the native communities for various purposes. The buffer zone supports 29 species of mammals. Forty seven (47) villages are located in buffer zone of the reserve. The villagers are totally dependent on the forests for fuel, fodder, medicinal and wild edible plants and various other purposes

Under buffer zone 57.92 km^2 land is under Forest Panchayat land. These areas are under the direct control of Village Panchayat Committee and are looked after by them under the supervision and guidance of the Divisional Forest Officer. The major chunk of the buffer comprises of the Civil Forest Lands and the total area of such land is 4,595.10 km^2. The administrative control of these areas lies with the Revenue Department but the civil forest being protected forest lands the provisions of Indian Forest Act applies in these areas. The buffer zone of the NDBR has 490.17 km^2 of Reserve Forest areas. The

Reserve Forest Areas are totally owned and managed by the Forest Department of Uttarakhand.

Transition zone: The transition zone surrounding the buffer zone covers 546.34 km^2 area and inhabited by 52 villages. The inhabitants belong to schedule tribes, schedule castes, Brahmins and Rajputs. The vegetation mainly comprises of temperate, sub-alpine and alpine types. The land use pattern mainly comprises of forests, agricultural land, waste land, settlements, cultivable waste land, orchards, etc. The inhabitants are mainly dependent on horticultural and agricultural crops such as Apple (*Pyrus malus),* Walnut *(Juglans regia),* Apricot *(Prunus armeniaca)* Potato *(Solanum tuberosum),* Amaranth *(Amaranthus paniculatus),* Bee keeping, medicinal plants cultivation and sheep farming for income generation

Biodiversity of Project Influence Area

The major forest type observed in the project area up to an elevation of 2000-2200m is Upper Himalayan Pine forest. At higher elevations within the study area, scrubs are observed. *Pinus roxburghii* (Pine) chiefly occurs between the altitudinal range of 750 m and 1,600 m. Within the wide altitudinal distribution, the optimum zone of Chir is between 900 m and 1500 m, beyond which, it is observed in association with other species up to an elevation of about 1600 m. The forest of the project area fall under Badrinath and Kedarnath forest division.

The forests of the project area mainly fall in the degraded category. The forest areas are dominated by pine. The pine crops comprise mostly of middle age to mature trees. Young trees are generally deficient, occurring scattered or in small patches. Open shrub occupy the ground. Formation of plant story such as top, middle and lower is absent. Middle story and ground flora is absent in the pine forest. Pine forests are generally pure; no other species reaches the top canopy.

In the areas near habitation felling of trees is done for fuel, fodder and construction. The forests are open and poor in regeneration. The factors contributing to the degradation of the forest are

- Annual fire in the area.
- Grazing and browsing
- Felling for fuel, fodder and pole
- Agriculture & Horticulture Activities
- Natural factors – Dry rocky and steep slopes.

The major vegetation characteristics in the project area are Himalayan Moist Temperate Forest and Himalayan Dry Temperate Forest. The people from surrounding villages depend on forest for various purposes the Table given below depict various uses of trees by local people. The major uses of trees falling under the project area are as given below:

Uses of Major Species by Local Community

Name of Tree	Local	Shade	Food	Fodder	Fuel	Timber	Manure
Albizzia lebbek	Siris	_	-	+	+	+	-
Alnus nepalensis	Utis	_	-	+	-	+	+
Bauhinia variegata	Kachnar	_	+	+	+	-	+
Bombax ceiba	Semal	_	-	-	+	+	+
Cedrus deodara	Deodar	-	-	-	+	+	-

Name of Tree	Local	Shade	Food	Fodder	Fuel	Timber	Manure
Cinnamomum tamala	Tejpat	+	+	-	-	+	
Celtis australis	Kharik	+	_	+	-	+	+
Dalbergia sissoo	Shisham	+	-	+	-	+	-
Mallotus philippinenisis	Ruin	-	-	-	+	+	+
Morus alba	Tut	-	-	+	+	-	+
Pinus roxburghii	Chir	+	+	-	+	+	+
Poplus ciliata	Poplar	+	-	-	+	+	-
Pyrus pashia	Mehal	-	-	+	+	-	+
Quercus incana	Ban oak	-	-	+	+	+	+
Rhododendron arboreum	Burans	+	+	-	+	-	+
Cedrela toona	Tun	+	-	+	-	+	-

Source: Public consultation

* + In Use - Not in use

The fauna of the study area is represented by reptiles, birds and animals. The variation in altitude, climate, topography, forests type and forest cover leads to variation in animals. The fauna can be characterized as domestic animals and wild life.

