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CATCHMENT AREA TREATMENT PLAN

FOR

(100 MW) MALANA-II HYDROELECTRIC PROJECT

AT DISTRICT KULLU

HIMACHAL PRADESH

WAPCOS CENTRE FOR ENVIRONMENT

WATER & POWER CONSULTANCY SERVICES (INDIA) LIMITED

(A GOVT. OF INDIA UNDERTAKING)

PLOT 76-C, SECTOR-18, GURGAON-122015, HARYANA

CATCHMENT AREA TREATMENT

1. GENERAL

The Himachal Pradesh State Electricity Board (HPSEB) plans to commission hydroelectric projects in various parts of the state. The projects are proposed to be developed by private sector. In line with this approach, the state government of Himachal Pradesh has signed a Memorandum of Undertaking with Everest Power Private Limited (EPPL), New Delhi to develop Malana-II Hydro-electric project.

The Malana-II hydro-electric project is envisaged as a runoff the river scheme over Malana Nallah upstream Malana-I hydroelectric Project to harness the head available between diversion site of Malana-II hydroelectric project and diversion site of Malana-I hydro-electric project with an installation of 2x50 MW underground power house.

Malana Nallah is the major tributary of the river Parbati, originating from Duthan glacier in the Pir Panjal range of Great Himalayas. It is joined by several nallahs and glaciers on its course. The catchment area of Malana Nallah at diversion site of existing Malana hydroelectric project and proposed Malana-II hydroelectric project is 177.75 sq. km and 158 sq. km respectively.

The Malana-II hydroelectric project site is proposed to be located upstream of Malana-I barrage on Malana river, about 10 km from Jari village on the Bhuntar-Manikaran road, in Kullu Kullu, Himachal Pradesh. The power house is proposed to be constructed underground and located just upstream of Malana H.E.Project diversion site. The barrage site is located at a distance of 40 km from Kullu, town, which is the district headquarter as well. The project location map is shown in Figure 1.

FIGURES

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2. PROJECT DESCRIPTION

The Malana river is a tributary of Parbati river, which in turn flows into river Beas below Bhuntar. The Malana-II hydroelectric scheme envisages, the diversion of inflows of Malana Nallah near village Weichin. It is proposed to construct a 45 m high concrete dam across river Malana and divert the water through a 5.13 km long power tunnel on left bank. The power house is proposed to be underground located just upstream of the barrage site of existing Malana-I HEP. The discharge from Power house will be discharged back into Malana nallah, just upstream of barrage of Malana-I hydroelectric project by a 0.415 km long Tail Race Tunnel (TRT). The Malana-II hydroelectric project is proposed to generate (2x50) 100 MW of power, with an energy generation of 428 mu at 90% dependable year. The general layout of project map is at **Figure 2**

The salient features of project are briefly described as below:

- A concrete gravity dam about 45 m high above river bed across Malana Nallah about 3 km up stream of Malana Village with 2 Nos. of breast wall type spillway bays of size 4 m x 5 m to spill down design flood of the order of 650 cumecs.
- The FRL and minimum draw down level have been proposed at EL± 2543m and EL ±2528m respectively, to obtain a live storage of about 2.875 lakh cubic meter to meet diurnal peaking requirement during lean season.
- An Intake provided in the non-over flow section of the dam for 3.0 m diameter pipe and about 100m long from intake to Desilting Basin. The 3.0 m dia pipe takes off at EL ± 2523.0 m at intake and it bifurcates into two 2.2 m dia pipes to feed the two troughs of Desilting Basin.
- A surface desilting tank comprising 2 troughs of size 8.0 m x 6.0 m and x 130 m long, designed to exclude silt particles down to 0.2 mm size.

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- A cut and cover conduit of size 3 m x 2.75 m D shaped and 30 m long connecting Desilting Basin to Tunnel Portal.
- A 3 m x 2.75 m D-shaped, ± 4.847 km long head race tunnel on left bank of Makra Nallah designed to carry 20.0 cumecs discharge at a velocity of 2.73 m/sec. Velocity. Two intermediate adits are proposed to facilitate construction of Head Race Tunnel (HRT).
- An underground 6 m dia and 80 m deep surge shaft at the end of HRT. Adits to top and bottom of Surge Shafts are proposed to facilitate the construction of surge shaft and ventilation.
- A butterfly valve chamber of size 6 m x 10 m x 10 m located between surge shaft and pressure shaft housing a butterfly valve for emergency closure of flow for maintenance of penstock & pressure shaft.
- A single pressure shaft 2.5 m dia, ± 666 m long to carry 20.0 cumecs discharge into power house at a velocity of 4.07 m/sec. Construction adits will be provided at top and intermediate level to facilitate excavation and erection of steel liner in the pressure shaft. The 2.5 m dia pressure shaft will bifurcate into two penstocks of 1.8 m dia and 22.0 m long immediately upstream of powerhouse to feed 2 units of 50 MW in the power house.
- An underground power house of size 20.25 m wide x 68.0 m long and 31 m high in left bank hill of Makra Nallah houses 2 Nos. of vertical axis Pelton wheel driven generating units of 50 MW each to provide total installed capacity of 100 MW.
- The transformer will also be housed in the same cavern. The underground Power House is approachable by a 6 m x 6 m and about 368 m long main access tunnel. The

construction adit at the top of Power House Cavern will serve as a Ventilation Tunnel.

- A 5 m x 5 m D-shaped, Tail Race Tunnel (TRT) ± 415 m long discharges the water back into Malana Nallah immediately upstream of diversion weir of Malana-I hydroelectric project. The Tail Race Tunnel will also serve as Cable Tunnel.

3. NEED FOR CATCHMENT AREA TREATMENT

It is a well-established fact that reservoirs formed by weirs on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity, and thus affecting the water availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment adversely affects the agricultural production. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above-mentioned adverse process of soil erosion.

Soil erosion may be defined as the detachment and transportation of soil. Water is the major agent responsible for this erosion. In many locations, winds, glaciers, etc. also cause soil erosion. In the catchment area of a hilly area like that being considered for the proposed project, water erosion is a common phenomenon and the same has been studied as a part of the Catchment Area Treatment (CAT) Plan. Soil erosion leads to:

- loss in production potential
- reduction in infiltration rates
- reduction in water-holding capacity
- loss of nutrients

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* increase in tillage operation costs
* reduced transport and storage capacity and
* reduction in water availability

The Catchment Area Treatment (CAT) plan pertains to preparation of a management plan for the treatment of erosion prone areas in the catchment area of a water resources project. It has been observed from past experience that the life span of a reservoir is greatly reduced due to erosion in its catchment area. The cost of dredging and disposal of the sediment increases, whereas the storage capacity of the reservoir decreases. Thus, adequate preventive measures are needed for the treatment of catchment area so that the area is stabilized against future erosion.

As a part of the EIA study for the proposed Malana II hydro-electric project, a Catchment Area Treatment (CAT) plan for the catchment area has been prepared for areas with high soil erosion rates.

4. APPROACH FOR THE STUDY

The catchment area treatment involves

- Understanding of the erosion characteristics of the terrain and,
- Suggesting remedial measures to reduce the erosion rate.

In the present study '**Silt Yield Index' (SYI)**, method has been used. In this method, the terrain is subdivided into various watersheds and the erodability is determined on relative basis. SYI provides a comparative erodability criteria of catchment (low, moderate, high, etc.) and do not provide the absolute silt yield. SYI method is widely used mainly because of the fact that it is easy to use and has lesser data requirement. Moreover, it can be applied to larger areas like sub-watersheds, etc.

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The total catchment area of Malana Nallah intercepted by the weir is approximately 15,800 ha.

A detailed database on natural resources, terrain conditions, soil type of the catchment area, socio-economic status, etc. is a pre-requisite to prepare treatment plan keeping in view the concept of sustainable development. Various thematic maps have been used in preparation of the CAT plan. Due to the spatial variability of site parameters such as soils, topography, land use and rainfall, not all areas contribute equally to the erosion problem. Several techniques like manual overlay of spatially index-mapped data have been used to estimate soil erosion in complex landscapes.

Geographic Information System (GIS) is a computerized resource data base system, which is referenced to some geographic coordinate system. In the present study, real coordinate system has been used. The GIS is a tool to store, analyze and display various spatial data. In addition, GIS because of its special hardware and software characteristics, has a capacity to perform numerous functions and operations on the various spatial data layers residing in the database. GIS provides the capability to analyze large amounts of data in relation to a set of established criteria.

In order to ensure that latest and accurate data is used for the analysis, satellite data has been used for deriving landuse data and ground truth studies too have been conducted.

The various steps involved in the study are as follows:

- Definition of the problem
- Data acquisition and preparation
- Data analysis
- Output presentation

The above mentioned steps are briefly described in the following paragraphs.

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4.1 Definition of the Problem

The requirement of the study was first defined and the outputs expected were noted. The various data layers of the catchment area used for the study are as follows:

- Slope Map
- Soil Map
- Land use Classification Map
- Current Management Practices
- Catchment Area Map.

4.2 Data Acquisition and Preparation

The data available from various sources was collected. The ground maps, contour information, etc. were scanned, digitized and registered as per the requirement. Data was prepared depending on the level of accuracy required and any corrections required were made. All the layers were geo-referenced and brought to a common scale (real coordinates), so that overlay could be performed. A computer programme was used to estimate the soil loss. The formats of outputs from each layer were firmed up to match the formats of inputs in the program. The grid size to be used was also decided to match the level of accuracy required, the data availability and the software and time limitations. The format of output was finalized. Ground truthing and data collection was also included in the procedure.

4.3 Data Analysis

The input data was analysed for each layer as detailed later. Land use classification was done using Remote Sensing techniques. Digitized contours from toposheets were used for preparation of Digital Elevation Model (DEM) of the catchment area and to prepare a slope map. Various layers thus prepared were used for Modeling. Software was prepared to calculate the soil loss using input from all the layers.

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4.4 Output/Presentation

The result of the Modeling was interpreted in pictorial form to identify the areas with high soil erosion rates. This output and the other primary and secondary data collected as a part of the field studies was used to prepare a Catchment Area Treatment (CAT) Plan for the catchment area of the Malana-II hydro-electric project.

5. METHODOLOGY USED FOR THE STUDY

5.1 Data Acquisition

For the present study IRS 1C-LISS III digital satellite data was used for interpretation & classification. LISS data is multi-spectral data with 4 bands. The spatial resolution of bands 1, 2 and 3 is 23.5 m and that of band 4 (1.55 μ to 1.70 μ bandwidth) is 70 m. Multi-spectral data is necessary for interpreting the land use classes on the ground. Various land use classes on the ground can be identified using varying reflections in different wavelengths and can be interpreted based on their reflectance in different bands. It is also possible to add, subtract, multiply and divide the pixel brightness from two bands of image data to form a new image. These are used to highlight regions of change between two images of the same area.

For the purpose of ordering the satellite data, the extremes of the directly draining catchment area were used as reference points for judiciously deciding the number of scenes required. The data received was corrected for atmospheric noise. The data is raster data i.e. the information is in form of pixels.

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Referencing & Geocoding

i) Selection of Ground Control Points

Expressing image pixel addresses in terms of a map coordinate base is often referred to as geocoding. As various thematic layers were to be overlaid for this project, all the layers were georeferenced to real world coordinates.

An assumption to be made in this procedure is that a map of the region corresponding to the image is available, that is in the real world coordinates (expressed in the form of latitudes and longitudes, oriented vertically in a north-south direction and to a geometric scale). The 1:50,000 scale toposheets of the directly draining catchment area were used for the purpose of georeferencing. The two maps (satellite images and the reference map) were in two different Cartesian coordinate systems and were correlated using a pair of mapping functions. As these functions are known for standard georeferencing procedures (polynomials of first, second, third or higher degree), point on the image was located, using its known position on the map. Unknown coefficients were estimated by identifying sets of features on the map (toposheet) that can also be identified on the image. These features called ground control points (GCPs) are well defined and spatially small and could be road intersections, bends in rivers, bridges, existing weirs, etc. A large number of GCPs were selected for reasonably accurate georeferencing/geocoding.

ii) Resampling

The next step was to find points in the image corresponding to each location in the pixel grid previously defined over the map. The spacing of the grid was chosen according to the pixel size required in the corrected image and need not be the same as that in the original image. The pixels were transferred to the appropriate locations on the destination grid (toposheet) to

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build up the rectified image. This process is known as Resampling. A map projection system (real world) was also defined while resampling.

iii) Interpolation

Grid centres from the map registered to pixel grid will not usually project to exact pixel centre locations in the image, therefore a technique was used for deciding what pixel brightness value should be chosen for placement on the new grid.

Nearest neighbour resampling technique was used for landuse application, since the image is to be classified later. This technique simply chooses the actual pixel that has its centre nearest to the point located in the image. The pixel is then transferred to the corresponding grid location on the toposheet. The original brightness value of the pixel is thus maintained.

