CHAPTER - 6

MUCK MANAGEMENT PLAN

6.1 GENERAL

For construction of different components of the project substantial surface and underground excavation in over burden and rock for intake structure tunnel, balancing reservoir and powerhouse etc. would be required. The excavation shall result in large quantity of excavated material i.e. muck which shall have to be evacuated, disposed off and roller compacted or laid on mild slopes pari-passu with the excavation work, to such designated areas where the muck piles do not substantially interfere with either environment / ecology or the river flow regime and cause turbidity impairing the quality of water. The disposal of muck has to be scientifically planned keeping in view the pecuniary aspects necessitating nearness to the generating component of work, which understandably reduce the travel time of dumpers, interference to surface flow and ground water aquifer, disposition of sedimentation are a few aspects borne in mind in evolving a muck management plan. The Hydro Power policy, 2006 of Himachal Pradesh government under Chapter-V para (XXIV) lays down that the company shall use such material for the project activities as may be found suitable for construction and the remaining material shall be allowed to be used by other development departments like PWD, I & PH etc. Even the private crusher owners etc and private users shall also be allowed to use such material from the site free of cost. In the present case it is proposed to utilize about 25% of the excavated material on the project activities and about 10% of the muck generated through free-of-cost lifting by other Government agencies and private users. The balance 65% shall have to be disposed off away from sites so as to make available the clear site for construction activities. The balance muck shall be properly stacked and roller compacted or laid on slopes and treated to mix and match with the surrounding environment with least change in landscape.

Based on the quantities of surface and underground excavation including 10% over break as contained in DPR a muck management plan, therefore, has been formulated to manage the disposal of muck and restore such areas from further degradation of the environment. During construction of the project huge quantities of excavation will be carried out from the underground and open air components and shall be either roller compacted to provide stable terraces for erection of labour camps, job facilities and storage area, or dumped in designated areas to provide stable slopes as per details given in **Table 6.1**.

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Table-6.1: Component Wise Details of the Muck Generated and Its Utilization

Sl. No.	Description of Components	Qty of muck generated (cum)	Qty of muck to be utilized (cum)	Qty of muck to be dumped on compact basis (10% voids)	Qty of muck to be dumped on basis of 40% swell factor (cum)	Dumping area	Remarks
	Stage-I						
1	Trench weir	1544	-	1698	-	D-9	Disposed muck shall be roller compacted to provide platform camp and job facilities
2	Conveyance Channel	26247	-	28872	-	D-9	do
3	Desanding arrangement	84728	-	93201	-	D-9	do
4	Power channel	32452	-	35697	-	D-9	do
5	Head race tunnel	47523	-	52275	-	D-9 & D-10	do
6	Balancing reservoir	51893	-	57082	-	D-10	do
7	Pressure shaft	16302	8151	8967	-	D-10	do
8	Power house	38912	15565	-	32685	D-11	40% to be used in cc
9	Transformer hall	105471	52736	-	73829	D-2, D-3	50% to be used in cc and retaining wall
10	Main access tunnel	11344	3403	-	11117	D-11	30% to be used in cc
11	Tail race tunnel	11624	-	-	16273	D2, D3	100% to be dumped
12	Other adits & tunnel	64184	64184	-	-		100% to be utilized in filling in roads and walls
	Total	**492224**	**144039**	**277792**	**133904**	-	-
	Stage-II & III	-	-	-	-	-	
1	Trench weir	1776	-	1954	-	D-1	100% muck shall be dumped and roller compacted
2	Adits at intake, Lappo	44534	-	48988	-	D-1	do
3	Conveyance Channel	3127	-	3440	-	D-1	do
4	Desanding basin	34460	-	37906	-	D-1	do
5	K K link tunnel	156244	4775	59408	-	D-1,	3% shall be utilized and rest shall be roller compacted
		-	-	107208	-	D-9 & D-10	100% shall be roller compacted

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6	Balancing reservoir-III	144464	65687	0	110288	D-4 D-5, D-6, D-7 & D-11	45.46% to be used in cc work
	Total	**384605**	**70462**	**258904**	**110288**	-	-
	Stage-IV	-	-	-	-	-	-
1	Trench weir	13396	6698	-	9377	D-12	50% to be used in cc and retaining wall
2	Conveyance tunnel	4718	-	-	6605	D-12	100% shall be dumped
3	Desanding basin and connecting tunnel	36508	-	-	51111	D-12	-100% shall be dumped
4	Head race tunnel	101312	30394	-	99285	D-12	30% to be used in aggregate in cc work and balance to be dumped
5	Pressure shaft	3185	956	-	3121	D-13	do
6	Power house complex	25163	7549	-	24659	D-13	do
7	Transformer hall	23614	7084	-	23142	D-13	do
8	Main access tunnel	25298	7589	-	24793	D-13	do
9	Tail race tunnel	2575	773	-	2523	D-13	do
10	Adits	61297	18389	-	60071	D-13	do
	Total	**297066**	**79432**	-	**304687**	-	-
	Grand Total	**1173895**	**293933**	**536696**	**548879**	-	-

6.2 QUANTITY OF MUCK GENERATED AND ITS CONSUMPTIVE USE

It is eloquent from Table 6.1 that 1173895 cum of muck will be generated due to excavation, out of which 229749 cum is proposed to be re-utilized as construction material for consumptive use in non wearing surface like back fill, shotoreting and plumb concrete in construction of water conductor system like HRT, balancing reservoir, pressure shaft, MAT, TRT, other adits and in development works. Besides this 64184 cum muck obtained from excavation of other adits and tunnels shall be fully utilized in construction of approach roads/haul roads, thus the total quantity of muck to be utilized on works aggregates to 2,93,933 cum leaving the remaining 8,79,962 cum quantity to be disposed off at thirteen various sites besides allowing for disposal of approx 88000 cum quantity through free of cost lifting by other Govt. development agencies and individuals. Thus the total disposal of muck at the designated sites shall be to the tune of 7, 91,962 cum. The disposed

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muck at three sites viz. D-1, D-9 and D-10 shall be roller compacted to develop terrace for erecting labour camps, site offices, storage yards and other job facilities. Therefore, 3,99,904 cum quantity of muck to be dumped and managed in these three sites have been adopted on compact basis whereas the balance muck quantity 3,92,058 cum which works out to 5,48,879 cum with 40% swell factor shall be disposed on slopes of hill at identified ten dumping locations well supported at base by suitable retaining structures. Subsequently all the spoil tips (muck disposal sites) will be developed by taking up plantation through bio-technological method to generate a thick forest canopy over them. The location of various dumping sites is depicted in Figure-6.1.