Biodiversity of Project Immediate Affected Area

The forest type of PIAA consist of Himalayan Chir Pine Forest and Himalayan Sub Tropical Scrub

Himalayan Chir Pine Forest

Major Associates*: Pinus roxburghii – Rhododendron - Albizzia*

Minor Associates*: Woodfordia - Berberis - Rubus*
Artemisia - Desmodium – Plectranthus

Himalayan Sub Tropical Scrub

Major Associates*: Debregeasia - Euphorbia - Woodfordia*

Minor Associates*: Berberis – Rubus - Prinsepia*

Biodiversity of Project Affected Area

The flora of project affected area is represented by 87 species. Physio-gnomically vegetation has been categorized as trees, shrubs, herbs grasses, climbers, pteridophytes and epiphytes. The trees dominated by contributing maximum number of 34 species followed by 26 species of shrubs, 18 species of herbs , 3 climbers, 4 species of grasses, 2 species of pteridophytes and one species of epiphyte.

Flora of Project Affected Areas

S. No.	Scientific name	Local name	Family
Trees			
1.	*Aegle marmelos*	Bel	Rutaceae
2.	*Albizzia lebbek*	Bhandir, Siris	Leguminosae
3.	*Alnus nepalensis*	Utis	Betulaceae
4.	*Bauhinia variegate*	Kachnar	Leguminosae
5.	*Bombax ceiba*	Semal	Malvaceae
6.	*Cedrela toona*	Toon	Meliaceae
7.	*Celtis australis*	Kharak	Ulmaceae
8.	*Citrus limon*	Nimu	Rutaceae

S. No.	Scientific name	Local name	Family
9.	*Citrus sp*	Malta	Rutaceae
10.	*Cupressus torulosa*	Surai	Cupressaceae
11.	*Dalbergia sissoo*	Shisham	Fabaceae
12.	*Emblica officinalis*	Amla	Euphorbiaceae
13.	*Ficus auriculata*	Timal	Moraceae
14.	*Ficus bengalensis*	Bargad	Moraceae
15.	*Ficus palmate*	Bedu	Moraceae
16.	*Ficus religiosa*	Pipal	Moraceae
17.	*Grevillea robusta*	Silver oak	Proteaceae
18.	*Juglans regia*	Akhrot	Juglandaceae
19.	*Mallotus philippinenisis*	Ruin	Euphorbiaceae
20.	*Mangifera indica*	Aam	Anacardiaceae
21.	*Melia azedarach*	Dhenk	Meliaceae
22.	*Morus alba*	Tut	Moraceae
23.	*Musa paradisiacal*	Kela	Musaceae
24.	*Phoenix humilis*	Khajoor	Palmae
25.	*Pinus roxburghii*	Chil	Pinaceae
26.	*Prunus armeniaca*	Chuli	Rosaceae
27.	*Prunus communis*	Aloocha	Rosaceae
28.	*Prunus persica*	Aroo	Rosaceae
29.	*Punica granatum*	Aanar	Punicaceae
30.	*Pyrus pashia*	Mehal	Rosaceae
31.	*Sapindus mukorossi*	Ritha	Sapindaceae
32.	*Sapium insigne*	Khinna	Euphorbiaceae
33.	*Syzygium cumini*	Jamun	Myrtaceae
34.	*Toona serrata*	Kakuru	Meliaceae
Shrubs			
35.	*Adhatoda vasica*	Basinga	Acanthaceae
36.	*Agave Americana*	Rambans	Agavaceae
37.	*Berberis aristata*	Karmshal, Kashmoi	Berberidaceae
38.	*Calotropis gigantea*	Aak	Asclepiadaceae
39.	*Cannabis sativa*	Bhang	Cannabaceae
40.	*Carissa spinarum*	Karonada	Apocynaceae
41.	*Colebrookea oppositifolia*	Bindu	Lamiaceae
42.	*Coriaria nepalensis*	Makhoi	Coriariaceae
43.	*Debregeasia hypoleuca*	Sihanru	Urticaceae
44.	*Eupatorium adenophorum*	Kala bansa	Asteraceae
45.	*Euphorbia royleana*	Shuru	Euphorbiaceae
46.	*Jatropha curcas*	Arand	Euphorbiaceae
47.	*Lantana camara*	Lantana	Verbinaceae
48.	*Opuntia dillenii*	Nagphani	Cactaceae
49.	*Plectranthus coesta*	Chichiri	Lamiaceae
50.	*Princepia utilis*	Bhekal	Rosaceae
51.	*Pyracantha crenulata*	Ghingaru	Rosaceae
52.	*Ricinus communis*	Arandi	Euphorbiaceae
53.	*Rosa brunonii*	Kunja	Rosaceae
54.	*Rubus ellipticus*	Hinsar	Rosaceae
55.	*Rubus niveus*	Kala Hinsalu	Rosaceae
56.	*Rumex hastatus*	Bhilmora	Polygonaceae
57.	*Urtica parviflora*	Kandali	Urticaceae
58.	*Woodfordia floribunda*	Dhaula	Lythraceae
59.	*Zanthoxylum alatum*	Timbur	Rutaceae
60.	*Ziziphus mauritiana*	Ber	Rhamnaceae
Herbs			