Unsupervised classification

Prior to ground truthing, the satellite data was classified using unsupervised classification technique. This technique assigns the pixels in an image to various spectral classes without the user having prior knowledge of the existence or names of those classes. This technique is used to determine the number and location of the spectral classes into which the data falls and to determine the spectral class of each pixel. These spectral classes were identified using visual observations during field survey.

Supervised classification

Supervised classification is an essential analytical tool for the extraction of quantitative information from remotely sensed image data. It is assumed in supervised classification that each spectral class can be described by a probability distribution in multi-spectral space. This

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is a multi-variable distribution with as many variables as dimensions of the space. Such a distribution describes the chance of finding a pixel belonging to that class at any given location in multi-spectral space. Gaussian or Normal distribution is generally used for analysis.

As the multi-dimensional normal distribution is specified completely by its mean vector and its covariance matrix, if these are known, then it is possible to compute the set of probabilities that describe the relative likelihood of a pattern at a particular location belonging to each of those classes. It can be considered as belonging to the class, which indicates the highest probability. This method referred to as maximum likelihood classification, is the most common supervised classification method used with remote sensing image data and the same was used in the present study.

The essential practical steps followed for supervised classification were:

1. Identification of landuse classes into which the image is to be classified. For the present study, eight broad classes were used.
2. Preparation of training data, i.e. selection of representative or prototype pixels from each set of classes. This data was collected from site visits or ground truthing and maps, toposheets, photographs, etc.
3. Use of training data to define the parameters of the particular class, called its signature.
4. Using the training classifier, every pixel in the image was classified as one of the desired landuse classification type. The whole image area of interest in the image i.e. directly draining catchment was classified in eight landuse classes. The area under each landuse class was computed.
5. Map compositions were then produced.

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Training (Ground Truthing) site selection and statistics extraction

Training sites within the image that are representative of the land-cover classes of interest were selected after classification. The training data should be of value, if the environment from which they were obtained is relatively homogenous. During the preliminary stages of a project, all significant environmental factors that contribute to confusion in classification of similar appearing ground data should be identified. There could be differences in water depth and clarity, crop species, unusual soil moisture conditions, etc. Such environmental conditions should be carefully annotated on the imagery and the selection of training sites made using geographic stratification of these data.

Once signature extension factors have been considered, representative training sites for each class were selected and the spectral statistics for each pixel found within each training site were estimated. Each site is usually composed of many pixels. The general rule is that if training data are being extracted from n bands then >10 n pixels of training data are collected for each class. This is sufficient to compute the variance-covariance matrices required by some classification algorithm especially maximum likelihood that is mostly used for landuse classification.

Reclassification

After the supervised classification procedure, a landuse map was prepared which the team at field verified, and any errors or omissions were identified. A reclassification of the landuse categories implementing the details and corrections, if any, was done. The reclassification output was used for the preparation of the final landuse classification map. This map after due verification was then composed and printed, as desired.

Output

The landuse classification map of the directly draining catchment area was prepared and important locations were marked on it. For modeling purpose, this map was geo-referenced to real coordinates and converted to a vector layer and each landuse class was converted to a polygon in different layers with its land use class information attached to it. The classified land use map of the catchment area using satellite data is shown as **Figure-3**. The landuse pattern of the catchment area is summarized in Table-1.

TABLE-1

Landuse pattern of the catchment area

S. No.	Category	Area (ha)
1.	Water bodies	264.85
2.	Mixed vegetation	146.1
3.	Dense vegetation	1476.23
4.	Scrubs	2394.53
5.	Grasslands	510.17
6.	Settlements	667.92
7.	Barren / Snow	7532.53
8.	Rocky outcrop	2807.59

5.2 Slope map preparation

Slope: A measure of change in the value of altitudes over distance, which can be expressed in degrees or as a percent. The first step in generation of slope map is to create surface using the elevation values stored in the form of contours or points.

Surface: It is a representation of geographic information as a set of continuous data in which the map features are not spatially discrete, i.e., between any two locations, there are no clear or well defined breaks between possible values of the map feature. Models, built from

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regularly or irregularly spaced sample points on the surface can represent surfaces. A surface can be approximated by combining irregularly spaced points, lines and polygons, each having high information content. On the earth's surface, these point and feature correspond to peaks, pits, passes, points of change in slope, ridges, stream channels and shorelines as features that define the frame of a surface. Thus, the TIN (Triangulated Irregular Network) concept was devised as an alternative means for representing surfaces effectively. Irregularly spaced data is not limited to point data structures.

TIN: It is a representation of a surface derived from irregularly spaced sample points and breakline features. Each sample point has x, y coordinate and surface or z value. These points are connected by edges to form a set of non-overlapping triangles that can be used to model the surface.

After converting the line and polygon vertical to points with x, y, z values, the features are developed into a series of connected triangles or facets. The nodes correspond to the irregularly spaced locations on the surface. Since the sample points can be located at optimum locations, it is possible for the TIN package to accurately represent a surface with less points than other data models.

Building TIN Surface Models

Tin surface models can be built from a number of data sources like spot elevations, contours, photogramatrically-collected data, etc. Slope map of the catchment area was prepared using the elevation information for the area from contour heights. Toposheets of the scale 1:50,000 were collected for the entire catchment area. These toposheets were then manually pasted together to form a seamless mosaic of the area and the directly drained catchment boundary for the proposed Malana-II hydro-electric project was marked on them.

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After marking the catchment area, all the contours on the toposheet were digitised (100 m interval). The output of the digitisation procedure was the contours as well as points contours in form of x, y & z points. (x, y location and their elevation). All this information was in real world coordinates (latitude, longitude and height in meters above sea level).

A Digital Terrain Model (DTM) of the area was then prepared, which was used to derive a slope map. The slope was divided in classes of slope percentages. The slope map of the directly draining catchment is shown in **Figure-4.**

6. ESTIMATION OF SOIL LOSS USING Silt Yield Index (SYI) METHOD

The Silt Yield Index Model (SYI), considering sedimentation as product of erosivity, erodibility and arial extent was conceptualized in the All India Soil and Land Use Survey (AISLUS) as early as 1969 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units within river valley project catchment areas.

The erosivity determinants are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the unit of the detached soil material. The relationship can be expressed as:

Soil erosivity = f (Climate, physiography, slope, soil parameters, land use/land cover, soil management)

Silt Yield Index

The Silt Yield Index (SYI) is defined as the Yield per unit area and SYI value for hydrologic unit is obtained by taking the weightage arithmetic mean over the entire area of the hydrologic unit by using suitable empirical equation.

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Prioritization of Watersheds/Subwatersheds:

The prioritization of smaller hydrologic units within the vast catchments are based on the Silt Yield Indices (SYI) of the smaller units. The boundary values or range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating the suitable breaking points. The watersheds/sub watersheds are subsequently rated into various categories corresponding to their respective SYI values.

The application of SYI model for prioritization of subwatersheds in the catchment areas involves the evaluation of:

a) Climatic factors comprising total precipitation, its frequency and intensity,

b) Geomorphic factors comprising land forms, physiography, slope and drainage characteristics,

c) Surface cover factors governing the flow hydraulics and

d) Management factors.

The data on climatic factors can be obtained for different locations in the catchment area from the meteorological stations whereas the field investigations are required for estimating the other attributes.

The various steps involved in the application of model are:

- Preparation of a framework of sub-watersheds through systematic delineation
- Rapid reconnaissance surveys on 1:50,000 scale leading to the generation of a map indicating erosion-intensity mapping units.
- Assignment of weightage values to various mapping units based on relative silt-yield potential.
- Computing Silt Yield Index for individual watersheds/subwatersheds.

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- Grading of watersheds/subwatersheds into very high, high medium, low and very low priority categories.

The area of each of the mapping units is computed and silt yield indices of individual subwater sheds are calculated using the following equations:

a. Silt Yield Index

$$\underline{SYI = \Sigma (Ai \times Wi) \times 100}\ ; \quad \text{where } i = 1 \text{ to } n$$

$$Aw$$

where

Ai = Area of ith unit (EIMU)

Wi = Weightage value of ith mapping unit

n = No. of mapping units

Aw = Total area of sub-watershed

The SYI values for classification of various categories of erosion intensity rates are given in Table-2.

TABLE-2

Criteria for erosion intensity rate

Priority Category	SYI Values
1. Very High	> 1300
2. High	1200-1299
3. Medium	1100-1199
4. Low	1000-1099
5. Very low	< 1000

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7. WATERSHED MANAGEMENT – AVAILABLE TECHNIQUES

Watershed management is the optimal use of soil and water resources within a given geographical area so as to enable sustainable production. It implies changes in land use, vegetative cover, and other structural and non-structural action that are taken in a watershed to achieve specific watershed management objectives. The overall objectives of watershed management programme are to:

- increase infiltration into soil;
- control excessive runoff;
- manage & utilize runoff for useful purpose.

The **watershed management measures** have been classified under the following categories:

I. Biological measures

II. Engineering measures

Biological Measures

The various measures covered in this category are:

- Afforestation
- Pasture Development
- Vegetated waterways

Engineering measures

The various erosion control measures in this category are :

- Gully plugging
- Contour cultivation
- Contour bunding
- Graded bunding

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The species recommended for afforestation are given in Table-3.

TABLE-3

Recommended tree species for afforestation

Botanical name	Local Name
Alnus nitida	Kosh
Celtis australis	Khirik
Pinus wallichiana	Kail
Populus ciliata	Fuls
Codar	
Oaks	
Medicinal Herbs	

8. CATCHMENT AREA TREATMENT MEASURES

The area under various erosion intensity rates is given in Table-4 (Refer **Figure-5**).

TABLE-4

Erosion intensity rates of catchment area

Intensity	Area (ha)
Very high	
Snow bound	1855.3
Unculturable areas	602.10
Culturable Areas	325.41
High	
Snow bound	3400.00
Unculturable areas	1595.25
Culturable Areas	1445.10
Medium	
Snow bound	2277.23
Unculturable areas	3019.24
Culturable Areas	1048.67
Low	-
Very low	231.7
Total	**15800.00**

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The objective of the SYI method is to prioritize sub-watershed in a catchment area for treatment. The area under high erosion categories have to be treated first, followed by areas under medium erosion category. The major landuse categories in the catchment area and the suggested treatment measures are listed in Table-*5*

TABLE-*5*

Suggested treatment measures for various land use categories

S. No.	Landuse category	Treatment
1	Settlement/unculturable areas	No treatment
2	Mixed vegetation	Rehabilitation of Degraded forest or densification of low density forest .
3	Pastures	Pasture Development i) Grass Sowing and Planting. ii) Mauring iii) Moisture retention intervention iv) Soil Moisture conservation.
4	Dense vegetation	No treatment
5	Water Streams	Check Dam Check Walls Gully Plugging
6	Scrubs	Pasture development/afforestation
7.	Blank Lands	Afforestation
8.	Agricultural Pvt. Land	Land Development, Horticulture.

Total Catchment Area of the project i.e. the catchment above diversion is 15800ha, out of which 7532.53ha is snow bound area and 5216.59ha is unculturable areas i.e. rocky outcrop, dense vegetation, settlements and water bodies. This has left the culturable areas limited to 2819.18 ha. As per our site visits with Forest Department most of the culturable areas are not accessible because of steep hills in between and remoteness which would make any treatment untenable. After exhaustive site visits it was found that only an area of 595 ha out of the cultarable areas can be treated in the following manner:

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- Afforestation
- Rehabilitation of Degraded Forest
- Pasture Development

In addition to the above, the following measures are proposed which would improve soil conservation of the catchment area:

- Check Dams
- Check Walls

The following infrastructure for the Forest Department has also been proposed:

- Construction of Forest Rest House near Malana Village
- Construction of Forest Guard hut near Dam Site
- Forest Rest houses furnishing
- Supply of photo copy machine, computers
- Telephone EPABX

In addition to the above, some social infrastructure development measures for the only village in the catchment area i.e. Malana village are also proposed. In summary it could be concluded that all the possible measures to improve the characteristics of Malana catchment above the diversion site of Malana-II HEP are being attended to. It is also pertinent to mention that Part of the Malana catchment is already being treated under CAT plan of Malana – I HEP of MPCL.

The cost details of various treatment measures of CAT plan are outlined in Table -6. The Forest Department, State Government of Himachal Pradesh, may implement the CAT plan.

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The expenditure for the same is to be borne by the project proponents, i.e. Everest Power Private Limited.

