

# MUCK MANAGEMENT PLAN

## 1.0 INTRODUCTION

The project envisages construction of headrace tunnel of about 2462 m length and underground powerhouse for execution of Rahi Kyoung HEP. Large quantity of material would be excavated from the head race tunnel and power house. Muck generated from excavation of any project component is required to be disposed in a planned manner so that it takes a least possible space and is not hazardous to the environment. An account of the same has been given in the following paragraphs.

## 2.0 QUANTITY OF MUCK TO BE GENERATED

The total quantity of muck generated from soil and rock excavation is about **113151 cum**. The quantity of muck after considering a swelling factor of 45% would be **164069 cum**. About **112821 cum** of soil and rock excavation are expected to be utilized for fillings of developing areas for construction facilities and material as aggregate. Total quantity of muck proposed to be disposed in designated muck disposal area would be **51248 cum**. The details are given in **Table 1**. Total quantity of excavation in common soil and quantity of rock excavation would have to be disposed in designated muck disposal area.

**Table 1: Quantity of muck to be generated from different project construction activities**

S. No	Project Component	Quantity of Muck/debris generation (m <sup>3</sup> )	Total Quantity of muck/debris including 45 % swell factor (m <sup>3</sup> )	Estimated Quantity of muck/debris proposed to be utilized (m <sup>3</sup> )	Estimated quantity of Muck/debris proposed to be dumped (m <sup>3</sup> )
1	<b>Trench Weir &amp; Intake Structure</b>				
	Muck from trench weir, intake structure, feeder channel, desilting tank, power channel and part of Head race tunnel	43215	62662	43863	18799
2	<b>Head Race Tunnel &amp; Adit</b>				
	Muck from part of HRT, adit, forebay and escape	41976	60865	42606	18260
3	<b>Power House, MAT, TRT etc</b>				
	Muck from powerhouse excavation and the excavation for the colony and utility areas	27960	40542	26352	14190
	<b>Total Excavation</b>	<b>113151</b>	<b>164069</b>	<b>112821</b>	<b>51248</b>