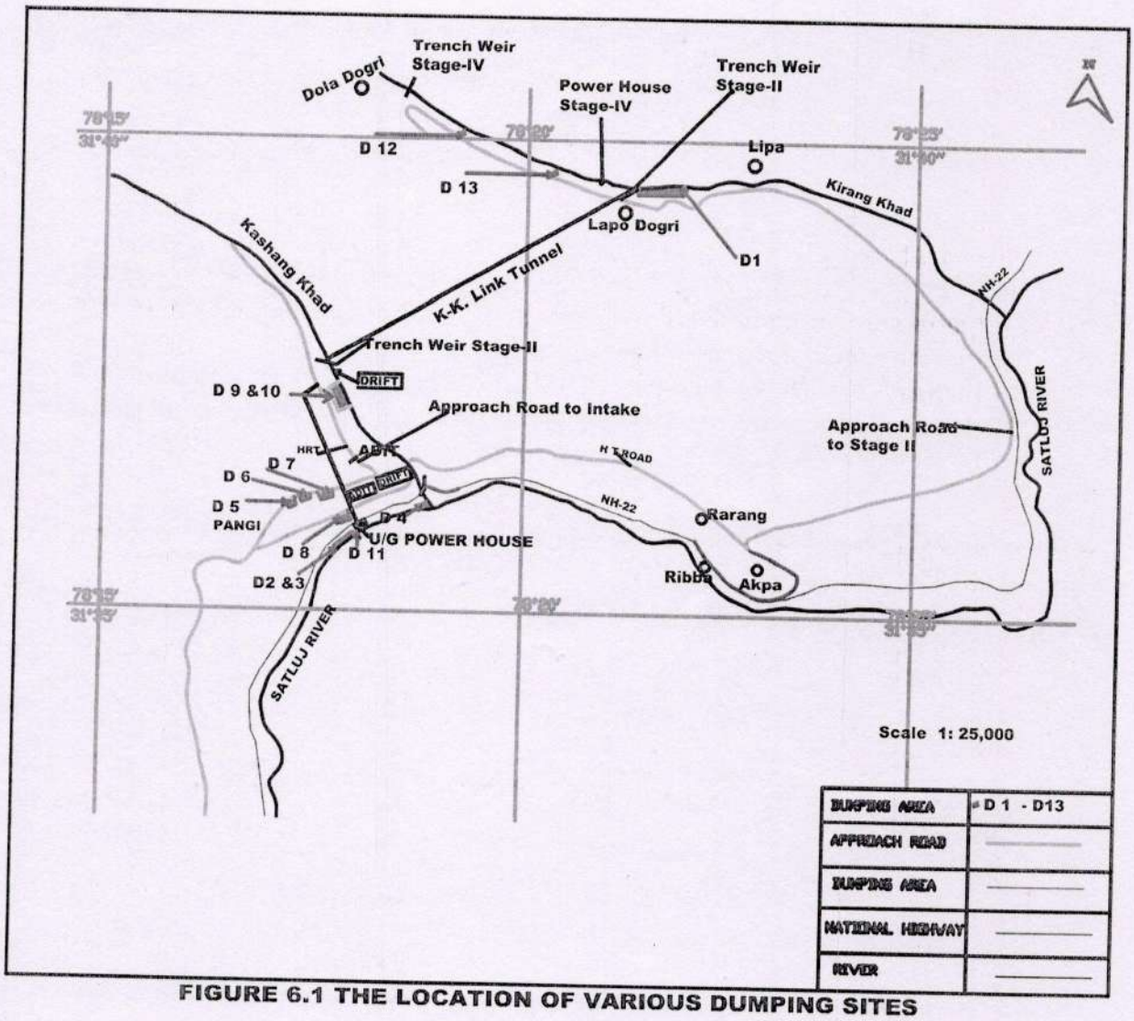

FIGURE 6.1 THE LOCATION OF VARIOUS DUMPING SITES

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The selection of muck disposal sites was carried out considering the quantity of the muck, landscape, cost effectiveness, nearness to source of generation, absence of ground and surface water, relief and scope for afforestation works. The details of dumping sites along with their total capacity and amount of muck to be disposed are enumerated in **Table 6.2**.

Table 6.2: Muck Disposal Site Details

Sl. No.	Location of Dumping Site	Area in Ha	Capacity in cum	Quantity to be dumped in cum	Height of dump (m)	Remarks
1.	D-1 located on right bank of Kerang Khad, 500 m d/s of intake of Stage-II	2.3695	166000	137904	7.0	The dumped muck shall be roller compacted
2.	D-2, D-3 and D-11 located below NH-22 and approach road to power house and above river Satluj	1.2702	181130	181130	7.50	Quantity is on swell basis
3.	D-4, located below NH-22 and in area between right bank of Kashang Khad on right bank of Satluj	0.4936	10000	8000	4.00	Quantity is on swell basis
4.	D-5, D-6 and D-7 located below Pangi Intake road between RD 3.12 km to 3.435 km.	0.7666	20000	19624	5.00	Quantity is on swell basis
5.	D-8 located below old HT road	0.7000	36000	35438	7.50	Quantity is on swell basis
6.	D-9 and D-10 located near intake of Stage-I	11.1299	400000	350000	4.00	The dumped muck shall be roller compacted
7.	D-12 and D-13 on right bank of Kerang Khad below intake of Stage-IV	5.0800	320000	304687	6.00	Quantity is on swell basis
	Total	21.8098	11133130	1036783		

6.3 DESCRIPTION OF MUCK DISPOSAL SITES

6.3.1 Muck Disposal Site D-1

The proposed disposal site is located about 500 m d/s of intake of stage-II on right bank of Kerang Khad in village Lappo. The designated site is located in forest area and for which diversion of 2.3695 ha of forestland is proposed. The dimension of the proposed site is 312 m long and 68 m average width and

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with 7 m average height it has capacity to hold 1,66,000 cum of muck against which 1,37,904 cum quantity obtained from excavation of trench weir, adits at intake, conveyance channel, descending basin and part of excavation of K-K Tunnel, Stage-III to the tune of 54,007 cum shall be disposed off and properly retained. The general view of the site is shown in **Figure 6.2(a)** and **Figure 6.2(b)**.