The various catchment area treatment measures are shown in **Figure 6.**

8.1 Afforestation:

S. No.	Name of the Forest Area	Area in (Ha)
1.	2/31 Tangrol DPF	
	a) Thalbelit area.	30.00
	b) Harsingahr area	30.00
	c) Saraphat area	20.00
	d) Muni area	15.00
2.	Nagar-III UPF	20.00
	Total	**115.00Ha**

8.2 Rehabilitation of degraded forest

S. No.	Name of the Forest Area	Area in (Ha)
1	Himakpih Thach	60.00
2	Bare Thach	10.00
3	Motagran Thach	22.00
4	Nihari Thach	10.00
5	Talberi Thach	8.00
6.	Muni Thach	20.00
	Total	**130.00**

8.3 Pasture Development

S. No.	Name of the Forest Area	Area in (Ha)
01	Anganat Thach	60
02	Himakpih Thah	45
03	Shilong Thah	65
04	Totu Thah	20
05	Riali Thach	40
06	Tumber Thach	45
07	Saraphat Thach	30
08	Muni Thach	25
09	Bhalang Thach	20
	Total	**350**

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Range Forest Officer's Office
Forest Range Kaso

Divisional Forest Officer
PARBATI Forest Division
SHAMSHI

8.4 Soil Conservation Works.

S. No.	Name of the Forest Area	Check Dam	Check Walls
1	Between Nihali Nallah & Khiruf Nalla	5	6
2	Upstream of Bare Nalla	7	5
3	In the tributary of Riali Thach	3	7
4	Tributary in Dudru Thach	2	7
5	Tributary in Tumber Thach	2	6
6	Tributary of Bakar Thach	2	7
7	Tributary of Saraphat Thach	3	4
8	Tributary of Muni Thach	2	5
9	Tributary passing through Choharpat Thah	6	6
10	Tributary of Bare Thach	2	5
11	Tributary of Anganat Thach	2	15
12	Tributary of Shupu Thach	3	12
13	Tributaries passing through Sumbha Thach		23
	Total	**39**	**108**

9. COST ESTIMATES

The total cost required for Catchment Area Treatment is Rs.310.1775 Lacs. The details are given in Table-6.

TABLE – 6

COST FOR CATCHMENT AREA TREATMENT

S. No.	Treatment measure	Qty	Unit cost (Rs)	Total cost (Rs. In lacs)
1.	Afforestation (1100 trees/ha) including 7 years maintenance	115 ha	52350/-	60.2025
2.	Rehabilitation of Degraded forest and densification of low density forest (600 trees/ha) including 7 years maintenance	130 ha	36550/-	47.515
3.	Pasture Development including 5 years maintenance	350 ha	21020/-	73.57
4.	Soil conservation works			
	a. Check Dam b. Check Walls	39 Nos. 108 Nos.	25000/- 5500/-	9.75 5.94
5.	Nursery Development Works and Nursery Cost	L/s	1000000/-	10.00
6	Infrastructure Development Works			
i.	Telephone EPABX 50 Lines and 1 Telephone Connection for Parbati Division	1 Set	100000/-	1.00
ii.	Telephone EPABX 50 Lines for circle office Kullu	1 Set	70000/-	0.70
iii.	Photo copier machine	2 Nos.	150000/-	3.00
iv.	Forest Rest House Furnishing a. Jari Forest Rest House b. Dhara Forest Rest House	 1 No. 1 No.	 100000/- 100000/-	 1.00 1.00
v.	Forest Guard hut near Dam Site Adjacent to road side	1 No.	400000/-	4.00
vi.	Computer with all accessories	6 Nos.	50000/-	3.00

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Vii	Forest rest house near Malana village including furnishing	1 Nos.	2000000	20.00
7	**Social Development Works**			
i.	Construction of permanent Hospital building at Malana village**	1 No.	1500000/-	15.00
ii.	Construction of storage tank for drinking water in Malana Village	1 No.	500000/-	5.00
iii.	Construction of PCC Path ways and PCC drains in Malana Village	LS	800000/-	8.00
iv.	Strengthening of existing Pathway between Malana Village and proposed dam site	LS	1000000/-	10.00
v.	Construction of Community toilets in Malana Village	4 Nos.	150000/-	6.00
vi.	Renovation of existing building of Malana Gram Panchayat	LS	450000/-	4.50
vii.	Construction of Dharamashala (Sarai) for pilgrims to the local Devta of Malana village	LS	450000/-	4.50
viii.	Construction of Pucca Platform (utak) for Local Devta of Malana Village	LS	500000/-	5.00
ix.	Dish Antenna for cable TV for Malana village	LS	150000/-	1.50
8	Development of Private Land (Construction of Check Dam, Check walls, Storage Tanks, Water Distribution system for Irrigation and providing gas connections to the affected people)	LS	1000000/-	10.00
	Total			**310.1775**

** The permanent building will be built at the existing hospital in the Malana village. In case of difficulty in this regard the hospital would be built in private land by hiring it on lease or rent. In no case additional forest land would be sought for this purpose.

The year-wise programme of works, planting and abstract of cost are outlined in Table-7

Table –7

Details of cost estimate for CAT plan

Year	Name of Area	Quantity	Rate in Rs	Amount (Rs. In Lakhs)	Maintenance Cost
1st year	**A. Plantation**				
	2/31 Tangrol DPF				
	i Thalbelit	30 Hac			
	ii. Saraphat Area	20 Hac			
	Total	50	27950	13.975	
	B. Rehabilitation of degraded forest				
	i. Himakpih Thach	30			
	ii. Bare Thach	10			
	Total	40	19530	7.812	
	C. Pasture Development				

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Year	Name of Area	Quantity	Rate in Rs	Amount (Rs. In Lakhs)	Maintenance Cost
	i. Anganat Thach	60 Hac			
	ii. Himakpih Thach	45 Hac			
	Total	105	12730	13.3665	
	D. Soil Conservation Works				
	u/s of Bare Nalla				
	i. Check Dam (in Nos.)	7	25000	1.75	
	ii. Check Walls (in Nos.)	5	5500	0.275	
	Tributary of Bare Nalla				
	i. Check Dam	2	25000	0.50	
	ii. Check Walls	5	5500	0.275	
2nd Year	**A. Plantation**				
	2/31 Tangrol DPF				
	i.Harsingahr Area	30 Hac			
	ii Muni Area	15 Hac			
	Total	45	27950	12.5775	
	B. Rehabilitation of degraded forest				
	i. Nihari Thach	10 ha			
	ii. Talberi Thach	8 ha			
	iii. Motagran Thach	22ha			
	Total	40	19530	7.812	
	C. Pasture Development				
	Shilong Thach	65 ha			
	Totu Thach	20ha			
	Total	85	12730	10.8205	
	D. Soil Conservation Works				
	Between Nihali Nalla & Khiruf Nalla				
	i. Check Dam (in Nos.)	5	25000	1.25	
	ii. Check Walls (in Nos.)	6	5500	0.33	
	Tributary of Riali Thach				
	i. Check Dam (in Nos.)	3	25000	0.75	
	ii. Check Walls (in Nos.)	7	5500	0.385	
	Tributary in Durdu Thach				
	i. Check Dam (in Nos.)	2	25000	0.5	
	ii. Check Walls (in Nos.)	7	5500	0.385	
	Tributary of Shupu Thach				
	i. Check Dam (in Nos.)	3	25000	0.75	
	ii. Check Walls (in Nos.)	12	5500	0.66	

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Year	Name of Area	Quantity	Rate in Rs	Amount (Rs. In Lakhs)	Maintenance Cost
	Mantenance of Plantation				
	E. 1st year plantation				
	i.Plantation in Hac	50	4470	2.235	
	ii.Rehabilitation of degraded forest in Hac	40	2770	1.108	
	iii. Pasture Development in Hac	105	2430	2.5515	5.8945
3rd Year	**A. Plantation**				
	i. Nagar-III UPF	20 ha			
	TOTAL	20	27950	5.59	
	B. Rehabilitation of degraded forest				
	i.Muni Thach in Hac	20	19530	3.906	
	C. Pasture Development				
	i. Riali Thach	40 ha			
	ii. Tumber Thach	45 ha			
	Total	85	12730	10.8205	
	D. Soil Conservation Works				
	Tributary in Tumber Tach				
	i. Check Dam in Nos.	2	25000	0.5	
	ii. Check Wall in Nos.	6	5500	0.33	
	Tributary in Bakar Thach				
	i. Check Dam in Nos.	2	25000	0.5	
	ii. Check Wall in Nos.	7	5500	0.385	
	Tributary in Saraphat Thach				
	i. Check Dam in Nos.	3	25000	0.75	
	ii. Check Wall in Nos.	4	5500	0.22	
	Tributaries Passing through Sumbha Tach				
	i. Check Wall in Nos.	23	5500	1.265	
	Maintenance of Plantation				
	1st year Plantation				
	i. Plantation in Hac	50	3780	1.89	
	ii.Rehabilization of degraded forest in Hac	40	2300	0.92	
	iii. Pasture Development in Hac	105	1910	2.0055	
	2nd year Plantation				
	i. Plantation in Hac	45	4470	2.0115	
	ii.Rehabilization of degraded forest in Hac	40	2770	1.108	
	iii. Pasture Development in Hac	85	2430	2.0655	10.0005

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Year	Name of Area	Quantity	Rate in Rs	Amount (Rs. In Lakhs)	Maintenance Cost
4th Year	**A. Rehabilization of degraded forest**				
	i. Himakpith Thach	30 Ha			
	Total	30	19530	5.859	
	B. Pasture Development				
	i. Saraphat Thach	30 ha			
	ii. Muni Thach	25 ha			
	iii. Bhalang Thach	20 ha			
	Total	75	12730	9.5475	
	C. Soil Conservation Works (check Dam)				
	Tributary in Muni Tach				
	i. Check Dam in Nos.	2	25000	0.5	
	ii.Check Wall in Nos.	5	5500	0.275	
	Tributary passing through Chohar Tach				
	i. Check Dam in Nos.	6	25000	1.5	
	ii.Check Wall in Nos.	6	5500	0.33	
	Tributary of Anganat Thach				
	i. Check Dam in Nos.	2	25000	0.50	
	ii.Check Wall in Nos.	15	5500	0.825	
	Maintenance of Plantation				
	1st year Plantation				
	i.Plantation in Hac	50	2790	1.395	
	ii.Rehabilization of degraded forest in Hac	40	1370	0.548	
	iii. Pasture Development in Hac	105	1450	1.5225	
	2nd year Plantation				
	i.Plantation in Hac	45	3780	1.701	
	ii.Rehabilization of degraded forest in Hac	40	2300	0.92	
	iii Pasture Development in Hac	85	1910	1.6235	
	3rd year Plantation				
	i. Plantation in Hac	20	4470	0.894	
	ii.Rehabilization of degraded forest in Hac	20	2770	0.554	
	iii. Pasture Development in Hac	85	2430	2.0655	11.2235
5th Year	**Mantenance of Plantation**				
	1st year Plantation				

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Year	Name of Area	Quantity	Rate in Rs	Amount (Rs. In Lakhs)	Maintenance Cost
	i. Plantation in Hac	50	2420	1.21	
	ii.Rehabilization of degraded forest in Hac	40	1370	0.548	
	iii. Pasture Development in Hac	105	1450	1.5225	
	2nd year Plantation				
	i. Plantation in Hac	45	2790	1.2555	
	ii.Rehabilization of degraded forest in Hac	40	1370	0.548	
	iii.Pasture Development in Hac	85	1450	1.2325	
	3rd year Plantation				
	i.Plantation in Hac	20	3780	0.756	
	ii.Rehabilization of degraded forest in Hac	20	2300	0.46	
	iii. Pasture Development in Hac	85	1910	1.6235	
	4th year Plantation				
	i.Rehabilization of degraded forest in Hac	30	2770	0.831	
	ii. Pasture Development in Hac	75	2430	1.8225	11.8095
6th year	**Mantenance of Plantation**				
	1st year Plantation				
	i. Plantation in Hac	50	1840	0.92	
	ii.Rehabilization of degraded forest in Hac	40	1070	0.428	
	iii. Pasture Development in Hac	105	1050	1.1025	
	2nd year Plantation				
	i.Plantation in Hac	45	2420	1.089	
	ii.Rehabilization of degraded forest in Hac	40	1370	0.548	
	iii. Pasture Development in Hac	85	1450	1.2325	
	3rd year Plantation				
	i. Plantation in Hac	20	2790	0.558	
	ii.Rehabilization of degraded forest in Hac	20	1370	0.274	
	iii. Pasture Development in Hac	85	1450	1.2325	
	4th year development				
	i.Plantation in Hac	30	2300	0.69	
	ii.Rehabilization of degraded forest in Hac	75	1910	1.4325	9.507