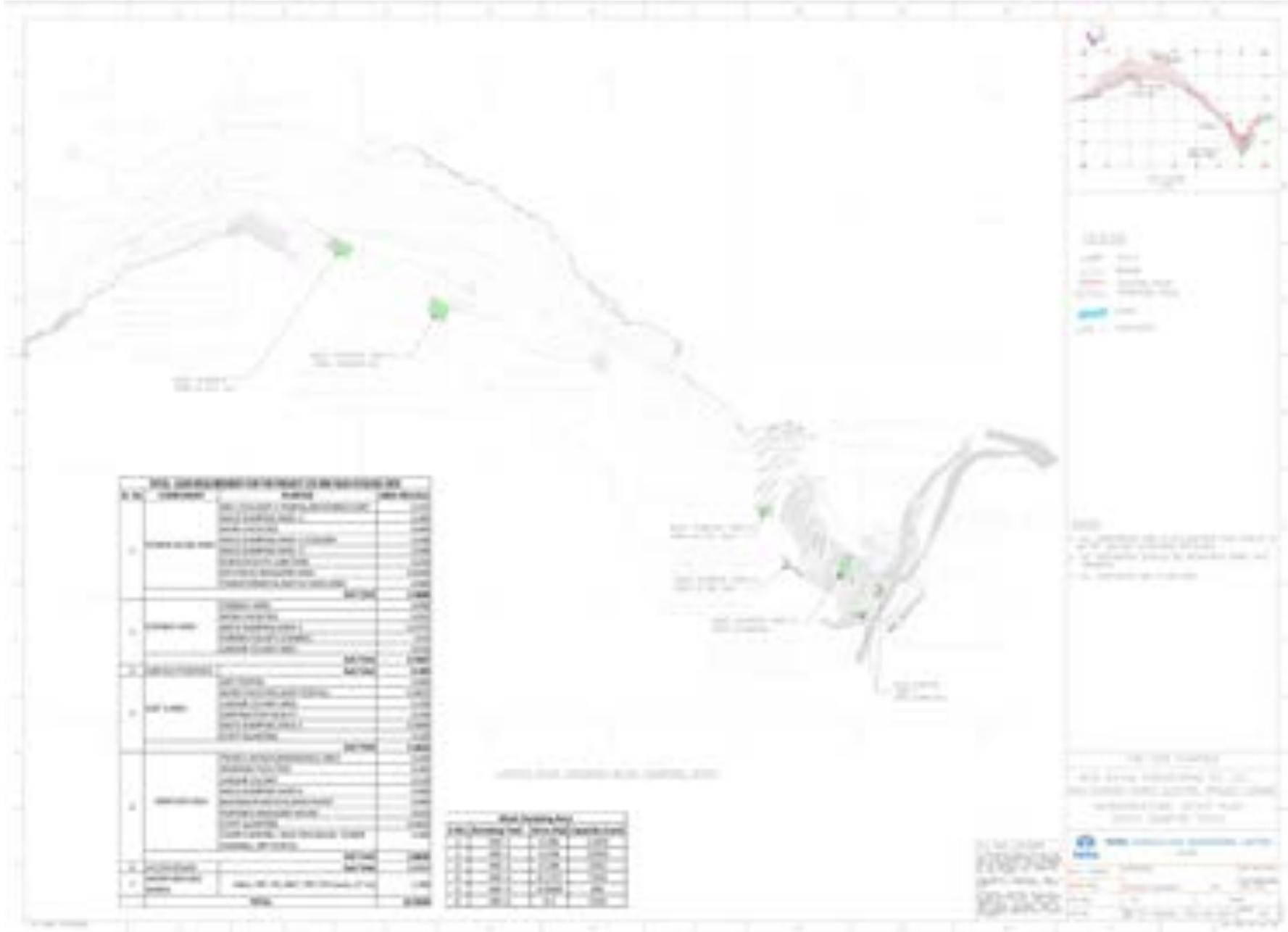


Figure 1: Layout Plan of Rahi Kyoung HE Project showing Muck Dumping Sites

### 3.0 DUMPING SITES

The identification of muck disposal areas is done in line with the topographic and site specific conditions. Muck is to be dumped in 6 pre-identified sites (**Refer Figure 1**). Total capacity of these sites is about **52907 cum**. The quantity of excavated muck to be accommodated at each site is given in **Table 2**.

**Table 2: Detail of Muck disposal sites**

S.No.	Dumping Yard	Area (Ha)	Capacity (cum)
1	MD -1	0.286	11059
2	MD -2	0.338	23928
3	MD -3	0.108	3262
4	MD -4	0.1727	7320
5	MD -5	0.5008	305
6	MD -6	0.40	7033
	<b>Total</b>	<b>1.8055</b>	<b>52907</b>

#### 3.1 Criteria for Selection of Dumping Sites

Based on the geological nature of the rocks and engineering properties of the soil, a part of the muck can be used as construction material. However, the balance requires being suitably disposed. In the proposed project 112821 cum of muck generated from rock excavation is to be reused for fillings of developing areas for construction facilities. Rest of the 51248 cum is to be disposed at muck disposal sites in a total area of 1.8055 ha.

The following points were considered and followed as guidelines for finalization of the areas to be used as dumping sites:

- i) The dumping sites have been selected as close as possible to the project area to avoid long distance transport of muck.
- ii) The sites are free from active landslides or creep and care has been taken that the sites do not have a possibility of toe erosion and slope instability.
- iii) The dumping sites are either at higher level than the flood level or are away from the river course so that the possibility of muck falling into the river is avoided.
- iv) There is no active channel or stream flowing through the dumping sites.
- v) The sites are far away from human settlement areas.

The selection of muck disposal sites was done based upon site inspections and available best conditions of the land availability, land stability, accessibility from the portals, sloping pattern, minimum vegetative and tree cover, away from any ecological sensitive area, river bed conditions and away from high flood levels of the Rahi Chhu. After surveys six suitable sites were identified (MD1, MD2, MD3, MD4, MD5 and MD6 shown in **Figure 1**). The proposed locations are spread over land area of **1.8055 ha**. Total capacity of muck disposal areas is more than total quantity of unused muck to be disposed (**see Table 2**). The unused excavated material expected to be comprised of fragmented rock mixed with soil would be piled at an angle of repose around 30° at the proposed dumping sites. This will be done to provide stability to the slopes and also to provide ample space for planting of trees which would further help in holding and consolidation of the material stacked at the proposed dumping sites.

In order to maintain an angle of repose less than 30° at the proposed dumping sites, the slopes at dumping sites would be broken up by creating benches across the slope. This will be done to provide stability to the slopes and also to provide ample space for planting trees, which would further help in holding and consolidating the material stacked at different sites. The description regarding the stabilization of the stacked material along the proposed roads has been discussed in the following paragraphs.

The options like dumping muck in stages and allowing it to consolidate/settle through the monsoon, compacting the dumped muck with dozer movement, zoning the dump judiciously to ensure the stability of 30° slope under all superimposed conditions will be utilized. The contour plan and cross-sections of proposed muck dumping sites are given at **Figures 2 - 7**.

#### **4.0 METHODOLOGY OF DUMPING**

The main objectives of process of muck dumping and restoration of these muck disposal sites are:

- to protect and control soil erosion;
- to create greenery in the muck disposal areas;
- to improve and develop the sites into recreational sites;
- to ensure maximum utilization of muck for the construction purpose;
- to develop the muck disposal sites/ dumping yards to blend with the surrounding landscape; and
- to minimize damages due to the spoilage of muck in the project area.