6.3.2 Muck Disposal Sites D-2, D-3 and D-11

All these sites are located below approach road to power house area which in turn is located below NH-22 and are about 8 km distance from Reckong Peo. The site D-2 and D-3 are contiguous while D-11 is 400 m from power house. All these sites are overlooking river Satluj and have a combined capacity of holding 1, 81,130 cum of muck to be brought from excavation of power house, transformer hall, MAT, TRT and part of excavation of balancing reservoir. Diversion of 1.2702 ha of forestland for these sites has already been sanctioned. The general view of the site is shown in **Figure 6.3** and **Figure 6.4**.

6.3.3 Muck Disposal Site D-4

The site is located below NH-22 and is below the road bridge in an area covered between right bank of River Satluj and Kashang Khad. The dimensions of the proposed site are 80 m x 50 m and with an average height of 4.0 m of dump, the storing capacity works out to 8000 cum. The site is designated to receive part muck from balancing reservoir. The Diversion of 0.4936 ha of forestland for the site has already been sanctioned. The general view of the site is shown in **Figure 6.5**.

6.3.4 Muck Disposal Site D-5, D-6 and D-7

These sites are located below Pangi – Intake road of Stage-I in between RD 3.12 km to 3.435 km and have dimensions 87.5 m x 40 m, 77.5 m x 30 m and 45 m x 45 m respectively. With an average height of 5 m of dump, the combined capacity is about 20000 cum. The site is about 3.5 km from intake and lies in forest. The diversion of 0.7666 ha of forestland for these sites has already been sanctioned. The general view of these sites is shown in **Figure 6.6, Figure 6.7 & Figure 6.8**.

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Figure 6.2(a): Muck Disposal Site D-1 (Part) near Lappo (Stage-II)

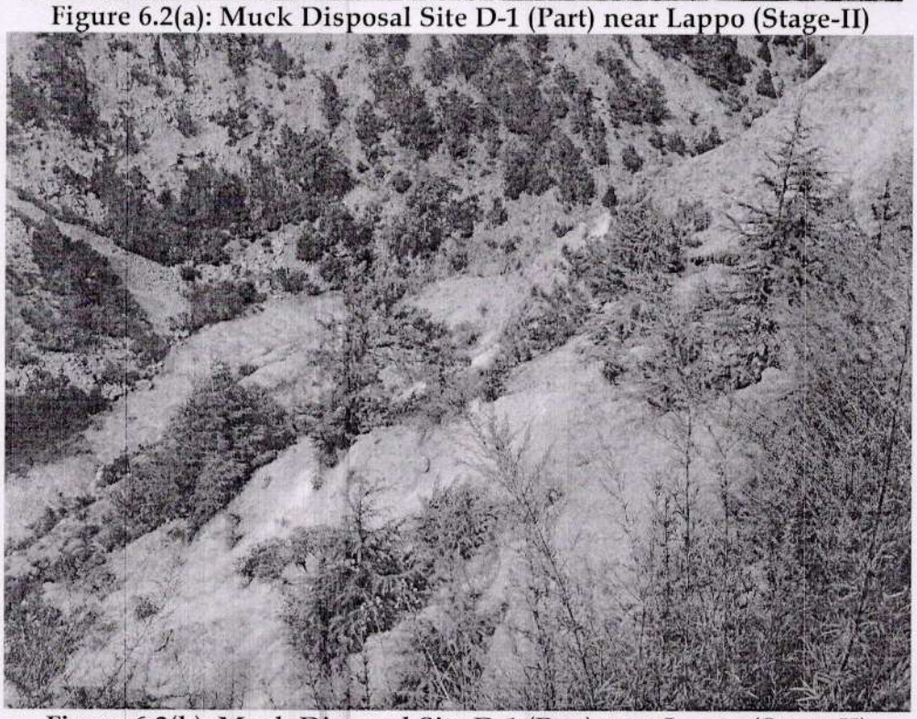

Figure 6.2(b): Muck Disposal Site D-1 (Part) near Lappo (Stage-II)