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Year	Name of Area	Quantity	Rate in Rs	Amount (Rs. In Lakhs)	Maintenance Cost
7th year	**Maintenance of Plantation**				
	1st year Plantation				
	i. Plantation in Hac	50	1550	0.775	
	ii.Rehabilization of degraded forest in Hac	40	1070	0.428	
	2nd year Plantation				
	i.Plantation in Hac	45	1840	0.828	
	ii.Rehabilization of degraded forest in Hac	40	1070	0.428	
	iii. Pasture Development in Hac	85	1050	0.8925	
	3rd year Plantation				
	i. Plantation in Hac	20	2420	0.484	
	ii.Rehabilization of degraded forest in Hac	20	1370	0.274	
	iii. Pasture Development in Hac	85	1450	1.2325	
	4th year development				
	i.Rehabilization of degraded forest in Hac	30	1370	0.411	
	ii. Pasture Development in Hac	75	1450	1.0875	6.8405
8th year	**Maintenance of Plantation**				
	1st year Plantation				
	i. Plantation in Hac	50	1550	0.775	
	ii.Rehabilization of degraded forest in Hac	40	1070	0.428	
	2nd year Plantation				
	i.Plantation in Hac	45	1550	0.6975	
	ii.Rehabilization of degraded forest in Hac	40	1070	0.428	
	3rd year Plantation				
	i. Plantation in Hac	20	1840	0.368	
	ii.Rehabilization of degraded forest in Hac	20	1070	0.214	
	iii. Pasture Development in Hac	85	1050	0.8925	
	4th year development				
	i.Plantation in Hac	30	1370	0.411	
	ii.Rehabilization of degraded forest in Hac	75	1450	1.0875	5.3015
9th year	**Maintenance of Plantation**				
	2nd year Plantation				
	i.Plantation in Hac	45	1550	0.6975	
	ii.Rehabilization of degraded forest in Hac	40	1070	0.428	

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Year	Name of Area	Quantity	Rate in Rs.	Amount (RS. in lakhs)	Maintenance cost
	3rd Year Plantation				
	i. Plantation in Hac	20	1550	0.31	
	ii. Rehabilitation of degraded forest in Hac	20	1070	0.214	
	4th Year Development				
	i. Plantation in Hac	30	1070	0.321	
	ii. Rehabilitation of degraded forest in Hac	75	1050	0.7875	2.758
10th Year	**Maintenance of Plantation**				
	3rd Year Plantation				
	i. Plantation in Hac	20	1550	0.31	
	ii. Rehabilitation of degraded forest in Hac	20	1070	0.214	
	4th Year Development				
	i. Rehabilitation of degraded forest in Hac	30	1070	0.321	0.845
11th Year	**Maintenance of Plantation**				
	4th Year Plantation				
	i. Rehabilitation of degraded forest in Hac	30	1070	0.321	0.321
	Total			**182.277**	**64.501**

The year wise physical and financial targets are given in table-8

TABLE-8
Year wise physical & financial targets for CAT Plan

S. No.	Treatment measure	Year 1		Year 2		Year 3		Year 4	
		PHY (ha)	FIN (Rs. In lacs)	PHY (ha)	FIN (Rs. in Lacs)	PHY (ha)	FIN (Rs. in Lacs)	PHY (ha)	FIN (Rs. in Lacs)
1.	Afforestation	50	16.975	45	15.2775	20	6.79	-	-
2.	Rehabilization of Degraded forest	40	10.212	40	10.212	20	5.106	30	7.659
3.	Pasture Development	105	13.3665	85	10.8205	85	10.8205	75	9.5475
4.	Check Dam	9 No.	2.25	13	3.25	7	1.75	10	2.5
5.	Check Wall	10 No.	0.55	32	1.76	40	2.2	26	1.43
6.	Nursery	1 (No)	10.0	-	-	-	-	-	-
7.	Infrastructure Development Works	-	13.70	-	20.00	-	-	-	-
8.	Social Development works	-	15.00	-	10.00	-	19.00	-	15.50
9.	Development of Private Land	-	-	-	5.00	-	5.00	-	-
	Total		**82.0535**		**76.32**		**50.6665**		**36.6365**

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Operation & Maintenance Cost

The O&M would be done at the project cost for 7 years after implementation of the CAT measures. The total O&M cost will be Rs.64.501 Lacs. The details of year wise O&M cost are given in Table-9

TABLE-9

Details of year wise O&M costs

Year	O&M Cost (Rs. In Lacs)
1	-
2	5.8945
3	10.0005
4	11.2235
5	11.8095
6	9.507
7	6.8405
8	5.3015
9	2.758
10	0.845
11	0.321
Total	**64.501**

The total cost for CAT (including O&M & Escalation) is Rs. 337.8233 Lacs. The year wise expenditure on CAT Plan including O&M cost is given in Table-10.

TABLE-10

Year wise expenditure for Catchment Area Treatment Plan Including O & M Cost & 5% Escalation

Year	Expenditure (Rs. In Lacs)	With Escalation 5% annually
1	82.0535	82.0535
2	82.2145	86.3252
3	60.667	66.7337
4	47.86	55.039
5	11.8095	14.1714
6	9.507	11.8837
7	6.8405	8.8926
8	5.3015	7.1570
9	2.758	3.8612
10	0.845	1.225
11	0.321	0.481
TOTAL	**310.1775**	**337.8233**

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ESTIMATE FOR CONSTRUCTION OF CHECK DAM

S No.	Description	No.	Measurement			Qty	Rate in Rs.	Amount in Rs.
			L	B	H/D			
1.	Site clearance					LS		150.00
2	Excavation in foundation							
i	Foundations of check dam	1	10	1.8	0.7	12.6		
ii	Sides of check dam	2	0.5+2.5/2	1.8	1.5	8.1		
	Total					20.7cum	90	1863.00
3	Hammer dressed RR masonry in CM 1:6 for check dam							
i	Check dam	1	10	0.6+1.5/2	1.8	18.9		
ii	Deduction of spillway	1	5	0.6	0.3	(-)0.9		
	Total					18.0cum	120	2160.00
4	200mm Thick stone packing apron	1	5	1.0	0.2	1.0cum	54.90	54.90
5	Collection of boulders & stones					18.0cum	37	666.00
6	Collection of sand					5.5 cum	37	203.50
7	Breaking of boulders & stone					18.0cum	38.20	687.60
8	Dressing of boulders & stone					5.0cim	38.20	191.00
9	Carriage of stones over a distance of 1km					18.0cum	255/cum/km	4590.00
10	Carriage of sand over a distance of 1km					5.5cum	255/cum/km	1402.50
11	Filling of sides of check dam							
i	Foundation	1	10	0.3	0.7	2.1		
ii	Sides	2	0.5+2.5/2	0.3	1.5	1.35		
	Total					3.45cum	18.00	276.00
	Total							**12244.50**
	Add 27.45% of increase in labour cast							3361.10
	Total							**15605.60**
12	Cost of material							
i	Cost of cement (including transportation)					27 bags	200.00	5400.00
	Total							**21005.60**
	Add 17.5% administrative expenses							376.00
	Total							**24681.6**
	Say							**25000.0**

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COST ESTIMATE FOR PLANTATION (AFFORESTATION) OF 1 Ha. FOR CAT PLAN

S. No.	Particulars of works	Quantity	Rate	Amount
1.	Survey and demarcation of plantation area including marking of sections, patch and preparation of map	1 Ha.	44.36 per Ha.	44.36
2.	Cutting and preparation of wooden posts 1.80 mtr long and 8 to 10 cm dia including debarking and fastening the top 15cm in conical shape	60 Nos.	561.36 per hundred	336.81
3.	Carriage of fence post upto 2 mtr long and 8 to 10cm dia over distance 1 Kms	60 Nos.	295.41 per hundred per km.	177.24
4.	Preparation/digging of holes 20-30cm dia and 45cm deep	60 Nos.	393.02 per hundred	235.81
5.	Fixing of wooden posts including strutting	60 Nos.	301.64 per hundred	180.98
6.	Carriage of B/wire over average distance of 1 km. Up hills	1 qtls.	73.93 per Qtls per km.	73.93
7.	Stretching and fixing of barbed wire with U-staples in each strand (3 stands)	540 Rmt.	2.05 per Rmt.	1107.00
8.	Bush cutting in the plantation site	1 ha	517.00 per ha	517.00
9.	Interlacing of thorny bushes in B/wire obtained from planting site	180 Rmt.	1.78 per Rmt.	320.40
10.	Preparation of inspection path 60cm wide	250 Rmt.	4.71 per Rmt.	1177.50
11.	Layout of pits over	1 ha	73.82	73.82
12.	Digging of pits 45x45x45cms(40 % of Total)	440 No.	413.60 per hundred	1819.84
13.	Digging of pits 30x30x30 cm (60 % of Total)	660	206.85 per hundred	1365.21
14.	Filling of pits 45x45x45cms	440 No.	118.51 per hundred	521.44
15.	Filling of pits 30x30x30 cms	660 No.	82.70 per hundred	545.82
16.	Carriage of naked root plants over distance 2 kms. Up hills (BL as well as conifers)	400 No.	15.27 per hundred / Km.	122.16
17.	Carriage of plants in P/ bags over distance 2kms. Up hills.	700 No.	94.51 per hundred / p Km.	1323.14
18.	Planting of entire Plants raised in P/ bags	700 Nos.	94.57 per hundred	661.99
19.	Planting of Naked root plants	400 Nos.	79.73 per hundred	318.92
20.	Nursery cost of Plants	1100 Nos.	4.00 per plant	4400.00
21.	**Total**			**15323.37**
22.	Soil and moisture conservation works (25% of initial planting cost at serial no. 21)	1 ha	25 % of initial Planting cost	3830.75
23.	**Total**			**19154.12**
24.	Add cost of B/wire including cost of U Nails	75 kg.	23.00 per kg.	1725.00
25.	Layout of patches over 1 Ha	1 Ha	73.82/ha	73.82
26.	Preparation of patches 60x60x25cm	350	280.64per hundred	982.24
27.	Planting of grass seeds in patches	350	82.71 per hundred	289.48

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28.	Cost of grass seeds	1400	0.25	350.00
29.	Carriage of grass seeds over a distance of 2Kms up hill	0.5 Qtl	64.99 per hundred/Km	64.99
30.	Total			22639.65
31.	Add 17.50% Departmental Charges			3961.93
32.	Total			26601.58
33.	Add: 5% contingencies			1330.08
34.	Total			27931.66
35.	Or say			**27950.00**
	MAINTENANCE COST			
	1st year maintenance 25% mortality			
1.	Re-digging of pits 45x45x45 cms	110 Nos.	206.85 per hundred	227.53
2.	Re-digging of pits 30x30x30 cms	165 Nos.	103.40 per hundred	170.61
3.	Filling of pits 45x45x45 cms	110 Nos.	118.51per hundred	130.45
4.	Filling of pits 30x30x30 cms	165 Nos.	82.70 per hundred	136.45
5.	Planting of Polythene bags plants	175 Nos.	94.57 per hundred	165.49
6.	Planting of Naked root plants	100 Nos.	79.73 per hundred	79.73
7.	Carriage of Polythene bags plants over a distance of 2 kms. up hills.	175 Nos.	94.51 per hundred	330.78
8.	Carriage of Naked root plants over a distance of 2 Kms up hills	100 No.	15.27 per hundred	30.54
9.	Nursery cost of plants	275 Nos.	4.00 per plant	1100.00
10.	Repair of fence	180 Rmt.	0.70 per Rmt.	126.00
11.	Repair of inspection path		L/s	300.00
12.	Repair of soil and moisture conservation works		L/s	400.00
13.	**Maintenance of pasture**			
14.	**1st year maintenance 25% mortality**			
15.	Preparation of patches 60x60x25cm	88	280.64 per hundred nos.	246.96
16.	Planting of grass seeds in patches	88	82.70 per hundred nos.	72.77
17.	Cost of grass seeds	352	0.25 each	88.00
18.	Carriage of grass seeds over a distance of 2Kms up hill	0.125	64.99 per hundred Kms	16.24
19.	Total			3621.55
20.	Add 17.5 % Departmental Charges			633.77
21.	Total			4255.32
	Add: 5% contingencies			212.76
				4468.08
	Or Say			**4470.00**
	Second year maintenance 20 % mortality			
1.	Re-digging of pits 45x45x45 cms	88 Nos.	206.85 per hundred	182.02
2.	Re-digging of pits 3ox 30x30 cms	132 Nos.	103.40 per hundred	136.48
3.	Filling of pits 45x45x45 cms	88 Nos.	118.51 per hundred	104.28
4.	Filling of pits 30x30x30cms	132 Nos.	82.70 per hundred	109.16

