

HEAD OFFICE

Uttarakhand Pollution Control Board

46-B, I.T. Park, Sahastradhara Road,
Dehradun (Uttarakhand)



Action Taken Report

Original Application No. 61 of 2019

Gram Pradhan & Residents of Tapovan

Vs

State of Uttarakhand

In compliance of order dated 02.01.2020

of the

Hon'ble National Green Tribunal,

Principal Bench, New Delhi

Action Taken Report

In the matter of Original Application No. 61 of 2019

Gram Pradhan and Residents of Tapovan

Vs

State of Uttarakhand

In context to the Original Application No. 61/2019 Gram Pradhan & Residents of Tapovan Vs State of Uttarakhand, Hon'ble National Green Tribunal, Principal Bench, New Delhi on dated 02.01.2020 issued following directions:-

"Let the NTPC and the TDCL take necessary steps in the matter forthwith, Once such steps are identified by an Expert Committee comprising Himalayan Forest Research Institute, Shimla, Central Soil and Water Conservation Research and Training Institute, Dehradun and the SPCB. The SPCB will be nodal agency for coordination and compliance, The committee may give its report within one month."

With compliance of the order passed by the Hon'ble NGT, inspection of the site was carried out by the expert committee on dated 7th and 8th March 2020. Expert Committee consisted of Dr. D.V. Singh- Principal Scientist (Soils), ICAR- Indian School of Soil and Water Conservation, Dehradun; Dr. D.K. Verma- Scientist G and Head, Forest Ecology & Climate Change Division, Himalayan Forest Research Institute, Shimla; Sh. Sompal Singh- Environment Engineer, Head Office, Uttarakhand Pollution Control Board, Dehradun. Expert Committee Report enclosed as Annexure-1

JF.

Expert Committee's Report
on
**Muck Disposal and Management in
Tapovan -Vishnugad Hydroelectric Project**
National Thermal Power Corporation Ltd., Uttarakhand

Original Application No. 61/2019

Gram Pradhan and Residents of Tapovam

vs

State of Uttarakhand

Submitted to

**Hon,ble National Green Tribunal
Principal Bench, New Delhi**

In compliance to the order dated January 02, 2020

Expert Committee's Report
on
**Muck Disposal and Management in
Tapovan -Vishnugad Hydroelectric Project**
National Thermal Power Corporation Ltd., Uttarakhand

Original Application No. 61/2019
Gram Pradhan and Residents of Tapovam vs State of Uttarakhand

"In compliance to the order of Hon,ble National Green Tribunal dated January 02, 2020, members of constituted Expert Committee visited the Project sites during March 7-8, 2020 and prepared the following report on muck disposal and management".

Introduction

In a development project, muck is the material excavated, tunnelled, dislodged or caused to be dislodged as collateral effect of primarily human interference from its natural position to its new location. Generally muck is the mixture of rock fragments, soil parent material and soil but in case of tunnelling it is mostly the mixture of grounded and fragmented rocks. Environmentally safe disposal or management of muck is a pre-requisite for development projects as improper muck dumping may lead to potential environmental hazard in terms of mass erosion, water pollution, sedimentation of water bodies, loss of green cover and detrimental effects in aquatic ecosystem. Geological mapping, analysis of bearing capacity and slope stability analysis of an identified muck dump site is highly essential to prevent failures. This aspect becomes supremely important when huge amounts of muck are expected to be generated in a highly fragile geological and ecological ecosystem like the Himalayan region.

In the state of Uttarakhand very high soil erosion is prevalent due to the occurrence of steep slope, high intensity rainfall events and high soil erodibility. Under such situation, if muck generated from development project in terms of loose and disaggregated material is dumped improperly, then rates of erosion from these dumps will be manifold higher than normal course and may turns into mass erosion during high intensity rainfall events. Therefore, poorly managed muck dumps can act as hot-spots for very severe erosion during high intensity rainfall events. Accelerated soil erosion will not only be detrimental on-site but also be having harmful off-site effects in terms of increased sediment deposition and suspended load in streams, rivers and reservoirs (dams). Also, increased suspended load in aquatic system will have detrimental effects on aquatic fauna and flora.