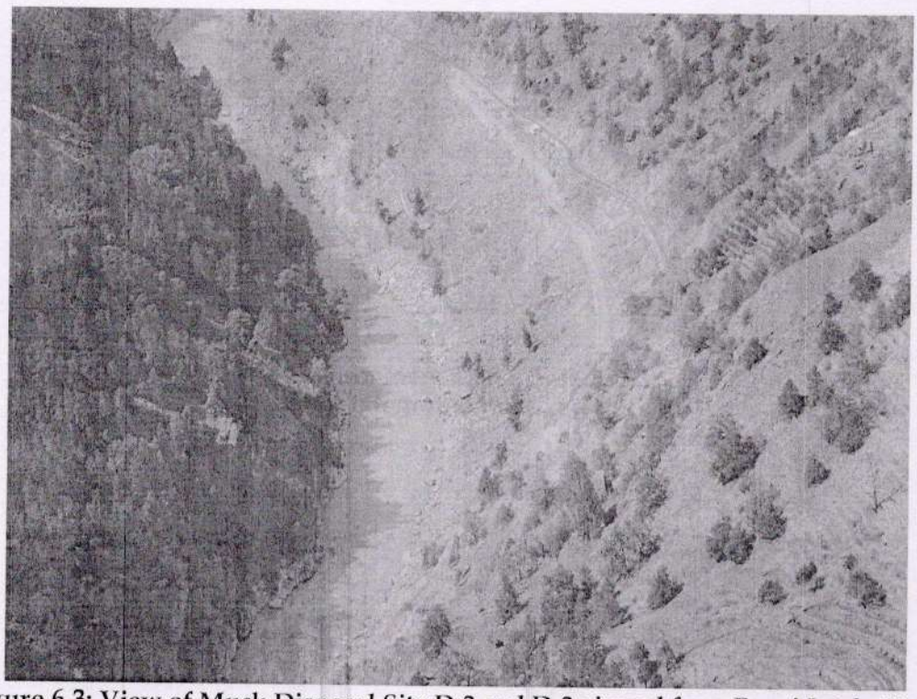

Figure 6.3: View of Muck Disposal Site D-2 and D-3 viewed from Pangi Intake Road

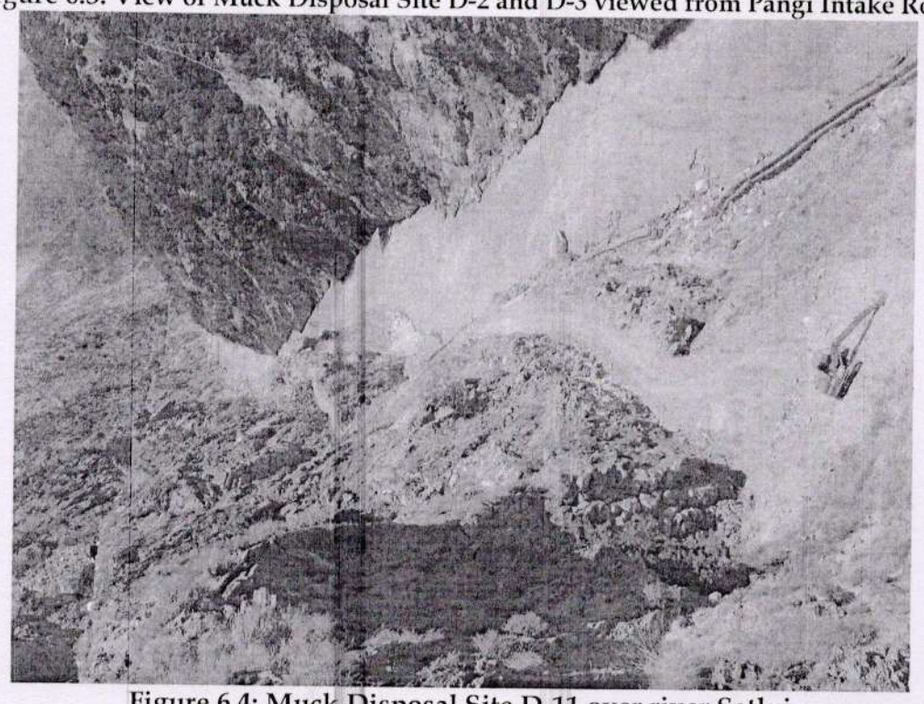

Figure 6.4: Muck Disposal Site D-11 over river Satluj

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Figure 6.5: Muck Disposal Site D-4 at confluence of Kashang Khad with river Satluj

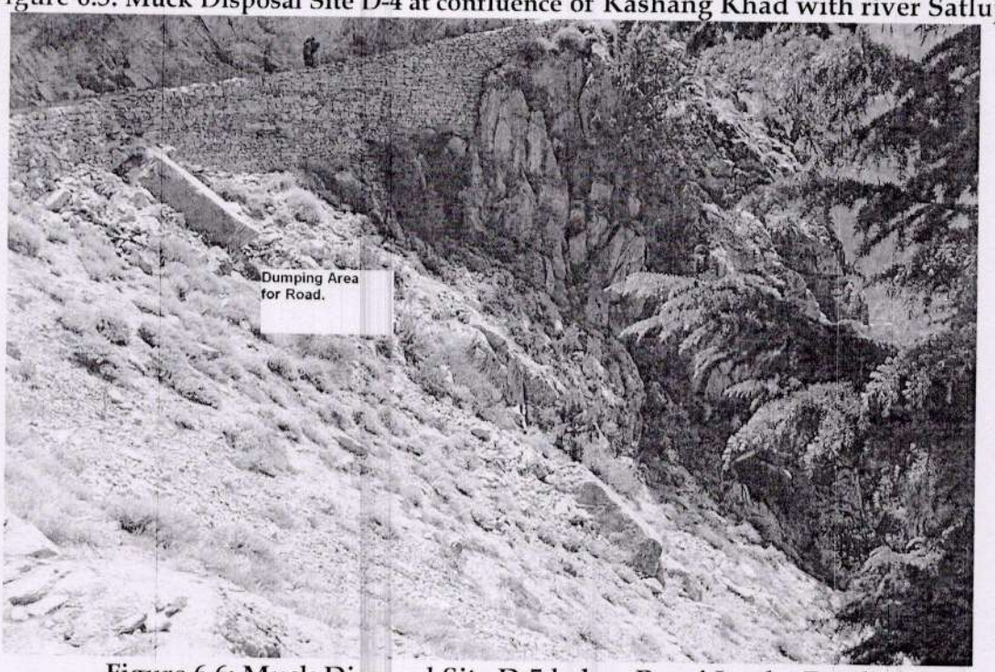

Figure 6.6: Muck Disposal Site D-5 below Pangi Intake Road

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Figure 6.7: Muck Disposal Site D-6 below Pangi Intake Road

Figure 6.8: Muck Disposal Site D-7 below Pangi Intake Road

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6.3.5 Muck Disposal Site D-8

The site is located below old Hindustan Tibet Road and is about 100 m away from portal of intermediate adit to pressure shaft of Stage-I project. The dimension of the dumpsite is 135 m x 70 m and with an average height of 7.50 m it can hold 35437 cum of muck. The site is designated to receive muck from balancing reservoir. The diversion of 0.7000 ha of forestland for the site has already been sanctioned. The general view of the site is shown in **Figure 6.9**.

6.3.6 Muck Disposal Site D-9 and D-10

The sites are located below proposed Pangi Intake road of Stage-I and are about 0.75 km away from intake on the right bank of Kashang Khad. The combined capacity of the dump area is about 4.0 lacs cum. The dumped muck shall be roller compacted to provide platforms for erection of labour camps, job facilities and storage areas etc. The dumping site extends over an area of 11.1299 ha comprising of 9.9465 ha of private land in "Mohal" Kashang Getenge and 1.1834 ha of forest land acceptance of whose diversion has already been accorded. The general view of the site is shown in **Figure 6.10**.

6.3.7 Muck Disposal Site D-12

The site is located on the right bank of Kerang Khad about 0.8 km downstream of intake and totally lies in the forest area. The quarry area will be about 2.6 ha and shall have a capacity of holding 1.70 lac cum of muck. The general view of the site is shown in **Figure 6.11**.