In Rahi Kyoung HEP during identification of the dumping sites above mentioned aspects were kept in mind. All possible alternate sites were inspected and examined before rejecting or selecting any site. All the dumping sites:

- i) have minimum possible forest cover,
- ii) the settlement areas are far away from the identified dumping sites so as to have least impact on human life,
- iii) the proposed dumping sites are located at a distance varying from 30m to 40m away from the HFL at these sites as all the dumping sites are at a higher level than the flood level from the river course to provide protection from high flood, and
- iv) the identified muck sites are close to the sites from where muck is to be generated to avoid hazards related to transport of muck to long distances.

##### **4.1 Dumping Process**

The generated muck will be carried in dumper trucks covered with heavy duty tarpaulin properly tied to the vehicle in accordance with best international practices. All precautionary measures will be followed during the dumping of muck. All dumpers will be well maintained to avoid any chances of loose soil from being falling during the transportation. All routes will be periodically wetted with the help of sprinklers prior to the movement of dumper trucks. Dumping would be avoided during the high speed wind, so that suspended particulate matters (SPM) level could be maintained. Further, the dumping will be avoided during heavy traffic. After the dumping the surface of dumps will be sprayed with water with the help of sprinklers and then compacted.

A retaining wall of 6m has been proposed to hold the muck on the lower part of the dumping site and shall be constructed prior to dumping of muck. Loose muck would be compacted layer-wise. The height of Gabion Wall is proposed to be 6 m on an average. The muck brought by dumpers will be spread in layers behind the wire crate walls and then compacted by rollers till the top level is achieved. The retaining wall shall be laid with proper berm and the muck dumped behind it in layers and compacted by rollers. The process shall be repeated up to 50 cm level below the desired height which shall be laid with good soil for providing grass cover. At a regular vertical interval of 1.5 m and 3.0 m c/c masonry drains (catch water drains) shall be provided to drain off the rain water. Proper fencing of the entire area will be done.

The muck disposal area will ultimately be covered with fertile soil and suitable plants will be planted adopting suitable bio-technological measures. The project authorities would ensure that the dumping yards blend with the natural landscape by developing the site with gentle slope, patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist spots with sufficient greenery by planting trees.

The Rehabilitation plan of muck dumping sites includes engineering and biological measures. Most of the total unused excavated muck would be placed at an angle of repose to avoid any slippage of the muck at the proposed dumping sites. Besides, required quantity would be stacked along the roads, which would be utilised either in widening of the road or in newly constructed roads. In the former case slopes would be broken up by creating benches across the slope. This will be done to provide stability to the slopes and also to provide ample space for planting of trees which would further help in holding and consolidating the material stacked at different sites. As stated earlier, efforts will be made to dispose the muck within short distances from sites of its generation.

The capacity/volume of the muck dumping sites is more than the volume of the muck to be disposed. All measures would be adopted to ensure that the dumping of muck does not cause injury or inconvenience to the people or the property around the area. The spillage of muck into the river at any site would be prevented by making concrete retaining walls to retain the muck pile. It shall be ensured that dumping is carried out at a minimum distance of 30 m away from the active river bank. The top surface would be leveled and graded after the capacity of any dumping site is exhausted. The top surface will be covered with soil and grass seeding will be ensured to promote vegetation cover.