Recognizing the above aspects, the Hon'ble National Green Tribunal, Principal Bench, New Delhi has observed that the "*gaps need to be specified*" in the process of muck disposal adopted in Tapovan - Vishnugad Hydroelectric Project being implemented in the state of Uttarakhand as "*this is necessary to ensure that there is no damage to environment*".

Therefore, an expert committee was constituted to identify adequate protective measures to be taken up by the NTPC and TDCL so that the possibility of muck reaching river system can be prevented.

Muck Management

A substantial quantity of boulders and gravels available from generated muck can be used in construction. These materials should be checked for their mechanical properties and then used appropriately in construction to reduce the quantity of muck. Preferably, muck dump sites are identified close to the muck generating locations to avoid air pollution due to dust generation and transportation but it must be away from rivers to avoid rolling of muck/loose materials into the river course. Hence, utmost care is needed in planning and implementation of site specific engineering and biological measures for proper muck management. Before muck is disposed at identified locations, it is necessary to ensure that the sub-stratum has enough shear strength to sustain the load without creating a slip hazard. Two forces work on the slope of a muck dump site *i.e.*, a driving force and a restraining force. Slopes will be unstable if the driving force is greater than the restraining force. Therefore, muck should be dumped in such a way so that driving force never exceeds restraining force. This can be achieved when the downstream slope of the muck dump does not exceed 35°. Generally, it is suggested to maintain the slope of muck dump within the range of 20°-30° (about 26° or 1:2) to keep the restraining force greater than the driving force. The gabion/protection walls are necessarily be constructed along the contours for better stability. Simultaneous compaction and narrow terracing by mechanical or vegetative means can increase the restraining force. The restoration plan employing integrated bioengineering approaches for fully utilized muck dump sites must includes analysis of dumped material for its physical and chemical properties to assess soil fertility. This will help to judiciously apply the required quantity of manures, bio-fertilizers and fertilizers for supporting faster growth of vegetation. Plantation of locally available plant species (trees, shrubs and grasses) are mostly preferred for rehabilitation of muck dump sites. For this purpose, help of local knowledge and involvement of forest department would yield better results. Grasses and shrubs are always preferred over trees to restore such degraded areas.

Muck Disposal in Tapovan-Vishnugad Hydro-electric Power Project

Details of muck disposal in Tapovan - Vishnugad Hydro-electric Power Project was collected from NTPC by State Pollution Control Board, Uttarakhand and presented in Table 1. In this project, a total of five muck disposal sites were identified with total capacity of 72.0 lakh m³. Three sites have been completed and currently only two sites are in active state. All muck disposal sites were located quite near to the place of muck generation. Since, deep excavations are inevitable in such power projects for vital activities like tunnelling, dam and power house constructions, sufficient quantity of top soil will not be available to spread over muck dumping sites. It has also been observed that muck material is mostly comprised of rock fragments and boulders which is devoid of plant nutrients and organic matter.

Table 1. Details of Muck Disposal Sites (MDSs) in the Tapovan - Vishnoogad Hydro-electric power project.

S. No.	Muck Disposal Site	Area allocated (ha)	Capacity of the disposal site (lakh m ³)	Muck disposal till Nov. 2019 (lakh m ³)	Approx. distance from River bank (m)	Present status	Visual taken on 8-3-2020
1	Dhak near ITI	5.5	16.0	4.57	600	Active	Photo 1a and 1b
2	Near TBM adit	7.0	40.0	1.86	550	Active	Photo 2a and 2b
3	Barrage site at Tapovan	5.25	10.0	9.50	300	Completed (4 years)	Photo 3a and 3b
4	Near BVC pressure shaft	1.9	1.0	0.80	500	Completed (3 years)	Photo 4a and 4b
5	Power house site at Animath	3.1	5.0	2.50	300	Completed (5 years)	Photo 5a and 5b
		22.75	72.0	19.23			

Field Observations

Expert committee along with officials from NTPC conducted field visit during March 7-8, 2020 to the muck disposal sites in Tapovan – Vishnugad Hydro-electric Power Project. The following observations were recorded:

A. Active Muck Disposal Sites

In Tapovan – Vishnugad Hydro-electric Power Project, two muck disposal sites (At Dhak and near TBM) are active. On site visit and discussion held with officials from NTPC, the expert committee has made the following important observations:

1. Dhak muck disposal site is located with geographical coordinate of latitude 30° 30' 10.6"N, longitude 79° 36' 47.0" and altitude 2015m. This site is active but near completion (Photo 1a and 1b). Gabion toe wall has been constructed but found to be with improper foundation and backfilling. Downstream slope of dumped material is more than 45° which is prone to very severe erosion during high intensity rainfall event. Dump surface is mostly uneven and undulating with dominance of boulder, rock fragments and inert material. Comparatively a little amount of soil has been spread over a few patches of the muck dump. This site has not been fully utilized to its capacity as usable part of muck generated might have been used in construction.

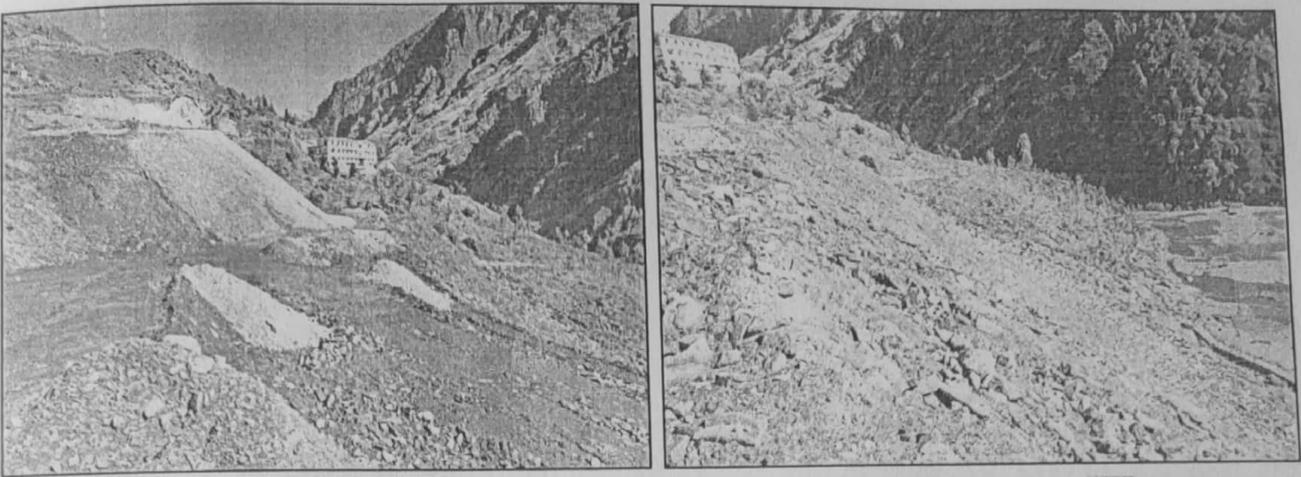


Photo 1a and 1b: Current view of the active dumping site at Dhak near ITI

2. Muck disposal near TBM adit is located with geographical coordinate of latitude $30^{\circ} 32' 25.2''N$, longitude $79^{\circ} 31' 29.9''$ and altitude 1713 m. This site is active and dumping of the muck material being generated in tunnelling is going on (Photo 2a and 2b). The toe wall has been constructed but it was found as damaged in one side of the dumping zone. The slope of muck dump is observed to be about 60° which is hazardously double the standards. Upstream side of the muck dump is subjected to the entry of water which has further added to trigger severe mass erosion. Under such unstable conditions, as expected, huge mass erosion has been seen in terms of very deep gully formation in downstream of this muck dump. Since, deep excavations are inevitable in tunnelling, only grounded and fragmented rocks are being dumped and no soil is available to spread over this muck dump site. On older portion of this dump, native grass (*Chrysopogon*), shrub (*Eupatorium*) and tree (*Alnus*) could be observed.