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5.	Planting of polythene bags plants	140 Nos.	94.57 per hundred	132.39
6.	Planting of Naked root plants	80 Nos.	79.73 per hundred	63.78
7.	Carriage of Polythene bags plants over a distance of 2 Kms up hills	140 Nos.	94.51 per hundred	264.62
8.	Carriage of Naked root plants over a distance of 2 Kms up hills	80 Nos .	15.27 per hundred	24.42
9.	Nursery cost of plants	220 Nos.	4.00 per plant	880.00
10.	Repair of fence	180 Rmt.	0.70 per Rmt.	126.00
11.	Repair of inspection path		L/s	300.00
12.	Repair of soil and moisture conservation works		L/s	400.00
13.	**Maintenance of pasture**			
14.	**2nd year maintenance 20% mortality**			
15.	Preparation of patches 60x60x25cm	70	280.64 per hundred	196.44
16.	Planting of grass seeds in patches	70	82.70 per hundred	57.89
17.	Cost of grass seeds	280	0.25 each	70.00
18.	Carriage of grass seeds over a distance of 2Kms up hill	0.1 Qtls	64.99 per hundred/Km	12.99
19.	Total			3060.47
20.	Add 17.5% Departmental Charge			535.58
21.	Total			3596.05
22.	Add: 5% contingencies			179.80
23.	Total			3775.85
24.	Or Say			**3780.00**
	Third year maintenance 15% mortality			
1	Re-digging of pits 45x45x45 cms	66 Nos.	206.85 per hundred	136.52
	Re-digging of pits 30x30x30 cms.	99 No.	103.40 per hundred	102.36
3	Filling of pits 45x45x45 cms	66 Nos.	118.51 per hundred	78.21
4	Filling of pits 30x30x30 cms	99 Nos.	82.70 per hundred	81.87
5	Planting of polythene bags plants	105 Nos.	94.57 per hundred	99.29
6	Planting of Naked root plants	60 Nos.	79.73 per hundred	47.83
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	105 Nos.	94.51 per hundred	198.46
8	Carriage of Naked root plants over a distance of 2 Kms up hills	60 Nos.	15.27 per hundred	18.32
9	Nursery cost of plants	165 Nos.	4.00 per hundred	660.00
10	Repair of fence	200 Rmt	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	300.00
12	Repair of soil and moisture conservation works		L/s	400 .00
13	Total			2262.86
14	Add 17.5% Departmental Charge			396.00
15	Total			2658.86
16	Add: 5% contingencies			132.94
17	Total			2791.80
18	Or Say			**2790.00**

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	Fourth year maintenance 15% mortality			
1	Re-digging of pits 45x45x45 cms	66 No.	206.85 per hundred	136.52
2	Re-digging of pits 30x30x30 cms	99 Nos.	103.40 per hundred	102.36
3	Filling of pits 45x45x45 cms	66 Nos.	118.51 per hundred	78.21
4	Filling of pits 30x30x30 cms	99 Nos.	82.70 per hundred	81.87
5	Planting of polythene bags plants	105 Nos.	94.57 per hundred	99.29
6	Planting of Naked root plants	60 Nos.	79.73 per hundred	47.83
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	105 Nos.	94.51 per hundred	198.47
8	Carriage of Naked root plants over a distance of 2 Kms up hills	60 Nos.	15.27 per hundred	18.32
9	Nursery cost of plants	165 Nos.	4.00 per plant	660.00
10	Repair of fence	200 Rmt.	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	200.00
12	Repair of soil and moisture conservation works		L/s	200.00
13	Total			1962.87
14	Add 17.5% Departmental Charge			343.50
15	Total			2306.37
16	Add: 5% contingencies			115.31
17	Total			2421.68
18	Or Say			**2420.00**
	Fifth year maintenance 10% mortality			
1	Re-digging of pits 45x45x45 cms	44 Nos.	206.85 per hundred	47.83
2	Re-digging of pits 30x30x30 cms	66 Nos.	103.40 per hundred	68.24
3	Filling of pits 45x45x45 cms	44 Nos.	118.51 per hundred	52.14
4	Filling of pits 30x30x30cms.	66 Nos.	82.70 per hundred	54.58
5	Planting of polythene bags plants	70 Nos.	94.57 per hundred	66.19
6	Planting of Naked root plants	40 Nos.	79.57 per hundred	31.89
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	70 Nos.	94.51 per hundred	132.31
8	Carriage of Naked root plants over a distance of 2 Kms up hills	40 Nos.	15.27per hundred	12.21
9	Nursery cost of plants	110 Nos.	4.00 per plant	440.00
10	Repair of fence	200 Rmt.	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	200.00
12	Repair of soil and moisture conservation works		L/s	200.00
13	Total			1488.57
14	Add 17.5% Departmental Charge			260.49
15	Total			1749.06
16	Add: 5% contingencies			87.45
17	Total			1836.51
18	Or Say			**1840.00**

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	Sixth year maintenance 10% mortality			
1	Re-digging of pits 45x45x45 cms	44 Nos.	206.85 per hundred	91.01
2	Re-digging of pits 30x30x30 cms	66 Nos.	103.30 per hundred	68.24
3	Filling of pits 45x45x45 cms	44 Nos.	148.54 per hundred	52.14
4	Filling of pits 30x30x30 cms	66 Nos.	82.70 per hundred	54.58
5	Planting of polythene bags plants	70 Nos.	94.57 per hundred	66.19
6	Planting of Naked root plants	40 Nos.	79.73 per hundred	31.89
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	70 Nos.	94.51 per hundred	132.31
8	Carriage of Naked root plants over a distance of 2 Kms up hills	40 Nos.	15.27 per hundred	12.21
9	Nursery cost of plants	110 Nos.	4.00 per plant	440.00
10	Repair of fence	150 Rmt.	0.70 per Rmt.	105.00
11	Repair of inspection path		L/s	100.00
12	Repair of soil and moisture conservation works		L/s	100.00
13	Total			1253.57
14	Add 17.5% Departmental Charge			219.37
14	Total			1472.95
15	Add: 5% contingencies			73.64
16	Total			1546.59
17	Or say			**1550.00**
	Seventh year maintenance 10% mortality			
1	Re-digging of pits 45x45x45 cms	44 Nos.	206.85 per hundred	91.01
2	Re-digging of pits 30x30x30 cms	66 Nos.	103.40 per hundred	68.24
3	Filling of pits 45x45x45 cms	44 Nos.	118.51 per hundred	52.14
4	Filling of pits 30x30x30x cms	66 Nos.	82.70 per hundred	54.58
5	Planting of polythene bags plants	70 Nos.	94.57 per hundred	66.19
6	Planting of Naked root plants	40 Nos.	i79.73 per hundred	31.89
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	70 Nos.	94.51 per hundred	132.31
8	Carriage of Naked root plants over a distance of 2 Kms up hills	40 Nos.	15.27 per hundred	12.21
9	Nursery cost of plants	110 Nos.	4.00 per plant	440.00
10	Repair of fence	150 Rmt.	0.70 per Rmt.	105.00
11	Repair of inspection path		L/s	100.00
12	Repair of soil and moisture conservation works		L/s	100.00
13	Total			1253.57
14	Add 17.5% Departmental Charge			219.37
15	Total			1472.94
16	Add: 5% contingencies			73.64
17	Total			1546.59
18	Or Say			**1550.00**

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COST OF WOODEN FENCE POST

S. No.	Particulars	Qty.	Rate	Amount
1.	Wooden Fence Post	60 Nos. per hac.	100 .00 each	**6000.00**

TOTAL COST ABSTRACT PER HAC

S.NO.	DESCRIPTION OF WORK	AMOUNT
1	Cost of plantation including grass sowing	27950.00
2	First year maintenance of plantation and grass	4470.00
3	Second year maintenance of plantation and grass	3780.00
4	Third year maintenance of plantation	2790.00
5	Fourth year maintenance of plantation	2420.00
6	Fifth year maintenance of plantation	1840.00
7	Sixth year maintenance of plantation	1550.00
8	Seventh year maintenance of plantation	1550.00
9	Cost of wooden fence post	6000.00
	Total	**52350.00**

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COST ESTIMATE FOR REHABILITATION OF DEGRADED FOREST FOR 1 Ha. (600 TREES PER Ha) FOR CAT PLAN

S. No.	Particulars of works	Quantity	Rate	Amount
1.	Survey and demarcation of plantation area including marking of sections, patch and preparation of map	1 Ha.	44.36 per Ha.	44.36
2.	Cutting and preparation of wooden posts 1.80 mtr long and 8 to 10 cm dia including debarking and fastening the top 15cm in conical shape	60 Nos.	561.36 per hundred	336.81
3.	Carriage of fence post upto 2 mtr long and 8 to 10cm dia over distance 1 Kms	60 Nos.	295.41 per hundred per km.	177.24
4.	Preparation/digging of holes 20-30cm dia and 45cm deep	60 Nos.	393.02 per hundred	235.81
5.	Fixing of wooden posts including strutting	60 Nos.	301.64 per hundred	180.98
6.	Carriage of B/wire over average distance of 1 km. Up hills	1 qtls.	73.93 per Qtls per km.	73.93
7.	Stretching and fixing of barbed wire with U-staples in each strand (3 stands)	540 Rmt.	2.05 per Rmt.	1107.00
8.	Bush cutting in the plantation site	1 ha	517.00 per ha	517.00
9.	Interlacing of thorny bushes in B/wire obtained from planting site	180 Rmt.	1.78 per Rmt.	320.40
10.	Preparation of inspection path 60cm wide	250 Rmt.	4.71 per Rmt.	1177.50
11.	Layout of pits over	1 ha	73.82	73.82
12.	Digging of pits 45x45x45cms(40 % of Total)	240 No.	413.60 per hundred	992.64
13.	Digging of pits 30x30x30 cm (60 % of Total)	360	206.85 per hundred	744.66
14.	Filling of pits 45x45x45cms	240 No.	118.51 per hundred	284.42
15.	Filling of pits 30x30x30 cms	360 No.	82.70 per hundred	297.72
16.	Carriage of naked root plants over distance 2 kms. Up hills (BL as well as conifers)	240 No.	15.27 per hundred / Km.	36.64
17.	Carriage of plants in P/ bags over distance 2kms. Up hills.	360 No.	94.51 per hundred / p Km.	340.23
18.	Planting of entire Plants raised in P/ bags	360 Nos.	94.57 per hundred	340.45
19.	Planting of Naked root plants	240 Nos.	79.73 per hundred	191.35
20.	Nursery cost of Plants	600 Nos.	4.00 per plant	2400.00
21.	**Total**			**9872.46**
22.	Soil and moisture conservation works (25% of initial planting cost at serial no. 21)	1 ha	25 % of initial Planting cost	2468.24
23.	**Total**			**12341.20**
24.	Add cost of B/wire including cost of U Nails	75 kg.	23.00 per kg.	1725.00
25.	Layout of patches over 1 Ha	1 Ha	73.82/ha	73.82

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26.	Preparation of patches 60x60x25cm	350	280.64per hundred	982.24
27.	Planting of grass seeds in patches	350	82.71 per hundred	289.48
28.	Cost of grass seeds	1400	0.25	350.00
29.	Carriage of grass seeds over a distance of 2Kms up hill	0.5 Qtl	64.99 per hundred/Km	64.99
30.	Total			15826.73
31.	Add 17.50% Departmental Charges			2769.67
32.	Total			18596.40
33.	Add 5% contingencies			929.82
34.	Total			19526.22
35.	Or say			**19530.00**
	MAINTENANCE COST			
	1st year maintenance 25% mortality			
1.	Re-digging of pits 45x45x45 cms	60 Nos.	206.85 per hundred	124.11
2.	Re-digging of pits 30x30x30 cms	90 Nos.	103.40 per hundred	93.06
3.	Filling of pits 45x45x45 cms	60 Nos.	118.51per hundred	71.10
4.	Filling of pits 30x30x30 cms	90 Nos.	82.70 per hundred	74.43
5.	Planting of Polythene bags plants	90 Nos.	94.57 per hundred	85.11
6.	Planting of Naked root plants	60 Nos.	79.73 per hundred	47.83
7.	Carriage of Polythene bags plants over a distance of 2 kms. up hills.	90 Nos.	94.51 per hundred	85.05
8.	Carriage of Naked root plants over a distance of 2 Kms up hills	60 No.	15.27 per hundred	9.16
9.	Nursery cost of plants	150 Nos	4.00 per plant	600.00
10.	Repair of fence	180 Rmt.	0.70 per Rmt.	126.00
11.	Repair of inspection path		L/s	200.00
12.	Repair of soil and moisture conservation works		L/s	300.00
13.	**Maintenance of pasture**			
14.	**1st year maintenance 25% mortality**			
15.	Preparation of patches 60x60x25cm	88	280.64 per hundred	246.96
16.	Planting of grass seeds in patches	88	82.70 per hundred	72.77
17.	Cost of grass seeds	352	0.25 each	88.00
18.	Carriage of grass seeds over a distance of 2Kms up hill	0.125	64.99 per hundred Kms	16.24
19.	Total			2239.82
20.	Add 17.5 % Departmental Charges			391.96
21.	Total			2631.78
22.	Add: 5% contingencies			131.58
23.	Total			2763.36
24.	Or Say			**2770.00**