6.3.8 Muck Disposal Site D-13

The site is located on the right bank of Kerang Khad about 1.6 downstream of intake and totally lies in the forest area. The quarry area will be about 2.48 ha and shall have a capacity to hold 1.50 lac cum of muck. The general view of the site is shown in **Figure 6.12**.

6.4 IMPLEMENTATION OF ENGINEERING AND BIOLOGICAL MEASURES

As already explained engineering measures like providing GI wire crates and retaining walls and compaction of muck will provide stability to the profile of muck piles.

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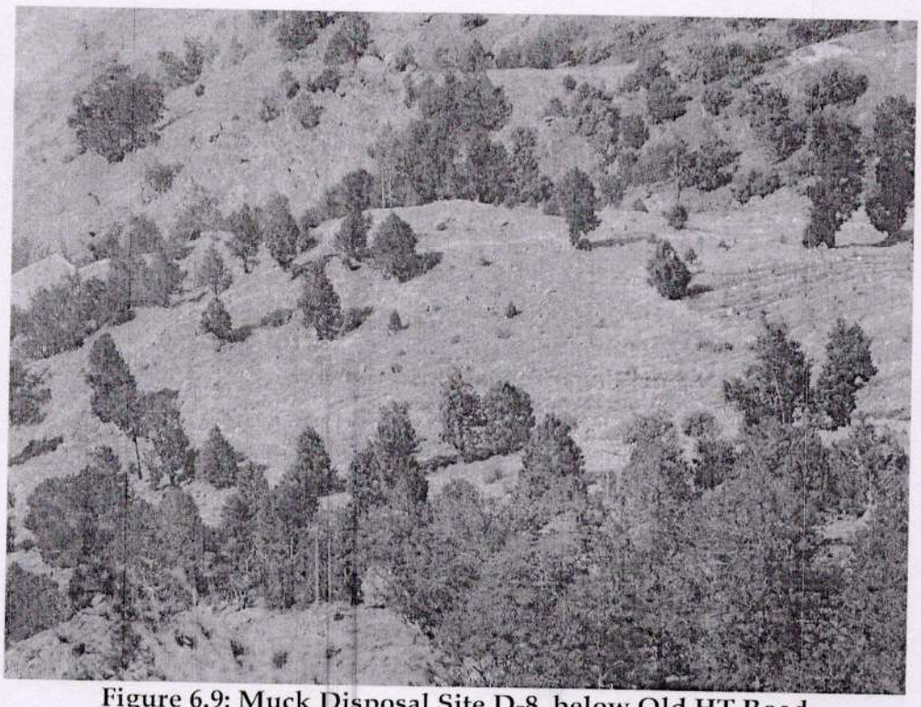

Figure 6.9: Muck Disposal Site D-8 below Old HT Road

Figure 6.10: Muck Disposal Site D-12

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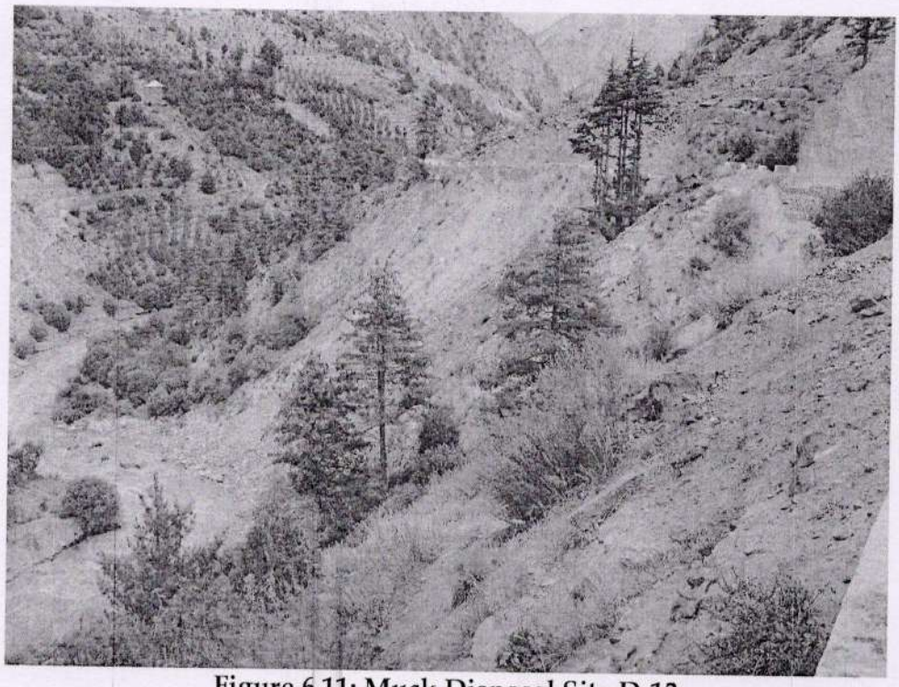

Figure 6.11: Muck Disposal Site D-13

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6.4.1 Engineering Measures

It has been observed that after excavation the disposal of muck creates problem as it is susceptible to scattering unless the muck disposal yards are supported with engineering measures such as retaining structures, crate walls and gabions. In the present case out of thirteen sites nine muck disposal sites viz. D-1, D-9, D-10, D-2, D-3, D-4 & D-11, D-12 & D-13 are proposed to be located near the river / stream banks and therefore, needs proper handling to avoid spilling of muck into the river water while dumping and in the post dumping stages. The muck disposal sites have to be developed from below the ground level by providing two rows of 3 m x 1.5 x 1.5 plum concrete (30%) launching blocks in front of 6 m high stone masonary (cm 1:4) retaining wall with 1:4 slope in respect of dump sites D-2, D-3, D-4 & D-11 all situated below NH-22 and one row of 3 m x 1.5 m x 1.5 m plum concrete (30%) launching blocks in front of 6 m high stone masonary retaining wall with 1:4 slope in respect of dump sites D-12, D-13 and D-1, D-9 and D-10 situated on the right bank of Kerang and Kashang Khad respectively. Proper weap holes with inverted filter behind shall be provided at a spacing of 1.5 m c/c. It is proposed to develop dumping sites D-12 and D-13 into terraces and restored by laying of soil on top, digging of pits and planting of saplings.