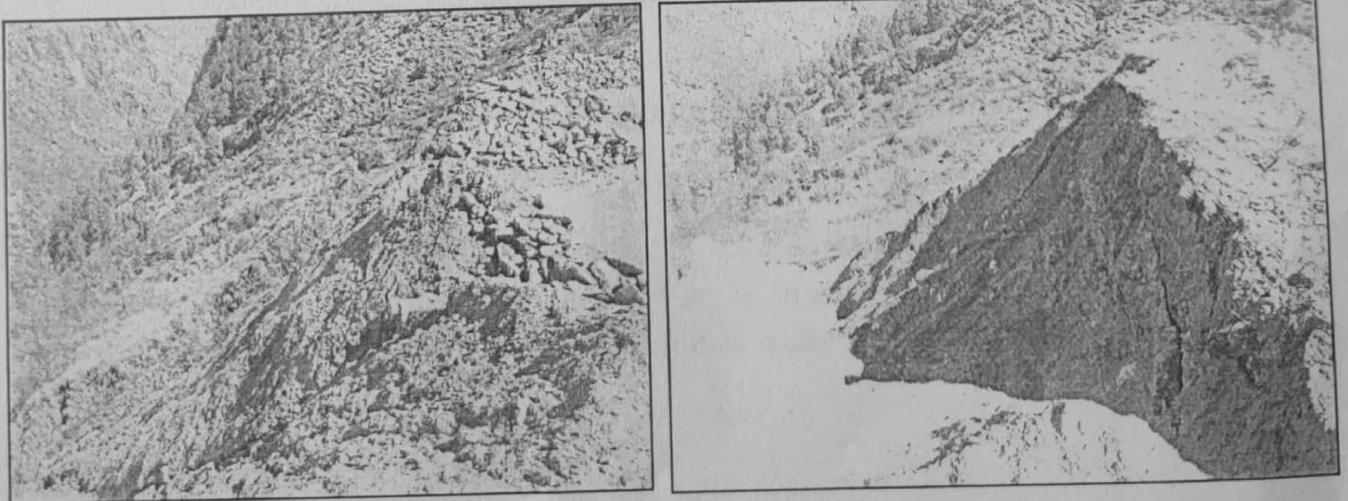


Photo 2a and 2b: Current view of the active dumping site at TBM adit

B. Completed Muck Disposal Sites

Out of a total of five muck disposal sites identified in Tapovan – Vishnugad Hydro-electric Power Project, three sites were found to be completed. These sites are moderately stabilized and native grass and shrubs have appeared to provide vegetation cover. Toe protection and contour stone walls were constructed but some of them are damaged or over turned. In addition to the details of these sites provided in Table 1, site wise specific observations recorded during the field visit are provided below:

1. **Barrage Site at Tapovan:** This sites is located with geographical coordinates of latitude $30^{\circ} 29' 30.7''$ N, longitude $79^{\circ} 37' 33.5''$ and altitude 1918m. In this site dumping of the material has been completed 4 years back (Photo 3a and 3b). The site is more or less stabilized but toe protection and contour stone barriers are damaged at some places. Some good soil was kept separately but not spread over the muck dump. Top surface is not smoothed and found uneven and undulating with bounders and other materials.



Photo 3a and 3b: Status of Daumping Site at Barrage Site, Tapovan

2. **Near BVC/Pressure Shaft:** This sites is located at latitude $30^{\circ} 32' 08.4''$ N, longitude $79^{\circ} 31' 27.8''$ and altitude 1704 m. In this site dumping of the material has been completed 3 years back. The site is more or less stabilized (Photo 4a and 4b).