S. No.	Scientific name	Local name	Family
61.	*Achyranthes aspera*	Aghada, Puthkanda	Amaranthaceae
62.	*Argemone mexicana*	Prickly poppy	Papaveraceae
63.	*Artemisia capillaris*	Pati	Asteraceae
64.	*Bidens bipinnata*	Kuru	Asteraceae
65.	*Bergenia ligulata*	Silphara	Saxiferaceaa
66.	*Cassia tora*	Chakunda	Caesalpinaceae
67.	*Cestrum verutum*	Kanjalu	Solanaceae
68.	*Chenopodium album*	Bathwa	Chenopodiaceae
69.	*Datura suaveolens*	Datura	Solanaceae
70.	*Euphorbia hirta*	Dudhi	Euphorbiaceae
71.	*Fragaria indica*	Bhumla	Rosaceae
72.	*Galinsoga parviflora*	Marchya	Asteraceae
73.	*Hedychium spicatum*	Banhaldu	Zingiberacea
74.	*Oxalis corniculata*	Amrit Sak	Oxalidaceae
75.	*Polygonum chinense*	Jangli palak	Polygonaceae
76.	*Sonchus asper*	Dudhi	Asteraceae
77.	*Thalictrum foliolosum*	Mamiri	Ranunculaceae
78.	*Tridex procumbens*	Ground weed	Amaranthaceae
Climbers			
79.	*Bauhinia vahlii*	Malo	Leguminosae
80.	*Clematis connata*	Kanguli	Ranunculaceae
81.	*Ipomea purpurea*	Besharam	Convolvulaceaea
Grasses			
82.	*Apluda mutica*	Tachula	Gramineae
83.	*Cynodon dactylon*	Dhub	Gramineae
84.	*Chrysopogan fulvus*	Godia	Gramineae
85.	*Parthenium hysterophorus*	Congress grass	Compositae
Ferns			
86.	*Pteris sp*	Fern	Pteridaceae
87.	*Adiantum sp*	Fern	Pteridaceae

There is a dense forest after Guniyala villages as the road approaches the Maina Adit site. Three herb species *Berginia ligulata* (Silpara), *Hedychium spicatum* (Ban haldi) and *Thalictrum foliolosum* (Mamiri) are reported in the forest area near Maina adit, these species fall in vulnerable category as per IUCN Red list. However these species are common in India in Himalayan region and are found in altitudinal range from 1000 to 3000 m.

Assessment of diversity index of the project affected area shows that the diversity of the area is low for both trees & shrubs and grasses & herbs. All the value of diversity index is below 2.5. The diversity of the area is lowest in the quarry site. The diversity index of the project areas is given below.

Diversity Index of Project Affected Area

S.No.	Site	Biodiversity Index		
		Trees	Shrubs	Grasses & Herbs
1	Dam Site	2.29	2.13	1.71
2	Powerhouse & Colony site	2.41	2.48	1.92
3	Gulabkoti Adit	2.07 (Trees & shrubs)		0.89
4	Langsi Adit	2.40 (Trees & shrubs)		1.37

S.No.	Site	Biodiversity Index		
		Trees	Shrubs	Grasses & Herbs
5	Quarry site Birahi	2.33 (Trees & shrubs)		1.16
6	Quarry site Patalganga	1.13 (Trees & shrubs)		1.06

Natural Fauna

The distribution of fauna is mainly dependant on availability and type of vegetation providing feeding, breeding, hiding & resting sites. As project, area is dominated by hilly tracks with less vegetation cover and interrupted by agriculture activities in the form of trench cultivation. Fauna of the project area is mainly represented by reptiles, birds and mammals.