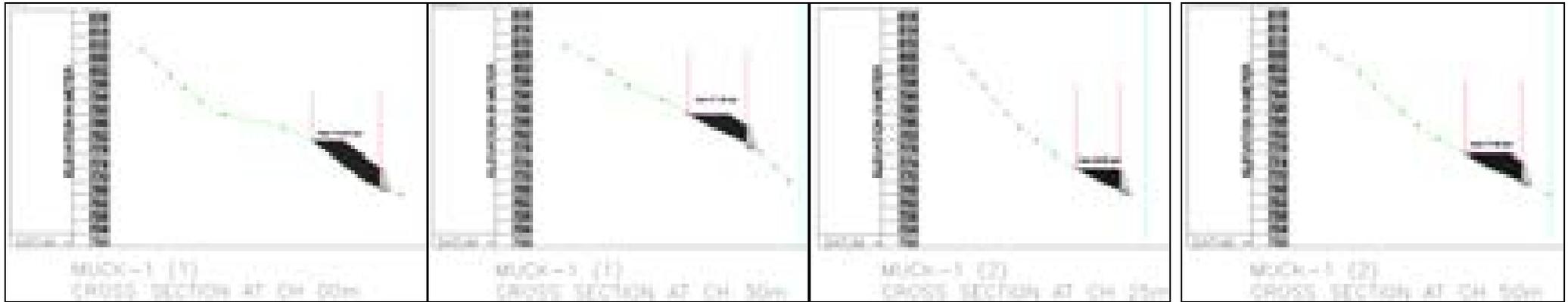


Figure 2: Cross Sections of the Muck dumping site D1

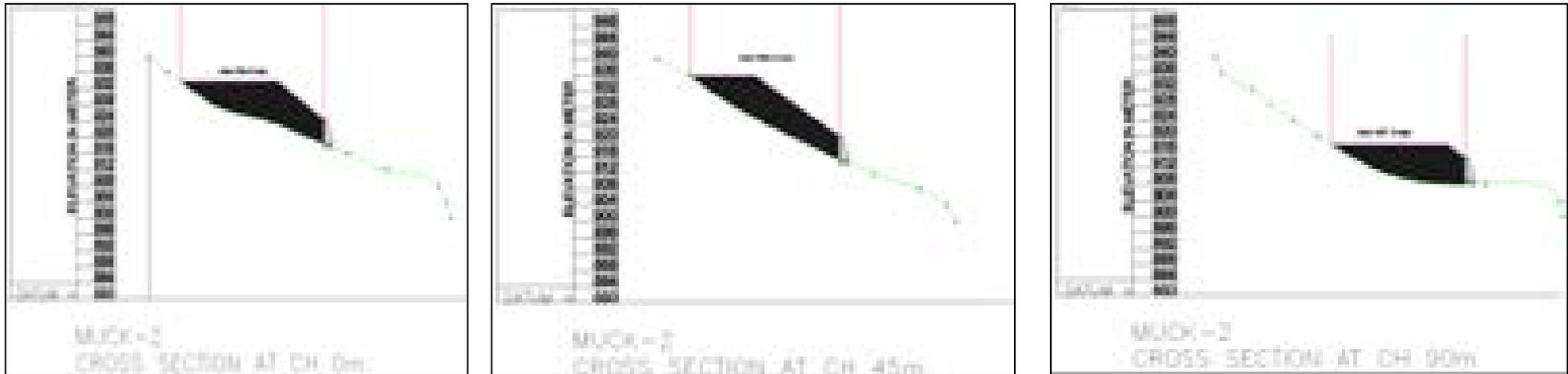


Figure 3: Cross Sections of the Muck dumping site D2

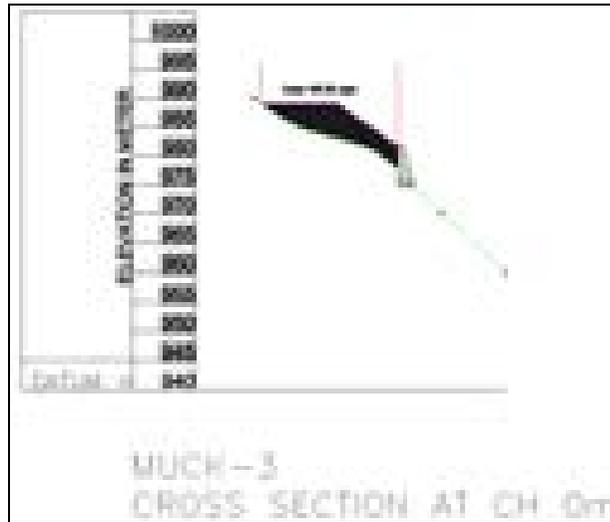


Figure 4: Cross Sections of the Muck dumping site D3

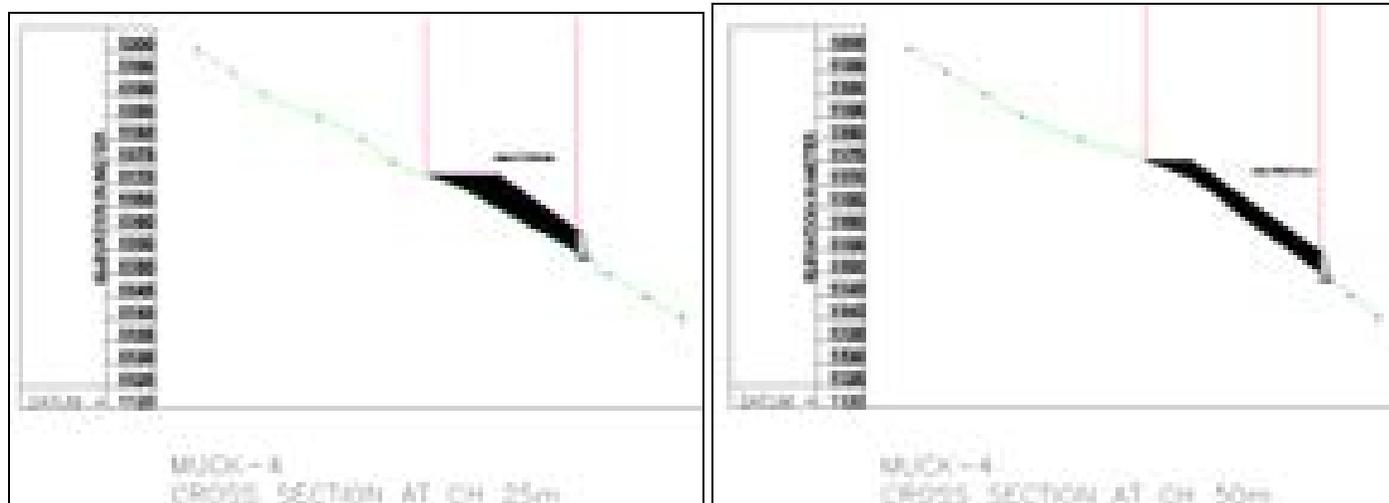


Figure 5: Cross Sections of the Muck dumping site D4

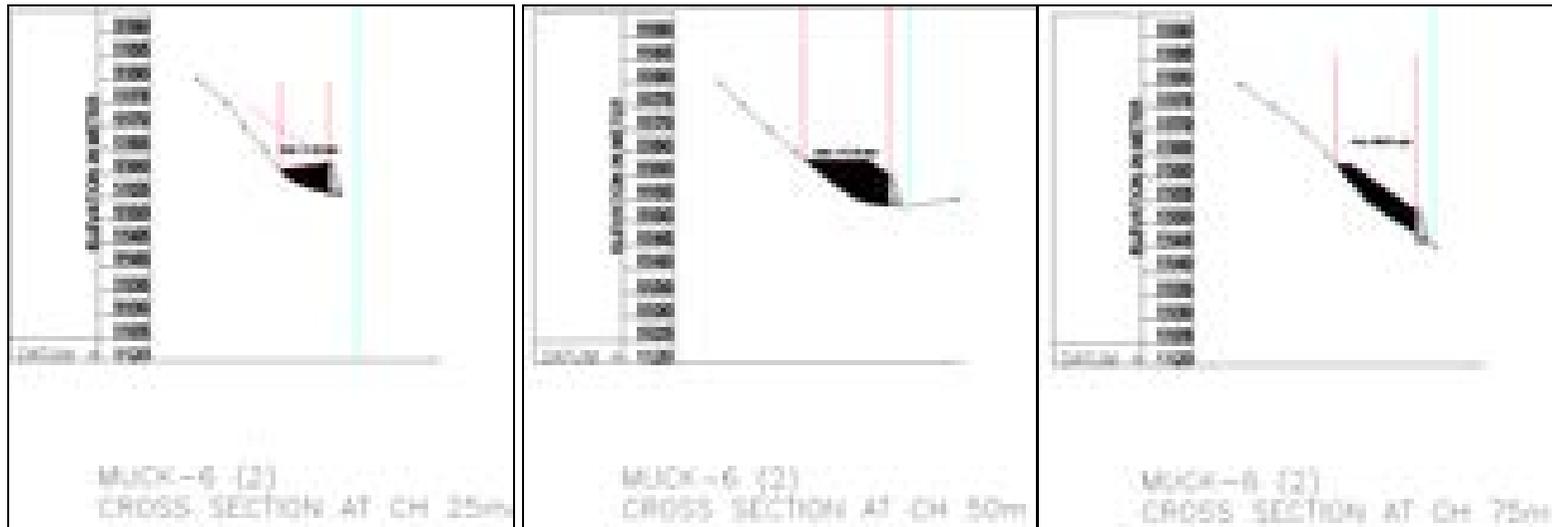


Figure 6: Cross Sections of the Muck dumping site D6

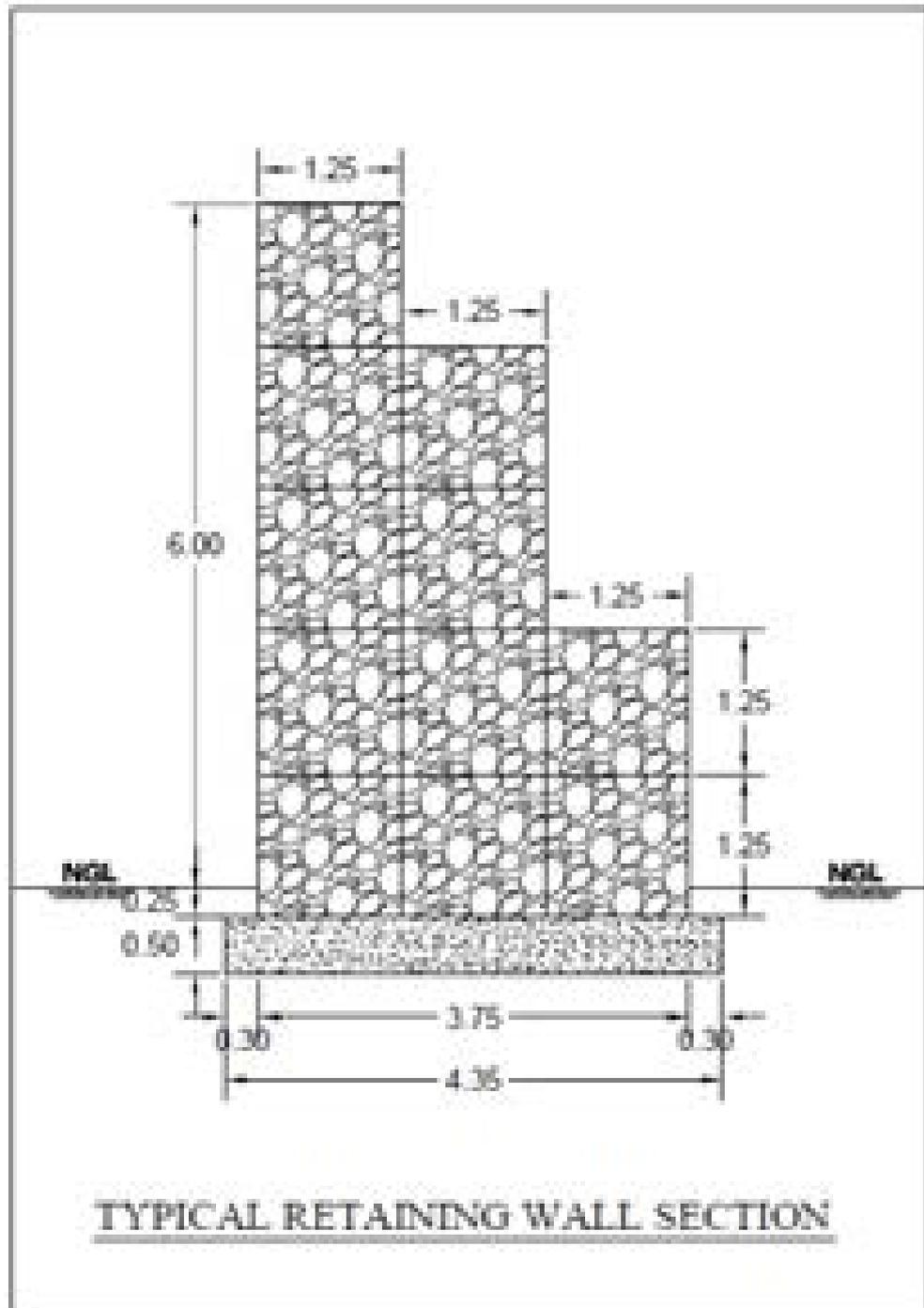


Figure 7: Cross Sections of the proposed retaining wall of muck dumping yard

## 5.0 REHABILITATION OF DUMPING SITES

The project authorities would ensure that the dumping yards blend with the natural landscape to develop the sites with gentle slopes, bunds, terraces, water ponds, and patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist spots with sufficient greenery by planting ornamental plants. The re-vegetation of dumping yards through 'Integrated Biotechnological Approach' would be undertaken. It