The dump sites D-5, D-6, D-7 and D-8 are not immediately located over river section and therefore, shall have to be developed from below by providing boulder wire crates of 8 SWG wire with 10 cm x 10 cm mesh size having dimension of 2.25 m x 1.25 m x 1.25 m. It is proposed to provide tiers of boulder wire crates with 0.4 m berm width. After placing of first tier of crates at the toe of muck disposal site, the muck brought in dumpers shall be dumped and manually spread behind the crates in such a manner that rock mass is properly stacked behind the crates with minimum of voids. The slope surface shall be developed by turfing.

The typical cross section of the dumpsite supported by retaining wall and boulder wire crates is shown in the following Figure.

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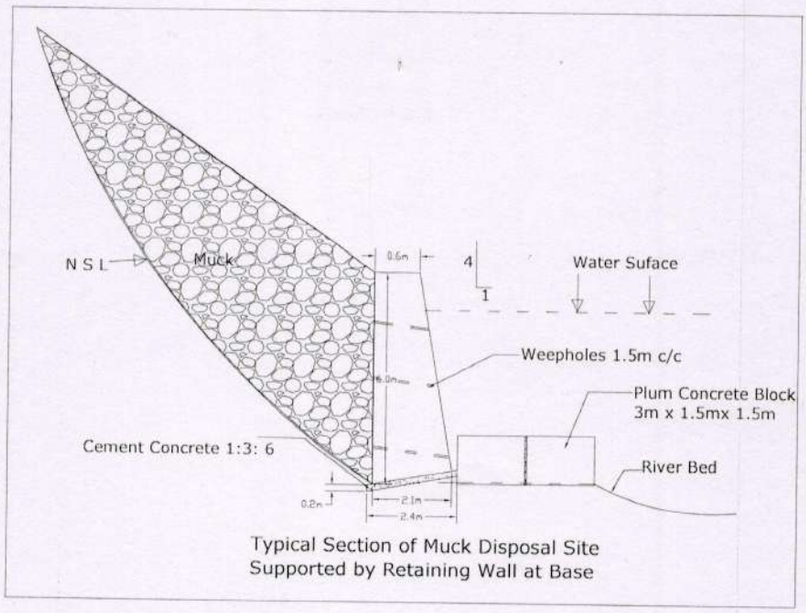

Figure: 6.12: Typical Section of Muck Disposal Site Supported by Retaining Wall at Base

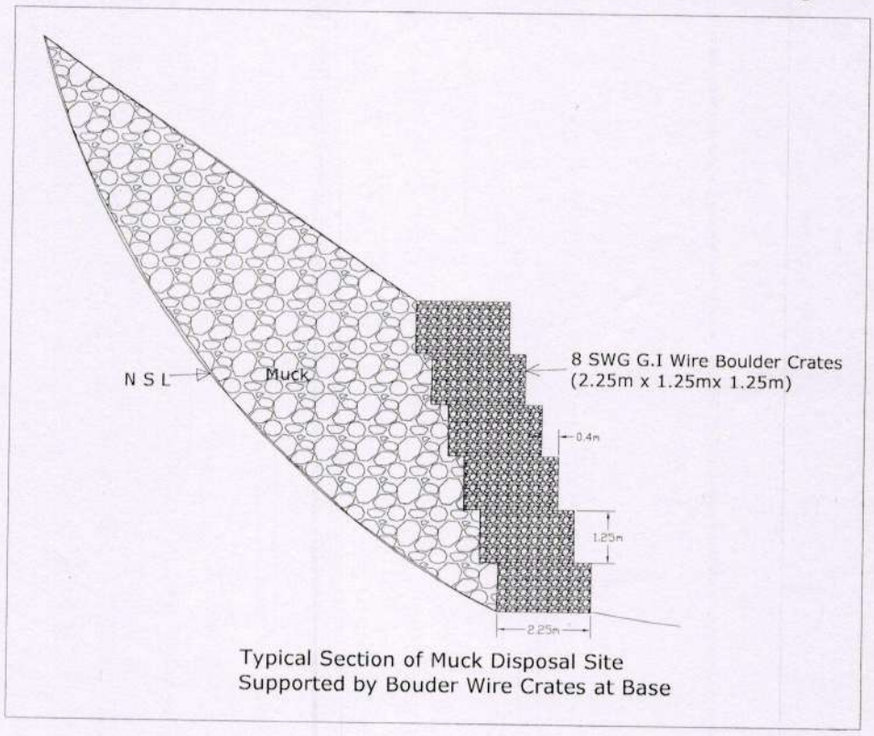

Figure: 6.13: Typical Section of Muck Disposal Site Supported by Boulder Wire Crates at Base

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6.4.2 Biological Measures

Biological measures, however, require special efforts, as the muck disposed in disposal yards will in general be devoid of nutrients and soil contents to support vegetation. The selection of soil for spreading over such an area would require nutrient profiling of soil for different base elements. Suitable ad mixture of nutrients would be done before placing the soil on the top surface of muck disposal areas to have administered growth of forest canopy.

6.4.2.1 Plantation Technique

In view of the peculiar site conditions particularly the soil conditions, the planting technique for all the categories of the plants has to be very site specific and suited to the stress conditions as anticipated and discussed above. The planting substrates would need to be considerably improved to support the plants in their initial stages of establishment. The moisture retention capability, availability of nutrients and soil aeration, permeability and porosity would require intervention and assistance.

Multistoried and multipurpose plantations are proposed to be raised on the muck dumping sites as also in road side strips using grasses, shrubs and bushes in the under storey and trees in the upper storey. Nursery raised grass slips, seedlings of shrubs & bushes and trees species would be planted in the area combined with grass sowing in patches. In addition, cuttings of bushes and shrubs can also be planted to supplement the nursery raised stock but this would substitute requirement of raising the nursery of these species. Intimate mixture of species would be avoided right at the planning stage and would be strictly followed during planting. Each patch should contain maximum of two species. Grasses would be mixed by groups in rows, shrubs and bushes by group again in rows.

Grass slip planting and grass seed sowing would be done in strips at 0.10 m x 0.10 m spacing in the prepared staggered patches of 1 m x 0.5 m with a depth of 0.30 m. Soil mixture would be used while filling the patches. Balance dug up soil/muck will be stacked along the patch on the downhill side for rain water tapping and enhanced percolation in the patch. Number of such patches in each hectare is proposed at 500.