Wildlife found in the Project Area

Scientific Name	Common Name	Family	Status	
			IWPA 1972	IUCN
Panthera pardus	Leopard	Felidae	Sch I	NT
Ursus aretos	Brown Bear	Ursidae	Sch I	LR/lc
Macaca mulatta	Monkey	Cercopithecidae	Sch II	LR/NT
Mus booduga	Field mouse	Muridae	Sch V	LR/lc
Caprolagus hispidus	Hispid Hare	Cervidae	-	-
Canis aureus	Siyar	Canidae	Sch II	LC
Muntiacus muntjak	Kakad	Cercopithecidae	Sch III	LR/lc
Vulpes bengalensis	Fox	Canidae	Sch II	LC
Suncus murinus	Chuchunder	Soricidae	-	LC
Presbytis entellus	Langur	Cercopithecidae	Sch II	LR/lc
Sus scrofa	Wild Boar	Suidae	Sch III	LR/lc
Lepus nigrocolis	Khargosh	Leporidae	-	-
Reptiles				
Varanus bengalensis	Monitor Lizard	Varanidae	Sch I	LC
Calotes spp	Common Lizard	-	-	-
Amphibians				
Bufo himalayanus	Toad	-	-	-

LC: Least Concern, LR: Low Risk NT: Near Threatened

As per IUCN Red List most of the wildlife fall in "LC" least concern category and only one species fall in vulnerable category. As per wildlife Protection Act (1972) three species *Panthera pardus Ursus aretos* and *Varanus bengalensis* fall in schedule I category and three species fall in schedule II category. Two species fall in schedule III and one in schedule V. Schedule I species are the species which are most critical and require appropriate protection measures. Birds were identified with binox. The common birds recorded during the survey were Myna, Magpai, Pigeon, Black Drongo, Grey Shrike and White Cheek Bulbul. All species present in the project area fall in the category of least concern, no species fall in threatened category.

Comparative Status of Natural Resources in the Project Area

Parameters	Uttarakhand	Alaknanda Basin	Project Influence Area	Project Immediate Influence Area	Project Directly Affected Area
Forests Type	8	5	3	1	1
Flora (total trees, shrubs,	4048	800	154	96	87

Parameters	Uttarakhand	Alaknanda Basin	Project Influence Area	Project Immediate Influence Area	Project Directly Affected Area
climbers, grasses, ferns etc.)					
Flora : Diversity Index	-	-	-	0.89 – 2.41	0.89 – 2.41
National Parks	6	2	0	0	0
Sanctuaries	6	1	0	0	0
Biosphere Reserve*	1	1	1	1	1
Threatened / Protected fauna (no. of species)	22	15	5**	3***	3***
Other Fauna	2248	-	33	32	32

* The project area lies in the transitional zone of NDBR
** *Varanus bengalensis, Panthera Pardus*, *Capricornis sumataensis Moschus chrysogaster, Ursus aretos (as per Indian Wildlife Protection Act 1972)*
*** *Panthera Pardus, Ursus aretos, Varanus bengalensis (as per Indian Wildlife Protection Act 1992)*

7.0 IMPACTS AND MITIGATION MEASURES

The development of the project will not have any impact on the Core and Buffer zone of the NDBR. The Impact in the transitional zone NDBR of is not significant. The project sites are located along the river course. The area along the river consists of steep rocky slopes with scattered pine forest. The implementation of CAT plan and Afforestation plan will enhance the resources and environment of NDBR area. A detail CAT is prepared by Forest Dept under which the interventions proposed for Nanda Devi include:

Forestry Work

- Afforestation work- 50ha
- Densification – 100 ha
- Medicinal plant plantation – 50 ha
- Assisted natural regeneration in the area 300 ha

Soil & Moisture Conservation Engineering Work such as

- Vegetative check dams- 250 No.
- Gully Plugging – 1500 No.
- Stone check dams - 500 No.
- Crate wire check dams -500 No.
- Spurs –200 No.
- Water percolation tanks – 500 No.