may be necessary to inoculate the spoil dumps for development of landscape as the soils would be poor in nutrients. This can be developed through culture of microorganism or vermiculture practices at the nurseries developed for this purpose.

All the spoiled areas will be developed as per the latest technology of dumping, impact of rain, time and angle of soil setting. In addition sprinkling of water may also be resorted to, if required to avoid or minimize dust pollution. Proper drainage system also has to be provided to ensure unobstructed flow of runoff. Planting with suitable species of trees, shrubs and other biomass will also be initiated.

The following engineering and biological measures have been proposed for the development of spoiled areas.

## 5.1 Engineering Measures

For stacking of dumped material retaining wall is proposed to be built before dumping of any material on to the sites (**refer Figure 7**). In all total length of about 1096 running meters (rmt) of retaining walls would be required to be built wall (for details see table below).

S.No.	Dumping Yard	Length of Retaining Wall (in Running meters)
1	Dumping Site MD1(1)	145
	Dumping Site MD1 (2)	106
2	Dumping Site MD2	167
3	Dumping Site MD3	90
4	Dumping Site MD4	120
5	Dumping Site MD5	203
6	Dumping Site MD6 (1)	135
	Dumping Site MD6 (2)	130

In addition, leveling would also be done after dumping the material on every cycle and simultaneously improving the drainage of the disposal site. All the approach roads to various project structures will be constructed by employing the methodology recommended by National Highway with minimal environmental damage. The methodology consists in developing the formation width is half cutting and half filling, so that the materials obtained from cutting are utilized in filling. The excavation on hill side will be done to get a stable slope for the materials encountered. At places breast wall, gabion walls shall be done in natural slope to retain filled material, particularly where there is problem of retaining the hill slope.