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	Second year maintenance 20 % mortality			
1.	Re-digging of pits 45x45x45 cms	48 Nos.	206.85 per hundred	99.28
2.	Re-digging of pits 3ox 30x30 cms	72 Nos.	103.40 per hundred	74.44
3.	Filling of pits 45x45x45 cms	48 Nos.	118.51 per hundred	56.88
4.	Filling of pits 30x30x30cms	72 Nos.	82.70 per hundred	59.54
5.	Planting of polythene bags plants	72 Nos.	94.57 per hundred	68.09
6.	Planting of Naked root plants	48 Nos.	79.73 per hundred	38.27
7.	Carriage of Polythene bags plants over a distance of 2 Kms up hills	72 Nos.	94.51 per hundred	68.04
8.	Carriage of Naked root plants over a distance of 2 Kms up hills	48 Nos.	15.27 per hundred	7.32
9.	Nursery cost of plants	120 Nos.	4.00 per plant	480.00
10.	Repair of fence	180 Rmt.	0.70 per Rmt.	126.00
11.	Repair of inspection path		L/s	150.00
12.	Repair of soil and moisture conservation works		L/s	200.00
13.	**Maintenance of pasture**			
14.	**2nd year maintenance 20% mortality**			
15.	Preparation of patches 60x60x25cm	70	280.64 per hundred	196.44
16.	Planting of grass seeds in patches	70	82.70 per hundred	57.89
17.	Cost of grass seeds	280	0.25 each	70.00
18.	Carriage of grass seeds over a distance of 2Kms up hill	0.1 Qtls	64.99 per hundred/Km	12.99
19.	Total			1865.18
20.	Add 17.5% Departmental Charge			326.40
21.	Total			2191.58
22.	Add: 5% contingencies			109.57
23.	Total			2301.15
24.	Or Say			**2300.00**
	3rd year maintenance 15% mortality			
1	Re-digging of pits 45x45x45 cms	36 Nos.	206.85 per hundred	74.46
	Re-digging of pits 30x30x30 cms.	54 No.	103.40 per hundred	55.83
3	Filling of pits 45x45x45 cms	36 Nos.	118.51 per hundred	42.66
4	Filling of pits 30x30x30 cms	54 Nos.	82.70 per hundred	44.65
5	Planting of polythene bags plants	54 Nos.	94.57 per hundred	51.06
6	Planting of Naked root plants	36 Nos.	79.73 per hundred	28.70
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	54 Nos.	94.51 per hundred	51.03
8	Carriage of Naked root plants over a distance of 2 Kms up hills	36 Nos.	15.27 per hundred	5.49
9	Nursery cost of plants	90 Nos.	4.00 per hundred	360.00

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10	Repair of fence	200 Rmt	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	100.00
12	Repair of soil and moisture conservation works		L/s	150 .00
13	Total			1103.88
14	Add 17.5% Departmental Charge			193.17
15	Total			1297.05
16	Add: 5% contingencies			64.85
17	Total			1361.90
18	Or Say			**1370.00**
	Fourth year maintenance 15% mortality			
1	Re-digging of pits 45x45x45 cms	36 Nos.	206.85 per hundred	74.46
2	Re-digging of pits 30x30x30 cms	54 No.	103.40 per hundred	55.83
3	Filling of pits 45x45x45 cms	36 Nos.	118.51 per hundred	42.66
4	Filling of pits 30x30x30 cms	54 Nos.	82.70 per hundred	44.65
5	Planting of polythene bags plants	54 Nos.	94.57 per hundred	51.06
6	Planting of Naked root plants	36 Nos.	79.73 per hundred	28.70
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	54 Nos.	94.51 per hundred	51.03
8	Carriage of Naked root plants over a distance of 2 Kms up hills	36 Nos.	15.27 per hundred	5.49
9	Nursery cost of plants	90 Nos.	4.00 per hundred	360.00
10	Repair of fence	200 Rmt	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	100.00
12	Repair of soil and moisture conservation works		L/s	150 .00
13	Total			1103.88
14	Add 17.5% Departmental Charge			193.17
15	Total			1297.05
16	Add: 5% contingencies			64.85
17	Total			1361.90
18	Or Say			**1370.00**
	Fifth year maintenance 10% mortality			
1	Re-digging of pits 45x45x45 cms	24 Nos.	206.85 per hundred	49.64
2	Re-digging of pits 30x30x30 cms	36 Nos.	103.40 per hundred	37.22
3	Filling of pits 45x45x45 cms	24 Nos.	118.51 per hundred	28.44
4	Filling of pits 30x30x30cms.	36 Nos.	82.70 per hundred	29.77
5	Planting of polythene bags plants	36 Nos.	94.57 per hundred	34.04
6	Planting of Naked root plants	24 Nos.	79.57 per hundred	19.09
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	36 Nos.	94.51 per hundred	34.02
8	Carriage of Naked root plants over a distance of 2 Kms up hills	24 Nos.	15.27per hundred	3.66
9	Nursery cost of plants	60 Nos.	4.00 per plant	240.00

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10	Repair of fence	200 Rmt.	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	100.00
12	Repair of soil and moisture conservation works		L/s	150.00
13	Total			865.88
14	Add 17.5% Departmental Charge			151.52
15	Total			1017.40
16	Add: 5% contingencies			50.87
17	Total			1068.27
18	Or Say			**1070.00**
	Sixth year maintenance 10% mortality			
1	Re-digging of pits 45x45x45 cms	24 Nos.	206.85 per hundred	49.64
2	Re-digging of pits 30x30x30 cms	36 Nos.	103.40 per hundred	37.22
3	Filling of pits 45x45x45 cms	24 Nos.	118.51 per hundred	28.44
4	Filling of pits 30x30x30 cms	36 Nos.	82.70 per hundred	29.77
5	Planting of polythene bags plants	36 Nos.	94.57 per hundred	34.04
6	Planting of Naked root plants	24 Nos.	79.57 per hundred	19.09
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	36 Nos.	94.51 per hundred	34.02
8	Carriage of Naked root plants over a distance of 2 Kms up hills	24 Nos.	15.27per hundred	3.66
9	Nursery cost of plants	60 Nos.	4.00 per plant	240.00
10	Repair of fence	200 Rmt.	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	100.00
12	Repair of soil and moisture conservation works		L/s	150.00
13	Total			865.88
14	Add 17.5% Departmental Charge			151.52
15	Total			1017.40
16	Add: 5% contingencies			50.87
17	Total			1068.27
18	Or say			**1070.00**
	Seventh year maintenance 10% mortality			
1	Re-digging of pits 45x45x45 cms	24 Nos.	206.85 per hundred	49.64
2	Re-digging of pits 30x30x30 cms	36 Nos.	103.40 per hundred	37.22
3	Filling of pits 45x45x45 cms	24 Nos.	118.51 per hundred	28.44
4	Filling of pits 30x30x30x cms	36 Nos.	82.70 per hundred	29.77
5	Planting of polythene bags plants	36 Nos.	94.57 per hundred	34.04
6	Planting of Naked root plants	24 Nos.	79.57 per hundred	19.09
7	Carriage of Polythene bags plants over a distance of 2 Kms up hills	36 Nos.	94.51 per hundred	34.02
8	Carriage of Naked root plants over a distance of 2 Kms up hills	24 Nos.	15.27per hundred	3.66
9	Nursery cost of plants	60 Nos.	4.00 per plant	240.00

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10	Repair of fence	200 Rmt.	0.70 per Rmt.	140.00
11	Repair of inspection path		L/s	100.00
12	Repair of soil and moisture conservation works		L/s	150.00
13	Total			865.88
14	Add 17.5% Departmental Charge			151.52
15	Total			1017.40
16	Add: 5% contingencies			50.87
17	Total			1068.27
18	Or Say			**1070.00**

COST OF WOODEN FENCE POST

S. No.	Particulars	Qty.	Rate	Amount
1.	Wooden Fence Post	60 Nos. per hac.	100 .00 each	**6000.00**

TOTAL COST ABSTRACT PER HAC

S. No.	Description of work	Amount
1	Cost of plantation including grass sowing	19530.00
2	First year maintenance of plantation and grass	2770.00
3	Second year maintenance of plantation and grass	2300.00
4	Third year maintenance of plantation	1370.00
5	Fourth year maintenance of plantation	1370.00
6	Fifth year maintenance of plantation	1070.00
7	Sixth year maintenance of plantation	1070.00
8	Seventh year maintenance of plantation	1070.00
9	Cost of wooden fence post	6000.00
	Total	**36550.00**

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COST ESTIMATE FOR PASTURE DEVELOPMENT FOR 1HAC. FOR CAT PLAN

S. No.	Particulars of works	Quantity	Rate	Amount
1.	Survey and demarcation of pasture development area including marking of sections, patches and preparation of map	1 Ha	44.36 per Ha.	44.36
2.	Bush cutting in the pasture development site	1 Ha	517.00 per Ha	517.00
3.	Preparation of inspection path 60cm wide	250 Rmt.	4.71 per Rmt.	1177.5
4.	Layout of patches over	1 Ha	73.82 per Ha	73.82
5.	Preparation of patches 60x60x25 cm	1100 Nos.	280.64 per hundred	3087.04
6.	Planting of grass Tufts in patches (4 tufts in each patch)	1100	82.71 per hundred	909.81
7.	Carriage of grass Tufts over distance 2 Kms. Up hills	2.2 Qtls.	64.99 per hundred / Km.	285.95
8.	Nursery cost of grass Tufts	4400 Nos.	0.50 / each	2200.00
9.	**Total**			**7438.38**
10.	Soil and moisture conservation works (25% of Initial planting cost at serial no. 21)	1 Ha	25% of initial Planting cost	1859.59
11.	**Total**			**9297.97**
12.	Add 17.50% Departmental Charges			1627.14
13.	Total			10925.11
14	Add: 5% contingencies			605.94
15	Total			12724.77
16.	Or say			**12730.00**
	MAINTENANCE COST			
	First year maintenance 25%			
1.	Re-preparation of patches 60x60x25 cms	275 Nos.	280.64 per hundred	771.76
2.	Planting of grass Tufts in patches	275 Nos.	82.71 per hundred	227.45
3.	Carriage of grass Tufts over a distance of 2 Kms up hills	0.55 Qtls	64.99 per Qtl/ Kms	71.48
4.	Nursery cost of Grass Tufts	1100 Nos.	0.5/ each	550.00
5.	Repair of inspection path		L/s	150.00
6.	Repair of soil and moisture conservation works		L/s	200.00
7.	Total			1970.69
8.	Add 17. 5% Departmental Charges			344.87
9.	Total			2315.56
10.	Add: 5% contingencies			115.77
11	Total			2431.33
10.	Or say			**2430.00**
	Second year maintenance 20 % mortality			
1.	Re-preparation of patches 60x60x25	220 Nos.	280.64 per hundred	617.40
2.	Planting of Grass Tufts in patches	220 Nos.	82.71 per hundred	181.96
3.	Carriage of Grass tufts over a distance of 2 Kms up hills	0.44 Qtls.	64.99 per Qtls/ Kms.	57.19
4.	Nursery cost of Grass Tufts	880 Nos.	0.5/ each	440.00
5.	Repair of inspection path		L/s	100.00
6.	Repair of soil and moisture conservation works		L/s	150.00
7.	Total			1546.55
8.	Add 17.5 % Departmental Charge			270.64
9	Total			1817.19

POWER PRIVATE LIMITED New Delhi

Range Forest Officer
KASOL

Divisional Forest Officer
PARBATI Forest Division
SHAMSHI

10	Add 5% contingencies			**90.85**
11	Total			**1908.04**
12	Or say			**1910.00**
	Third year maintenance 15% mortality			
1	Re-preparation of patches 60x60x25	165 Nos.	280.64	463.05
2	Planting of Grass Tufts in patches	165 Nos.	82.71	136.47
3	Carriage of Grass Tufts over a distance of 2 Kms up hills	0.33 Qtls.	64.99 per Qtl. / Km.	42.89
4	Nursery cost of Grass Tufts	660 Nos.	0.50 / each	330.00
5	Repair of inspection path		L/s	100.00
6	Repair of soil and moisture conservation works		L/s	100.00
7	Total			1172.41
8	Add 17.5% Departmental Charge			205.17
9	Total			1377.58
10	Add: 5% contingencies			68.87
11	Total			1446.45
12	Or say			**1450.00**
	Fourth year maintenance 15% mortality			
1	Re-preparation of patches 60x60x25	165 Nos.	280.64	463.05
2	Planting of Grass Tufts in patches	165 Nos.	82.71 per hundred	136.47
3	Carriage of Grass tufts over a distance of 2 Kms up hills	0.33 Qtls.	64.99 per Qtl. / Km.	42.89
4	Nursery cost of Grass Tufts	660 Nos.	0.50 / each	330.00
5	Repair of inspection path		L/s	100.00
6	Repair of soil and moisture conservation Works		L/s	100.00
13	Total			1172.41
14	Add 17.5 % Departmental Charge			205.17
15	Total			1377.58
16	Add: 5% contingencies			68.87
17	Total			1446.45
16	Or say			**1450.00**
	Fifth year maintenance 10% mortality			
1	Re-preparation of patches 60x60x25	110 Nos.	280.64 per hundred	308.70
2	Planting of Grass Tufts in patches	110 Nos.	82.71 per hundred	90.98
3	Carriage of Grass Tufts over a distance of 2 Kms up hills	0.22 Qtls.	64.99 per Qtl. / Km.	28.59
4	Nursery cost of Grass Tufts	440 Nos.	0.50 / each	220.00
5	Repair of inspection path		L/s	100.00
6	Repair of soil and moisture conservation works		L/s	100.00
7	Total			848.27
8	Add 17.5% Departmental Charge			148.44
9	Total			996.71
10	Add: 5% contingencies			49.83
11	Total			1046.54
12	Or say			**1050.00**