The total Budget for NDBR is Rs.4,39,80,500/- under CAT plan
The potential adverse impact of the project is considered to be loss of flora/ forests due to construction of dam/ reservoir. The forest land acquired is 100.39 ha (includes 23.13 ha land for underground works). Total 6,153 trees are to be felled/ cleared for the project. The impacts on biodiversity and the mitigation measure are given in the Table below

Impact on Biodiversity & Mitigation Measures

S. No	Project Phase	Activities	Impacts	Mitigation Measures
1.	**Construction Phase**	(i) Acquisition of Forest Land	Loss of Forests land is 100.39 ha (includes 23.13 ha land for underground works)	▪ Obtain Forest clearance from MoEF ▪ Strict implementation of approved Compensatory Afforestation Plan in accordance with Forest (conservation) Act 1980 and Uttarakhand Forest Policy. Carry out compensatory afforestation in 201 ha area. ▪ Strict compliance of MoEF stipulated condition for Forest clearance.
		(II) Felling of Trees	The clearing of project sites for construction requires felling of trees, a total number of 6,153 trees are be felled. The trees consist of plantation in forest land and Vanpanchayat land. All the species are commonly distributed throughout the project immediate influence as well as project influence area hence, the impact will be insignificant	▪ Compensatory Afforestation should be carried to compensate the loss of trees. Double no. of trees 12,306 trees shall be planted in lieu of trees felled. ▪ Compensation should be given as per R &R policy. ▪ Compensation for fruit bearing trees should be compensated as per R & R Policy. ▪ Under Road construction Trees falling outside the ROW should not be felled.
		(iii)Clearing of Project sites for construction activity	The project site is dominated by Plantation species and weedy shrubs which are commonly distributed throughout the area. 3 vulnerable species were observed in the project sites.	▪ Compensatory Afforestation will carried under the Degraded Forest Area Development scheme hence there will be increase in the forest cover ▪ The vulnerable species *Bergenia ligulata* (silpara), *Hedychium spicatum* (Banhaldi) and *Thalictrum foliolosum* (Mamiri) found in the area should be developed in separate herbal garden. ▪ THDC should undertake development of Herbal garden at suitable place in consultation with forest department and propagation of the species must be taken. Besides the three species

S. No	Project Phase	Activities	Impacts	Mitigation Measures
				other species of medicinal value may be also encouraged.
	Construction Phase -	Impact on Fauna	The wildlife is likely to be disturbed during construction phase due to various activities. The construction activity is likely to affect the movement of the animal Increase in noise may affect the feeding, breeding and movement of wildlife near forest area. Felling of trees is likely to affect the avifauna. Fragmentation of the habitat is not envisaged as the road construction and other construction works does not divide any habitat area.	▪ Poaching should be strictly banned in the Forest area. It may be ensured by the Contractor that no hunting is practiced at the site by any of the worker and that all site personnel are aware of the location, value and sensitivity of the wildlife resources ▪ The project area is located in the transitional zone of Nanda Devi Biosphere reserve. Movement of wildlife is reported in the area therefore monitoring unit should be established in the project sites in consultation with Forest Department. ▪ Plantation of tree species which are major sources of fodder for wildlife in consultation with forest department in degraded and open areas. ▪ Awareness program on Environment and Wildlife Conservation should be provided to the work force. Forest Act and Wildlife Act may be strictly adhered to.
		(i) Generation of dust by movement of vehicles and construction work, crusher operation	This may cause increase in SPM and RPM level in the area. Dust is also likely to settle on the surrounding flora. The impact shall be temporary, localized and reversible.	▪ All vehicles delivering materials to the site should be covered to avoid spillage of materials. ▪ All exiting approach road used by vehicles should be kept clean and clear of dust ▪ The roads surfaces should be host or watered using necessary equipments. ▪ Plants, machinery and equipment should be handled so as to minimize generation of dust.

S. No	Project Phase	Activities	Impacts	Mitigation Measures
			No significant impact on Project Influence Area and Alaknanda Basin.	▪ All earth work should be protected to minimize dust generation. ▪ All crusher used in construction should confirm to relative dust emission devises
		(ii) Generation of Noise	The noise level of the construction site is likely to increase due to various activities, which may cause disturbance to the fauna in the area. However this impact would be insignificant as the increase in noise shall be intermittent and temporary No significant impact on fauna of Project Influence Area and Alaknanda Basin	▪ The machineries, vehicles and equipments use in construction should strictly confirm to CPCB standard. ▪ All vehicles equipment machinery used in construction should be fitted by exhaust silencers. ▪ Equipments should be maintained regularly and soundproof gadgets should be used. ▪ Blasting should be carried out as per the statutory laws, regulation and rules pertaining to acquisition, transport, storage, handling and use of explosives
		(iii) Movement of Labour force and Technical Staff	The labour force and technical staff may poach on occasionally invaded wildlife in the area. No significant impact on Project Influence Area and Alaknanda Basin	▪ The contractor should arrange alternative source of energy such as Kerosene or LPG ▪ The Wildlife conservation Act should be strictly adhered. ▪ Environmental awareness training should be provided to the Contractor and workers.
		(iv) Quarry activities	Extraction of rocks and sand shall be done for the construction work from quarry sites. No significant impact on Project Influence Area and Alaknanda Basin.	▪ The extraction of material should be done from the identified quarry site only. ▪ The quarry area should be reclaimed back. The pits formed should be backfilled by construction waste and site should be stabilized. ▪ The topsoil (150mm) from all areas should be preserved in stockpiles. ▪ Stockpile should be utilized for redevelopment of quarry