To minimize the environmental damage, construction material like stones, sand, etc., required for the construction of road will be obtained mostly from the excavated material. In the streams, box culverts will be provided to prevent the erosion of nala bed. In addition, stone/concrete work on the downstream area will also be provided at vulnerable places to minimize erosion.

### i) Retaining Walls

Total area for the dumping of muck is **1.8055 ha** which can accommodate more than **52907 cum** whereas the estimated muck to be disposed is less than that i.e. **51248 cum**. The total length of retaining walls proposed to be constructed along the river at different muck dumping site would be about **1096 m**. Total financial outlay for the retaining walls is **Rs.40.00** lakhs and details are given in **Table 3**.

**ii) Compaction & Levelling**

Compaction is an engineering measure, which would reduce bulk density of the muck thereby optimising the use of muck disposal area and would make it suitable for the plantation and other biological measures. Top surface would be levelled and graded to make the alternative use. The muck will be spread in 50 cm thick layers. Top surface would be levelled and graded to make the alternative use. On top a layer of soil would be spread to make the land suitable for plantation. The total cost for the process of compaction is **Rs.20.00 lakhs.**

**iii) Fencing**

Fencing is a bio-engineering measure. After rehabilitation of muck the dumping areas need protection for some time from disturbing by human and domestic animals. For this reason fencing over the muck deposits is required. Barbed wire strands with two diagonal strands, clamped to wooden/ concrete posts placed at 3m distance are proposed around the dumping piles. Project authorities will establish temporary wind barriers around 3 sides of dumps in close of settlement area.

The muck is proposed to be filled in layers properly compacted. The cost of the same has been given in **Table 3**. In addition catch water drains are also proposed to be built and levelling of soil would also be done after dumping the material on every cycle and simultaneously improving the drainage of the disposal site. The estimated cost of engineering measures would be **Rs. 102.19 lakhs.**

**Table 3: Cost of Engineering Measures**

S. No.	Description	Qty (Cum)	Unit	Rate (Rs)	Amount (Rs in lakh)
I	Construction of Retaining Wall				
	1) Excavation	2000	cum	200	4.00
	2) PCC	500	cum	3700	18.50
	3) Stone craters in wire nets	3000 approx.	cum	3500	105.00
	Subtotal (1, 2 &3)				<b>127.50</b>
	Contingencies and Fencing, etc. @ 3% of cost of works				3.83
	<b>Sub-total-I</b>				<b>131.33</b>
II.	Construction of check dams along periphery of muck disposal sites				15.00
III.	Site Clearance for dumping area and compaction for different layers and levelling – Lump sum				15.00
IV.	Construction of drainage channels (1000 rmt)				10.00
	<b>Grand Total (I+II+III+IV)</b>				<b>171.33</b>

**5.1.1 Biological Measures**

Top surfaces and slopes of all dumping areas would be left with a total area of about **1.8055 ha**. These areas will be treated for the purpose of plantation. Vegetation cover controls the hydrological and mechanical effects on soils and slopes. Therefore, biological measures to stabilize the loose slope are essential. In order to implement the biological measures in dumping areas the following activities would be taken into account. The biological measures include the following:

**i) Soil treatment**

Muck dumped at various sites is not considered to be nutrient rich as it is excavated from tunnels and other structures. In order to make it suitable for the plantation it will be provided bio treatment. The work plan will be formulated for re-vegetation of the dumping sites through Integrated Biotechnological Approach.

**ii) Plantation**

The selected species will be planted after their nurseries have been developed. The dumping areas are very small therefore; separate nursery would not be required. The nurseries developed for the implementation of CAT plan can be used for the rehabilitation of dumping areas. Nearly 1-2 years old saplings would be used for the plantation. The plantation can be carried out in lines across the slopes. Grass and herb species would be used in the inter space of tree species. They will help in providing the continuous chain of support in retaining debris, reinforcing soil and increasing the infiltration capacity of the area.

After the completion of muck dumping process and compaction area of 1.8 ha will be available for the plantation. About 900 saplings will be planted at these dumping sites.

In order to stabilize the stacked dumped material, vegetation cover would be provided to hold dumped material over a period of time. Following steps are envisaged:

- Plantation of suitable tree species and soil binding using bio-fertilizer technology.
- Turfing of the exposed area and improvement of environment with ornamental species.
- Protection with mechanical support.
- Social fencing through mass public awareness.

The work plan formulated for re-vegetation of the dumping sites through 'Integrated Biotechnological Approach' is based on following parameters:

- i) Evaluation of dumped material for their physical and chemical properties to assess the nutrient status to support vegetation.
- ii) Formulation of appropriate blends of organic waste and soil to enhance the nutrient status of rhizosphere.
- iii) Isolation and screening of specialized strains of mycorrhizal fungi, rhizobium, azotobacter and phosphate solubilizers (bio-fertilizers inoculum) suitable for the dumped material.
- iv) Mass culture of plant specific bio-fertilizer and mycorrhizal fungi.
- v) Plantation of dumping sites using identified blend and bio-fertilizer inoculum.