Shrubs and bushes would be planted in elongated strips of 1.5 m x 0.5 m with a depth of 0.45m. Soil mixture would be used while filling the patches. Balance dug up soil/muck will be stacked along the patch on the downhill side for water tapping and better percolation in the patch. These would be staggered throughout the area numbering 500 per hectare. Each patch would have two row of planting with staggered spacing between plants in a row as 15 cm and distance between rows as 15 cm.

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Planting of trees would be done in contour staggered pits of 0.60 m x 0.60 m x 0.60 m size numbering 800 per hectare. Out of these 800 plants, about 200 plants per hectare are meant for planting along the periphery of the area. If the periphery gets filled up with lesser numbers, the remainder would be planted in the core/main area. Soil mixture would be used while filling the pits. Balance dug up soil/muck will be stacked on downhill side of the pit for trapping the rain water and allowing it to percolate in the pit.

It is proposed to use soil mixture in the pits & patches consisting of soil imported from nearby areas mixed with compost or human or vermin-compost or all of these. The ratio for the mix would be 5 parts: Compost/manure 2 parts: Sand 2 part: and humus or vermin-compost 1 part. This will make nutrients really available for the plants in the preliminary stages and also help to increase soil aeration, porosity & permeability and improved moisture available for the plants.

The stabilization sites from the time of execution of biological measures would be protected with barbed wire fencing on 2m. high RCC posts and provided with inspection paths. Since the muck dumping sites are being provided with either RCC walls or the wire crate (gabion) wall on the valley side (towards river) which is not negotiable by animals and human being, fencing would not be required along the entire perimeter. Hence, it would be done on the vulnerable sections i.e. towards the hillside only.

The proposed costs include nursery costs for initial planting and also for mortality replacement.

The biological measures shall be taken up towards the end of construction. The plantations would be maintained for a period of 5 years by irrigating the plantation during dry seasons, mortality replacement and repair of fencing & inspection paths with in the area. The task of irrigation would be performed by the watch & ward (chowkidar/rakha) provided in the cost estimate.

Although the sites would be either leveled or finished in a grade, yet due to rains and sliding etc, it tends to develop rills and gulley causing acceleration in the rate of erosion. As such, while carrying out plantation; suitable soil conservation measures would also be taken.

6.5 SPECIES FOR PLANTATION

Afforestation with suitable plant species of high ecological and economic value and adaptable to local conditions will be undertaken at the rate of 1500 plants per hectare in accordance with canopy cover requirement. The major plant species which can be used in the area are given in **Table 6.3**.

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Table 6.3: Name of the Plant Species

Botanical Name	Local Name
Alnus nitida	Kosh, Kunish, Nyun
Betula utilis	Bhojpatra, Pad
Cedrus deodara	Kelo, Diar, Kialmang
Cupressus torulosa	Devidiar
Juniperus macropoda	Guggal, Dhup, Shur
Pinus gerardiana	Neoza, Chilgoza, Ri
Prunus armeniaca	Chuli, Chul
Juglans regia	Akhrot
Prunus cornuta	Krun, Birdcherry
Pinus wallichiana	Kail
Fraxinus xanthoxyloides	Thum
Populus ciliata	Kramal
Salix alba	Shon

Beside, the above tree species, the shrub species identified for plantations are; *Cotoneaster bacillaris, Colutea nepalensis, Elaeagnus umbellata, Spiraea canescens* and *Rosa webbiana.*

6.6 REGULATION MECHANISM FOR MUCK LIFTING BY OTHER USERS

The muck generated at a particular project location shall be classified by the Engineer-in-charge as usable/non usable and both categories shall be stacked separately and the later category shall be disposed off at designated sites. Out of usable lot, after earmarking the quantity to be utilized as project work, the balance quantity shall be notified with respect to its quantum, location of availability. On receiving written request from other users viz. interested Development Departments/ private users, the Engineer-in-charge shall issue permit to them to lift the authorized quantities within certain stipulated period failing which it will be deemed that concerned party is not interested in lifting the usable muck which shall be disposed off in the area designated as non-usable muck.

In has already been mentioned that free-of-cost facility for using muck by private users has been provided in view of the Himachal Pradesh Hydro Power Policy, 2006. But, in order to obviate the situation where this , bonafide facility may not lead to a free-for-all situation at their leisure, the operational requirements of the project warrant a need to evolve a regulatory mechanism by means of which the objective is achieved with project work progress uninhibited.

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6.6.1 Guidelines for Regulation Mechanism

The lifting of usable muck by the other users viz. government department, private stone crushers and private individuals, henceforth called as user agency shall be regulated in the following manner.

- The other agencies and the private users shall be bound to comply the timing for lifting of muck which shall be mentioned in the permit issued and fixed with due consideration to normal functioning of the project.
- The user agency shall abide by the traffic rules and shall operate their vehicles in such a manner that the permissible noise level is not exceeded and also the fugitive emission from their vehicles shall be within the limit.
- The authorized lifted muck from the area shall be the property of the using agencies who shall be entirely responsible for its safe stacking / disposal at their end.
- The arrangements and the cost of loading / unloading and transportation shall be totally borne by the using agency who shall have to pay the entry fee of Rs. 15/- per truck per entry and Rs. 5.00 per trolley or canters as part recovery of regulation charges as fixed by the project authorities from time to time.
- The project authorities shall erect a barrier to regulate the traffic flow to and fro the muck piles site. Entry of all vehicles passing the barrier and the information regarding quantities lifted by various users shall be properly arrayed in a register in a most transparent manner and shall be liable to be made public by the project authorities, if required.
- Any tax or levy charges in any form levied by Government or local bodies on the lifted material shall be borne by the user agency.
- On the commencement of the rehabilitation of the muck dumping area, neither any free of cost lifting nor digging of the compacted muck shall be allowed.
- The decision of the project authorities, in context of any matter related to free-of-cost lifting of muck or arising from it, shall be final and binding on all parties.

6.7 COST ESTIMATE FOR MUCK DISPOSAL PLAN

The cost estimate for muck disposal plan indicating engineering, biological, bio-technological measures and maintenance is provided in **Table 6.4**.