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TOTAL COST ABSTRACT PER HAC

S. No.	Description of work	Amount
1	Cost of grass sowing	12730.00
2	First year maintenance of grass	2430.00
3	Second year maintenance of grass	1910.00
4	Third year maintenance of grass	1450.00
5	Fourth year maintenance of grass	1450.00
6	Fifth year maintenance of grass	1050.00
	Total	**21020.00**

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New Delhi

Divisional Forest Officer
PARBATI Forest Division
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FIGURES

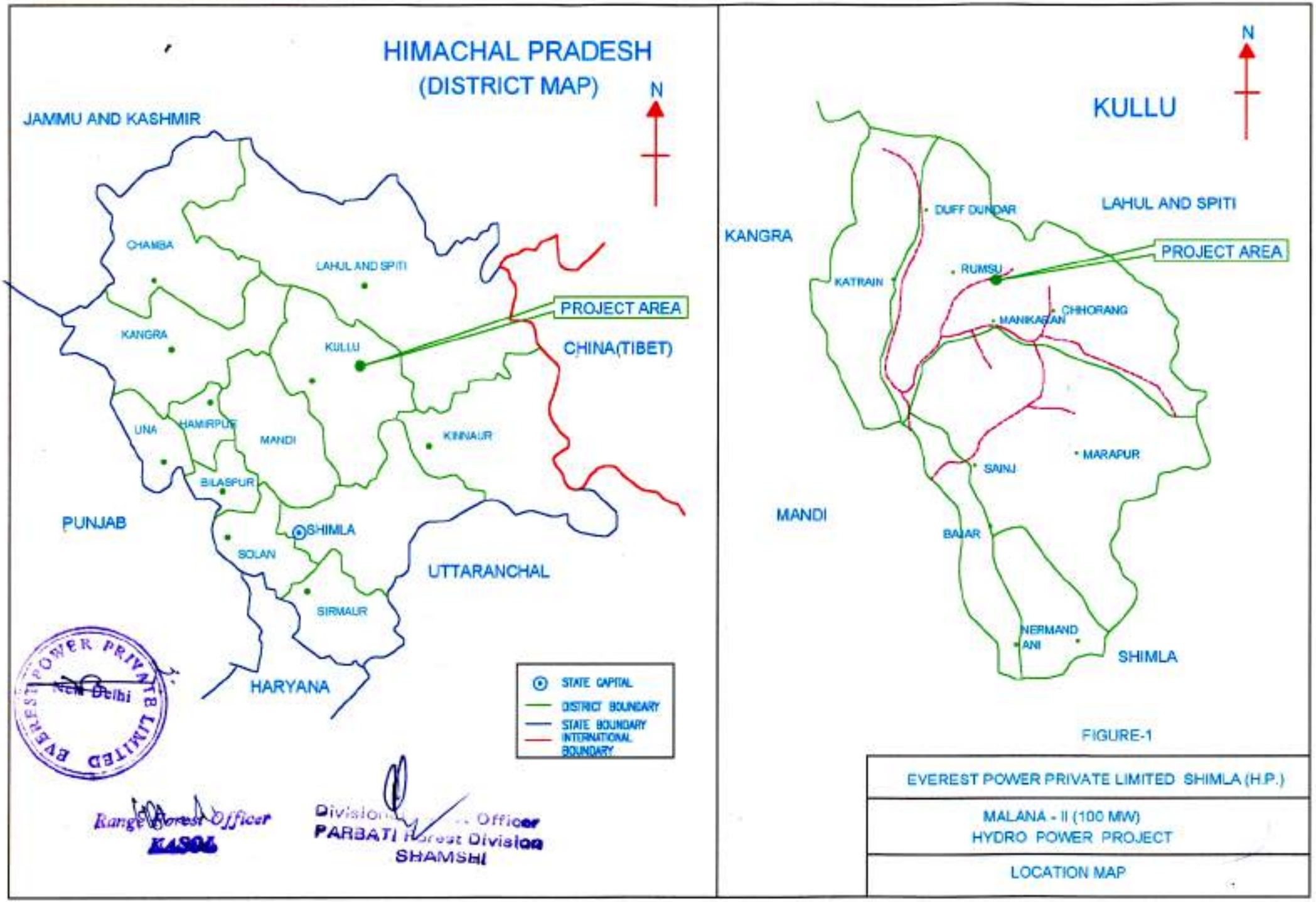

FIGURE-1

EVEREST POWER PRIVATE LIMITED SHIMLA (H.P.)

MALANA - II (100 MW)
HYDRO POWER PROJECT

LOCATION MAP

EVEREST POWER PRIVATE LIMITED New Delhi

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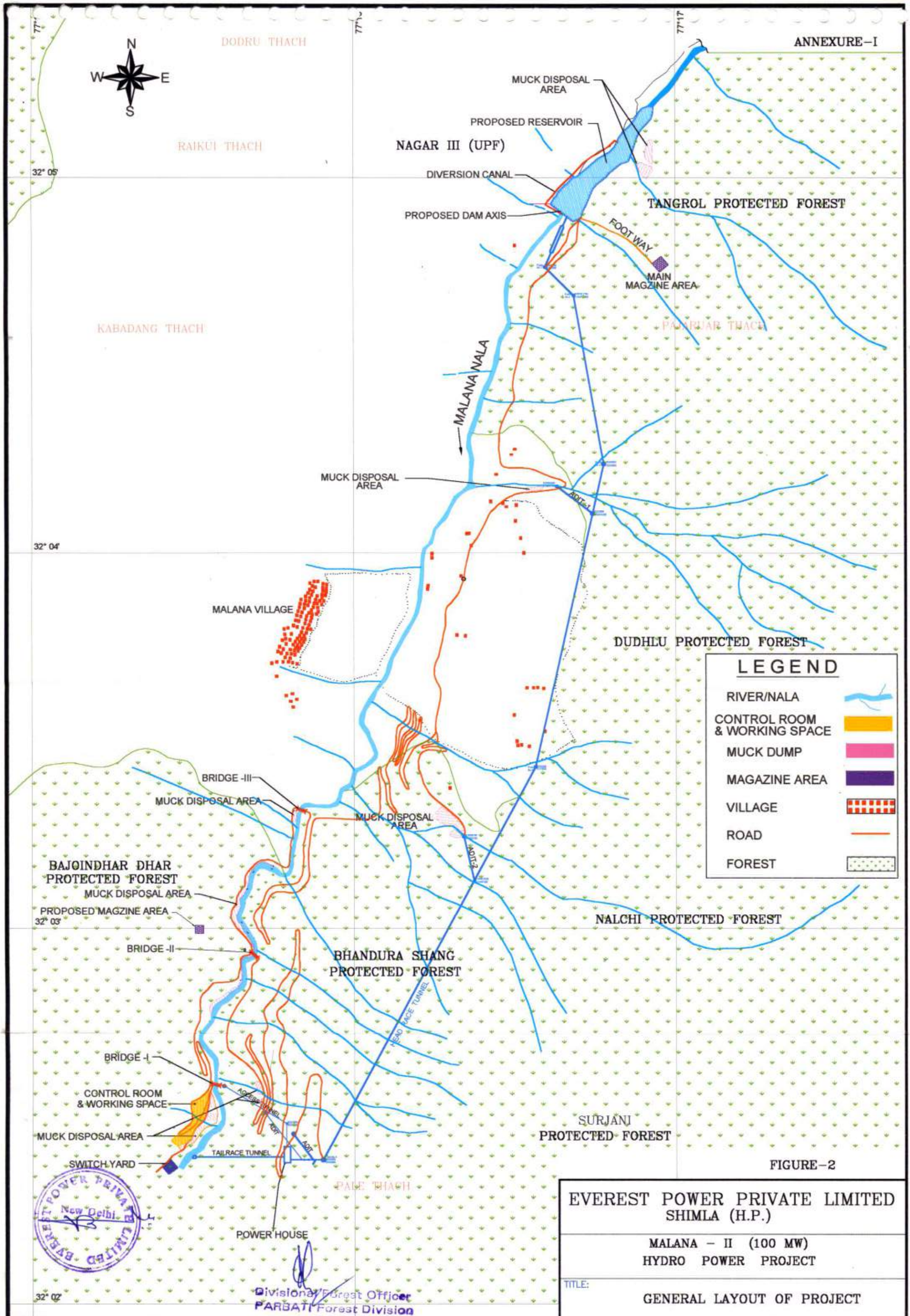
KASOL

Division ... Officer
PARBATI Forest Division
SHAMSHI

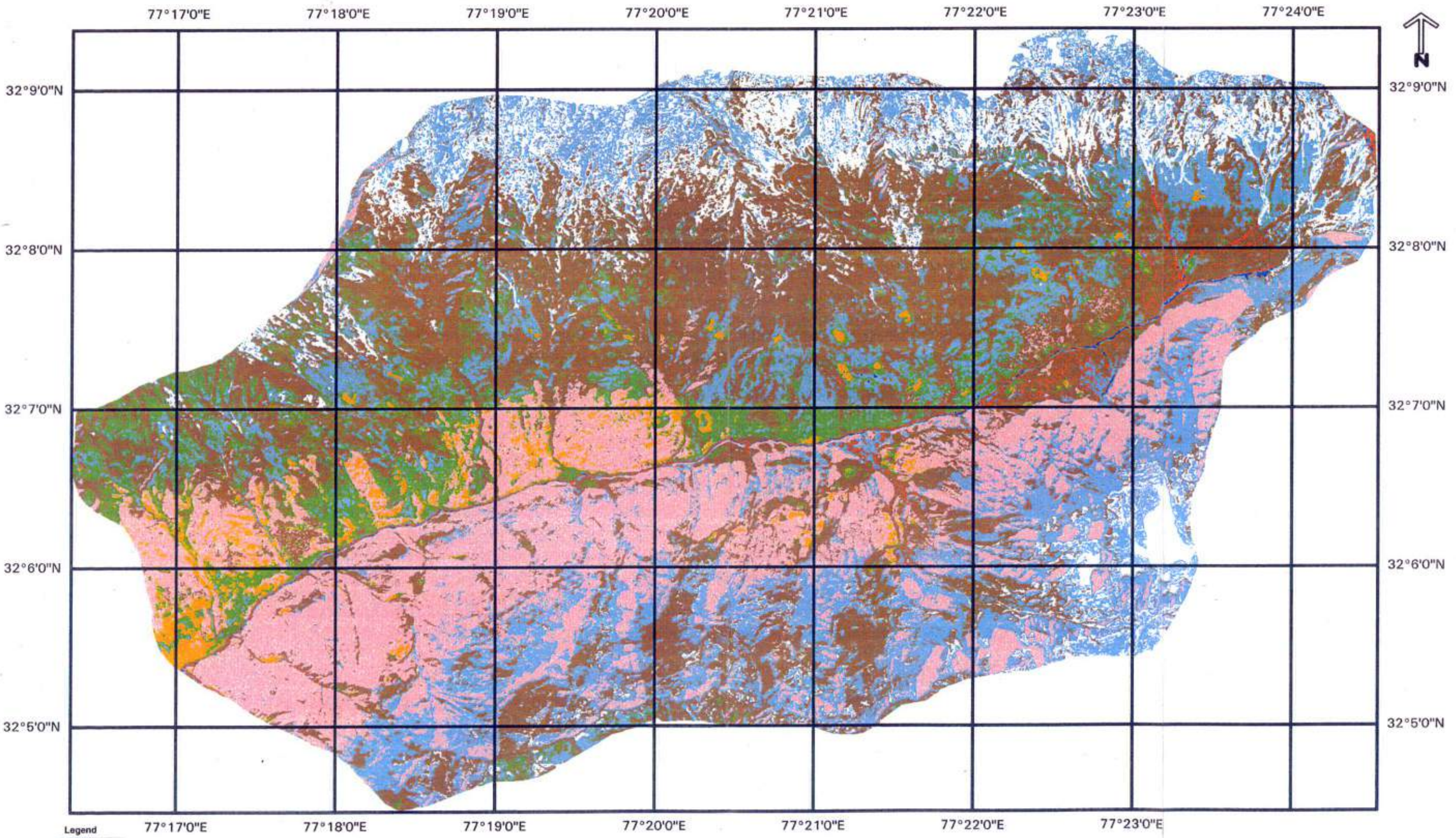


FIGURE–2

EVEREST POWER PRIVATE LIMITED
SHIMLA (H.P.)