The afforestation with suitable plant species of high ecological and economic value which can adapt to local habitat will be undertaken with 400-600 plants per hectare depending upon the canopy cover required. Major tree species which would be planted are *Albizia odoratissima*, *Albizia procera*, *Altingia excelsa*, *Brassaiopsis aculeata*, *Bischofia javanica*, *Castanopsis armata*, *Actinidia callosa*, *Kydia calycina*. The shrubs are planted in between the trees are *Bamboo spp.*, *Boehmeria macrophylla*, *Cinnamomum glaucescens*, *Debregeasia longifolia*, etc. A list of plant suggested for re-vegetation of spoil dumps is given below.

S. No.	Family	Name of species
<b>Trees</b>		
1	Betulaceae	<i>Alnus</i> spp.
2	Calophyllaceae	<i>Mesua ferrea</i>
3	Combretaceae	<i>Terminalia myriocarpa</i>
4	Elaeocarpaceae	<i>Elaeocarpus angustifolius</i>
5	Euphorbiaceae	<i>Phyllanthus emblica</i>
6	Fagaceae	<i>Castanopsis armata</i>
7	Altingiaceae	<i>Altingia excelsa</i>
8	Hamamelidaceae	<i>Exbucklandia populnea</i>
9	Lauraceae	<i>Beilschmiedia roxburghiana</i>
10	Magnoliaceae	<i>Magnolia hodgsonii</i>
11	Magnoliaceae	<i>Michelia champaca</i>
12	Malvaceae	<i>Kydia calycina</i>
13	Meliaceae	<i>Toona ciliata</i>
14	Mimosaceae	<i>Albizia lebbeck</i>
15	Moraceae	<i>Artocarpus lakoocha</i>
16	Myrtaceae	<i>Syzygium cumini</i>
17	Sterculiaceae	<i>Pterospermum acerifolium</i>
<b>Shrubs</b>		
1	Lauraceae	<i>Cinnamomum glaucescens</i>
2	Liliaceae	<i>Asparagus racemosus</i>
3	Poaceae	<i>Bambusa</i> spp.
4	Primulaceae	<i>Ardisia macrocarpa</i>
5	Rosaceae	<i>Rosa</i> spp.
6	Rubiaceae	<i>Mussaenda roxburghii</i>
7	Rutaceae	<i>Murraya paniculata</i>
8	Urticaceae	<i>Boehmeria macrophylla</i>
9	Urticaceae	<i>Debregeasia longifolia</i>
<b>Herbs</b>		
1	Amaranthaceae	<i>Achyranthes aspera</i>
2	Urticaceae	<i>Aboriella myriantha</i>
3	Nyctaginaceae	<i>Boerhavia diffusa</i>
4	Poaceae	<i>Cynodon dactylon</i>
5	Poaceae	<i>Capillipedium assimile</i>
6	Poaceae	<i>Chrysopogon gryllus</i>
7	Poaceae	<i>Saccharum</i> spp.
8	Poaceae	<i>Thysanolaena latifolia</i>
9	Saxifragaceae	<i>Bergenia ciliata</i>

**Table 4: Total financial outlay for the biological measures at dumping sites**

S. No.	Particulars	Quantity	Rate (in Rs.)	Amount in Lakhs
1	Plantation	2 ha	54117/ ha	1.08
2	Maintenance for 4 years	2 ha	31404	0.63
3	Wages for plantation watchman (1 no. for 5 years)	2 ha	8000/ month	4.80
<b>Total</b>				<b>6.51</b>

## 6.0 MONITORING & COMPLIANCES

Muck shall be dumped from bottom in layers of 50-70 cm depending on size of boulders.

- i) Each layer shall be rolled compacted.
- ii) A layer of soil shall be spread on top of it to make it suitable for plantation.
- iii) Water testing facilities shall be set up for checking quality parameter of water.

- iv) Soil samples shall be regularly collected and tested for checking the level of contamination.
- v) Prescribed norms and approvals will be sought from SSPCB wherever necessary.
- vi) All norms of Forest department, SSPCB and MoEF&CC and their acts related to muck disposal shall be complied with.
- vii) Design consultant shall be engaged for designing of retaining structures.
- viii) Plantation shall be done on the reclaimed land and native variety of plants and trees shall be planted.

## 7.0 FINANCIAL REQUIREMENT

The estimated cost of the relocation and rehabilitation of excavated material is given in **Table 5**. The total cost of these measures will be **Rs. 178.00 lakhs**.

**Table 5: Financial requirements for implementation of Muck Disposal Plan**

S. No.	Item	Amount (Rs.in lakhs )
1	Engineering measures	171.33
2	Biological measures	6.51
	<b>Total</b>	<b>177.84</b> <b>Say 178.00</b>