S. No	Project Phase	Activities	Impacts	Mitigation Measures
				areas. ▪ Grasses and shrub species should be planted.
		(v) Soil Erosion	The construction activities may lead to the erosion of soil in catchments area of Alaknanda Basin.	▪ Strict implementation of approved Catchment Area Treatment Plan for control of soil erosion. ▪ Work may be restricted in rainy season.
		(vi)Muck Disposal	The muck produced by the construction work shall be disposed at the dumping sites The disposal of muck shall destroy the flora at the sites. However the sites identified for muck disposal are open barren areas.	▪ The muck should be disposed at the identified sites only. ▪ Before disposal of muck retaining walls should be constructed at the edges to retain the muck as the sites area just above the river Alaknanda
3.	**Construction Phase**	(II) Influx of labour	Requirement of living places, hotels, filling stations, service stations and extra workers will arise. This will provide job opportunity to the local skilled and unskilled population.	▪ Cutting of trees should be strictly prohibited in the area for other construction work. ▪ Forest clearance should be obtained if there is any requirement for cutting trees.
		(III) Induced Commercial development	Development in Pipalkoti town and nearby places is likely to take place and land price may increase. New commercial development and adverse impacts are not envisaged The impact on Alaknanda. Basin will be insignificant	▪ Any new colonies developed in area should have provision for plantation in the colony area. ▪ As, Pipalkoti & Chamoli are well equipped with the commercial development which are very near from proposed sites hence any new Commercial development not envisaged

S. No	Project Phase	Activities	Impacts	Mitigation Measures
4.	**Operation Phase**	(i) Loss of flora	In operation phase no tree felling is anticipated. Compensatory afforestation and avenue plantation is likely to increase the greenery in the area. Hence the impact will be positive during operation phase.	▪ Proper protection measures should be taken for the plantation work carried under the project. Van Panchayats should be involved in afforestation activity and monitoring of the plantation work. ▪ Fencing of plantation area should be done. ▪ Watchman should be employed to take care of plantation for minimum 3 years.
	Operation Phase	(ii) Loss of fauna	Loss of fauna is not anticipated during operation phase as the wildlife is found in the upper reaches of hills far away from project area. No impact on fauna of Project Influence Area and Alaknanda Basin during operation phase.	▪ No impact is envisaged on fauna during operation phase. ▪ Wildlife conservation program should be supported by the project
		(iii) Biodiversity	No significant impact is envisaged on biodiversity in Project Influence Area and Alaknanda Basin	▪ Awareness programs should be held for the stakeholders to develop concern for conservation of biodiversity in the area.

8.0 Environmental Management Plan

A detail EMP is prepared defining mitigation measures, responsible agencies and buget for addressing environmental concerns. Implementation of management measures for impacts related to Forest and tree felling is the joint responsibility of THDC and State Forest Department. The State forest Department will be responsible for Implementing Catchment Area Treatment (CAT) plan, Compensatory Afforestation Plan, Wildlife Conservation Program, Develop Herbal Garden in consultation with State Medicinal Plant Board (SMPB) and facilitate and guide Van Panchayats

The EMC (Environmental Management Cell) of THDC shall be responsible for the technical planning, implementation and monitoring of all environmental mitigation and

compensation measures. Muck /Quarry Area Redevelopment Plan, Avenue Plantation and Landscaping will be implemented by THDC. THDC will also undertake environmental awareness program in the area involving Van Panchayats, Gram Panchayats, Schools and Mahila Mangal Dals (Women's group).

Wherever contractors are involved, they will be responsible to implement mitigation measures and THDC will monitor the implementation program.

The Van Panchayat is an important institute in the area and should be involved to protect plantation sites, cultivation of herbal species and develop nurseries for plantation under the project area.

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