MALANA – II (100 MW)
HYDRO POWER PROJECT

TITLE:
GENERAL LAYOUT OF PROJECT



Legend

Class-Names

- Settlement/Built-up areas
- Water bodies
- Rocky outcrops
- Snow cover/Barren areas
- Dense vegetation
- Grasslands
- Scrubs
- Mixed vegetation

LANDUSE CLASSIFICATION OF CATCHMENT AREA

(DERIVED FROM IRS 1D, LISS III & PAN MERGED PRODUCT)

Scale

1000 0 1000 2000 Meters

EVEREST POWER PRIVATE LIMITED New Delhi

Ranger Forest Officer
Forest Range Kasol

Divisional Forest Officer
PARBATI Forest Division
SHAMSHI

FIGURE-3

EVEREST POWER PRIVATE LIMITED SHIMLA (H.P.)
MALANA-II (100 MW) HYDRO ELECTRIC PROJECT
TITLE LANDUSE CLASSIFICATION OF CATCHMENT AREA (IRS 1D, LISS III & PAN MERGED PRODUCT)

77 15' 45" 77 18' 00" 77 20' 15" 77 22' 30" 77 24' 45"

32 09' 00" 32 09' 00"

32 06' 45" 32 06' 45"

32 04' 30" 32 04' 30"

77 15' 45" 77 18' 00" 77 20' 15" 77 22' 30" 77 24' 45"

Grid 45" interval

0 - 10 %
10 - 20 %
20 -30 %
30 - 40 %
>40 %

700 0 700 1400 Meters

FIGURE-4

EVEREST POWER PRIVATE LIMITED
SHIMLA (H.P.)

MALANA - II (100 MW)
HYDRO POWER PROJECT

TITLE **SLOPE MAP**

EVEREST POWER PRIVATE LIMITED New Delhi

Divisional Forest Officer
PARBATI Forest Division
SHAMSHI

Range Forest Officer
KASOL

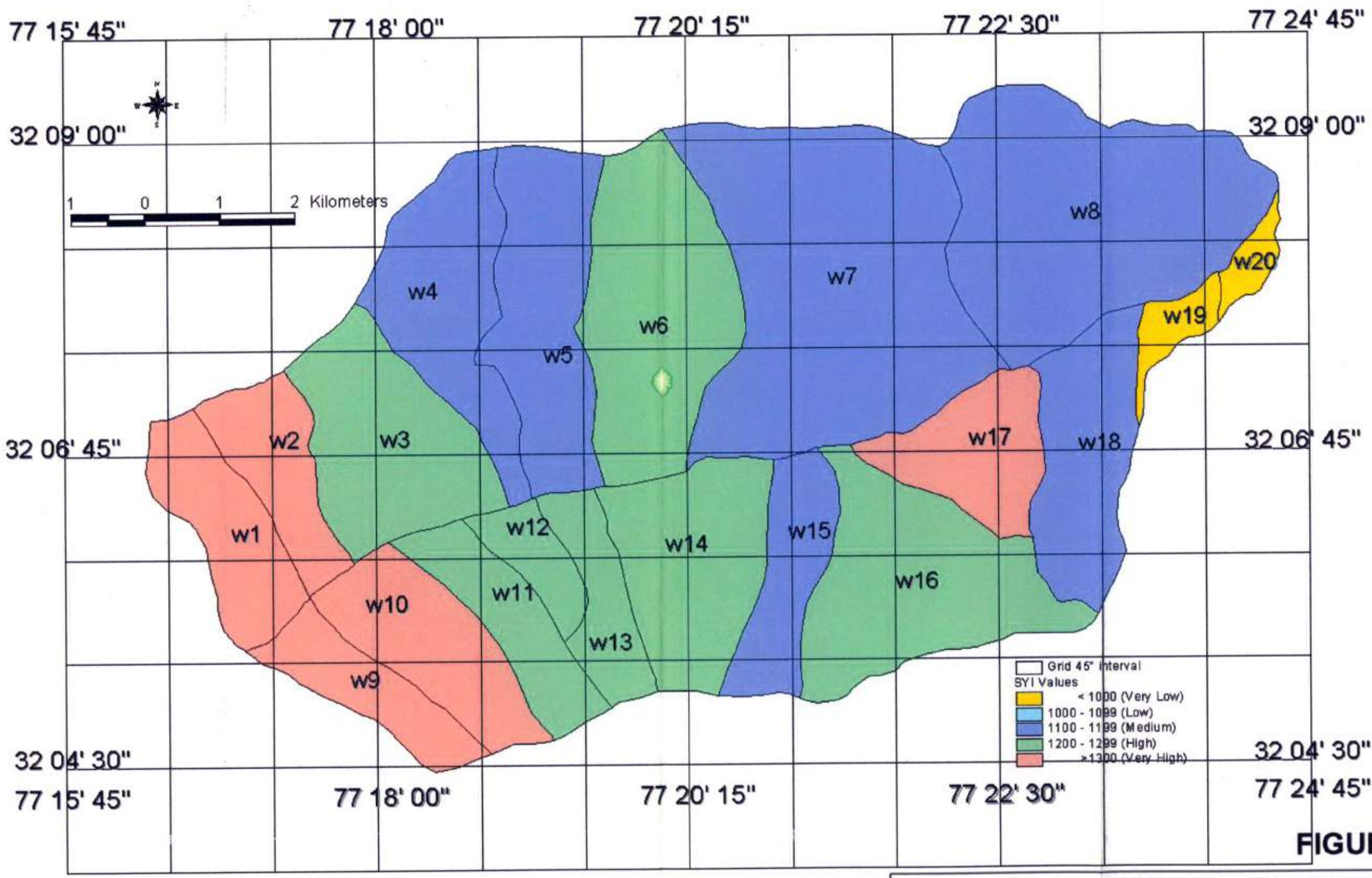


FIGURE-5

EVEREST POWER PRIVATE LIMITED
SHIMLA (H.P.)

MALANA - II (100 MW)
HYDRO POWER PROJECT

TITLE
VULNERABILITY ANALYSIS FOR WATERSHED PRIORITIZATION USING SYI VALUES

EVEREST POWER PRIVATE LIMITED New Delhi

Range Forest Officer
KASOL

Divisional Forest Officer
PARBATI Forest Division
SHAMSHI

77°16' 30" E | 77°17' 15" E | 77°18' 0" E | 77°18' 45" E | 77°19' 30" E | 77°20' 15" E | 77°21' 0" E | 77°21' 45" E | 77°22' 30" E | 77°23' 15" E | 77°24' 0" E

32°9' 0" N

32°8' 15" N

32°7' 30" N

32°6' 45" N

32°6' 0" N

32°5' 15" N

32°4' 30" N

32°3' 45" N

BAGRI THACH

GHOILAS THACH

UMBRPRUAR THACH

TOTU THACH

SUMBHA THACH

KIKSA THACH

SHILANG THACH

SHUPU THACH

DUKORA THACH

PURSORE THACH

BHALANG THACH

ANGANAT THACH

BARE THACH

MOTAGRAN THACH

MALANA NALLA

KHARIRUNI THACH

CHOHARPHAT THACH

BAKAR THACH

MUNI THACH

KOTHINAGAR

SARAPHAT THACH

HIMAKPIH THACH

DUDRU THACH

NIHARI THACH

TUMBER THACH

TALBELI THACH

T A N G R O L P R O T E C T E D F O R E S T

KHALI THACH

LEGEND

PASTURE

AFFORESTATION

GAP PLANTING

CHECK DAM / CHECK WALLS

EVEREST POWER PRIVATE LIMITED New Delhi

Range Forest Officer
Forest Range Kasol

Divisional Forest Officer
PARBATI Forest Division
SHAMSHI

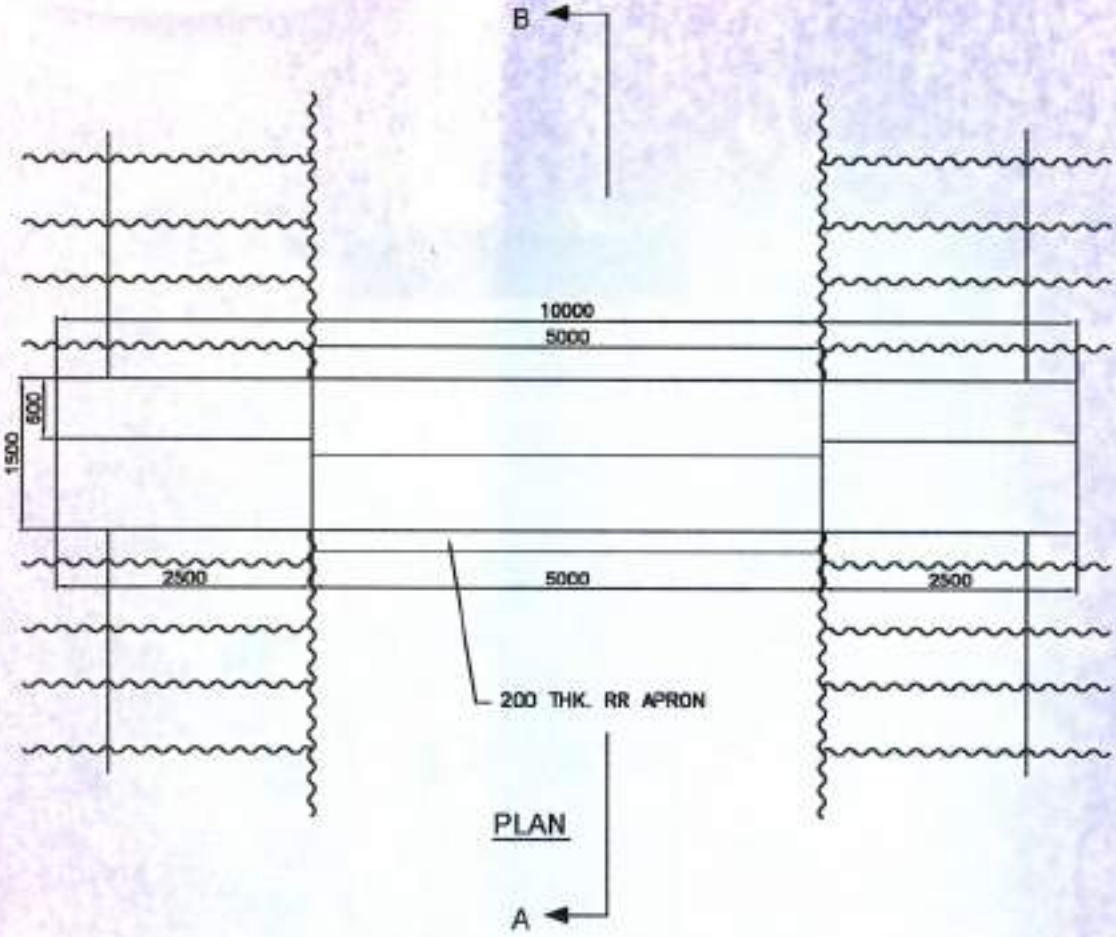
FIGURE–6

WAPCOS
CENTRE FOR ENVIRONMENT

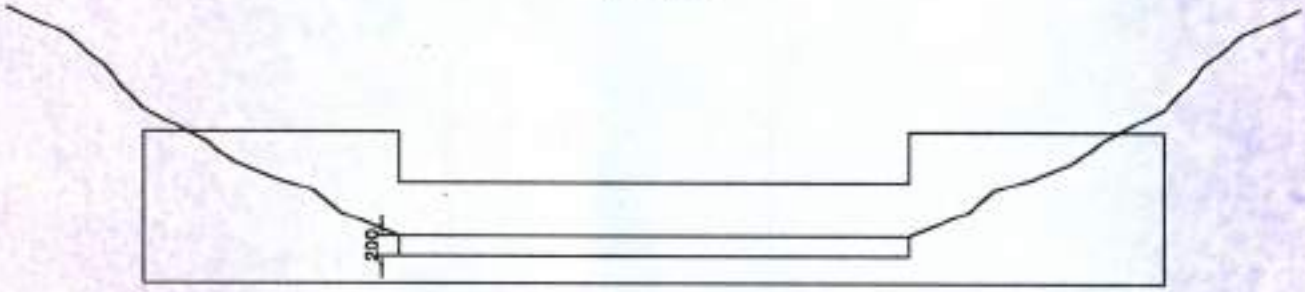
CLIENT: EVEREST POWER PVT. LTD. SHIMLA (H.P.)

PROJECT: MALANA – II (100 MW) HYDRO POWER PROJECT

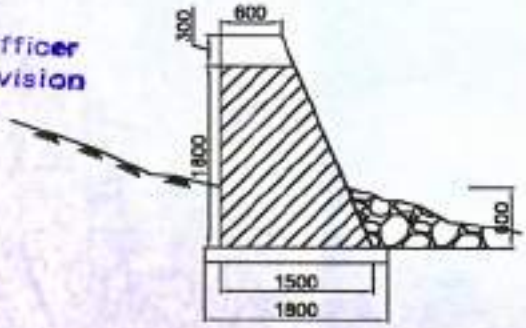
TITLE: MAP SHOWING THE VARIOUS CATCHMENT AREA TREATMENT MEASURES



PLAN



ELEVATION



X-SEC. ON AB

Divisional Forest Officer
PARBATI Forest Division
SHAMSHI

EVEREST POWER PRIVATE LIMITED New Delhi

Range Forest Officer
KASOL

FIGURE-7

EVEREST POWER PRIVATE LIMITED SHIMLA (H.P.)
MALANA - II (100 MW) HYDRO POWER PROJECT
DETAIL DRAWING OF CHECK DAM