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Table 6.4: Cost Estimate for Muck Disposal Plan indicating Engineering, Biological, Bio-Technological Measures and Maintenance

Sl. No.	Particulars	Quantity	Unit	Rate (Rs.)	Amount (Rs. In Lacs)
A. Engineering Measures					
1.	Supplying and placing in position GI wire crate 8 SWG, 10 cm in size at toe of muck piles in tiers of crates (2.25 m x 1.25 m x 1.25 m) on dumping site D-5, D-6 , D-7 and D-8 having length 40 m, 30 m, 45 m, and 70 m in 6/7 tiers	414	No	3000	12.42
2. (a)	RCC retaining wall 6 m height for retaining muck at disposal site D-2, D-3, D-4 and D-11 in total length of (415 + 250 + 180) i.e. 845 RM.				
	Cement Concrete M:20 Base: 845 x 0.40 x 3.60 = 1216.8 Stem = 845 x 5.6 x 0.33 = 1561.6 2778.4	2778	Cum.	5360	148.90
	Cost of Steel reinforcement	112	MT.	44880	50.27
2 (b)	RCC retaining wall 4 m height for retaining muck at disposal sits D1, D9, D10, D-12 and D13 in total length of 1812 m.				
i)	Cement Concrete M:20 Base = 1812 x 0.3 x 2.50 = 1284.00 Stam = 1812 x 3.7 x 0.26 = 1743.14 3027.14	3027	Cum.	5360	162.24
ii)	Cost of Steel reinforcement	121	MT.	44880	54.30
	Subtotal (A)				**428.13**
B. Biological Measures					
1.	Plantation of muck disposal sites.	22	ha	485,432	106.80
2.	Barbed wire fencing on 2m high RCC posts	22	ha	30,000	6.60
3.	Cost of portable pump with accessories	3	No.	150000	4.50
4.	Cot of sprinkler system of irrigation	22	ha.	20000	4.40
5.	Watch and ward 1 no. @ Rs. 3000 p.m. for 4 years	48	Month	3000	1.44
				Subtotal (B)	**123.74**
				Grand Total (A) + (B)	**551.87**
				Or Say	**552.00**

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6.8 RATE ANALYSIS

6.8.1 Engineering Works

The rate analysis of engineering works is based on the working rates for item of civil works as contained in Volume-II, Bill of Quantities and Estimation of Cost is given in **Table 6.5**.

Table 6.5: - Rate analysis of Engineering Works

(A.) G. I. Boulder Wire Crates (2.25 m x 1.25 m x 1.25 m) per number		
1.	Cost of 15.10 sq km G. I. wire mesh size 10 cm x 10 cm, 8 SWG with 5% allowance for overlaps @ Rs. 117/- per m^2 including cost of material spreading and tightening	1766.70
2.	Cost of boulder filling including cost of material i.e. 3.52 cum @ Rs. 245/cum	862.40
3.	1.406 cum common excavation @ Rs. 255/cm	358.50
	Total Rs.	**2987.60**
	Say Rs.	**3000 each**
(B)	Cement Concrete M ; 20 as per DPR, Vol-II	Rs. 5360/cum
(C)	Providing steel reinforcement as per DPR Vol-II	Rs. 44880/MT

6.8.2 Cost Model for Plantation.

The Cost model for Plantation on muck dumping sites in given in **Table 6.6**.

Table- 6.6: Cost Model For Plantation On Muck Dumping Sites (For 1.00 Hectare Area)

S. No.	Particular	Quantity	Unit	Rate	Amount
A.	PALANTATION:				
(1)	GRASS SLIP PLANTING AND GRASS SEED SOWING:				
1	Preparation of soil mixture (soil, sand, humus & compost) including digging, purchase, carriage to the site of work and mixing at site.	75.00	Cum.	850.00	63750
2	Digging of staggered patches 1 m x 0.50 m x 0.30 m @ 500 patches/ha.	75.00	Cum.	50.00	3750
3	Filling of staggered patches with imported soil mixture.	75.00	Cum.	15.00	1125
4	Extraction of grass slips from nursery beds @ 50 slips per patch.	25000	Per Slip	0.12	3000
5	Carriage of grass slips from nursery to work site.	25000	Per Slip	0.15	3750
6	Planting of the extracted grass slips in above patches @ 50 slips per patch.	25000	Per Slip	0.18	4500
7	Cost of grass slips (in nursery).	25000	Per Slip	0.5	12500

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8	Purchase of grass seeds @ 5 gm. Per patch.	2.50	Kg.	115.00	288
9	Sowing of grass seeds in furrows in each patch.	500	Patch.	2.50	1250
	TOTAL				**93913**
(II)	**SHRUBS AND BUSHES PLANTATION:**				
1	Preparation of soil mixture (soil, sand, humus & compost) including digging, purchase, carriage to the site of work and mixing at site.	168.75	Cum.	850.00	143438
2	Digging of elongated patches 1.5 x 0.50 m x 0.45 m @ 500 patches/ha.	168.75	Cum.	50.00	8438
3	Filling of elongated patches with imported soil mixture.	168.75	Cum.	15.00	2531
4	Extraction of shrubs & bushes from nursery beds @ 50 per patch.	25000	Per plant	0.15	3750
5	Carriage of shrubs & bushes from nursery to work site.	25000	Per plant	0.15	3750
6	Planting of the extracted shrubs & bushes un above patches @ 50 per patch.	25000	Per plant	0.20	5000
7	Cost of shrubs & bushes (in nursery).	25000	Per plant	1.00	25000
	TOATL				191906
(III)	**FOUR LINE STRIP PLANTATION (TREE SPECIES):**				
1	Preparation of soil mixture (soil, sand, humus & compost) including digging, purchase, carriage to the site of work and mixing at site.	18.225	Cum.	850.00	15491
2	Digging of pits (45cm x 45cm x 45cm) in periphery of area.	200	No.	4.45	890
3	Filling of pits (45cm x 45cm x 45 cm) with imported soil mixture.	200	No.	1.27	254
4	Extracted of plants from nursery beds.	200	No.	0.25	50
5	Carriage of plants from nursery to the work site over average distance of 10 km uphill carriage.	200	Nos. per Km.	0.17	340
6	Planting of extracted plants in above pits including ramming.	200	No.	0.86	172
7	Mulching of plants with grass.	200	No.	0.28	56
8	Cost of plants (in nursery).	200	No.	1.00	200
	TOTAL				**17453**

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