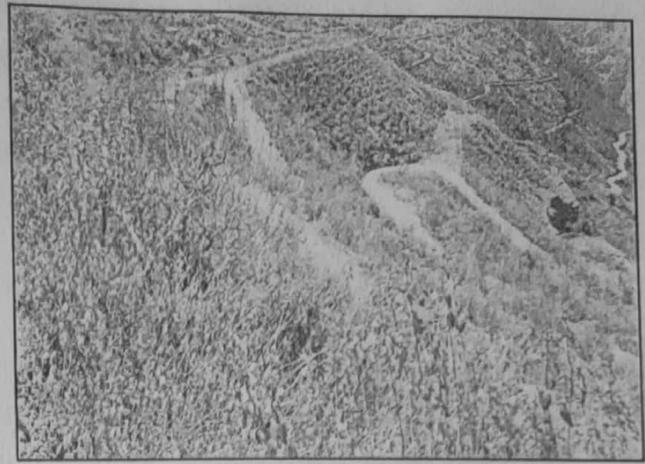


Photo 4a and 4b: Status of Daumping Site at BVC/Pressure Shaft

3. **Power House Site at Animath:** This sites is located at latitude $30^{\circ} 32' 00.1''$ N, longitude $79^{\circ} 31' 10.01''$ and altitude 1422 m. Muck dumping has been completed 5 years back in this site. The site has been moderately stabilized but area is not protected from uncontrolled human and animal interference (Photo 5a and 5b).

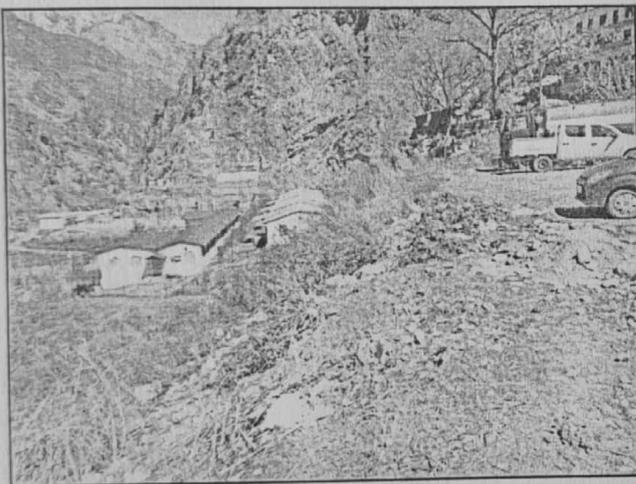


Photo 5a and 5b: Status of Daumping Site at Power House Site, Animath

Recommendations and Discussion

Based on the field observations, the following recommendations are made in order to prevent muck reaching river system and minimize environmental damage:

A. Recommendation for Active Muck Dumps

In Vishnugad – Tapovan Hydro-electric Power Project, two out of five muck dump sites are active while other three sites have been moderately stabilized. In active sites (Dhak and near TBM adit) muck (grounded and fragmented rocks) is being dumped and top soil is not available to spread it on the top of the muck dump on its completion. The following measures are recommended to restore these muck dumps:

- First of all toe/contour stone wall in each of the muck dump should be strengthened / constructed with proper engineering design. Another important aspect of the

toe/contour stone wall is the ratio of its height and bottom width which should be maintained around 1:2/3. Third important aspect of toe/contour stone wall construction at muck dump site is the porous nature of the structure; therefore, gabion structures are preferred. Fourth – foundation of toe/contour stone wall should be kept in originally existing land condition.

- Downstream slope of the muck dump should be kept within the range of 20° - 30° .
- Up-stream side of the muck dump, water entry should be restricted by providing concrete diversion drain. Flat portion of muck dump may be merged with sloping surface which will not only help in easing out of downstream steep slope but also restrict the entry of water in muck dump.
- Stepwise consolidation is required to be provided from bottom to top.
- Boulders, lumps of inert materials and rock fragments should be removed from the surface. These materials can be used in strengthening or constructing the toe wall or contour stone barriers.
- Contour stone barrier may be provided at 3-4 m vertical interval but their foundation should be kept in originally existing land condition and not on loose muck dump.
- Sloping surface should be smoothed.
- A layer of top soil (about 5 cm thick), if available, to be spread over smoothed surface of muck dump. Good native soil will not only be having plant nutrients and organic matter but also be serving as seed bank for native vegetation.
- Fertility can be improved by application of manures, bio-fertilizers and fertilizers. This will promote quick vegetation establishment. These things should be applied in contour furrow (15-20 cm deep) open at about 1 m spacing. First mixture of fertilizers (DAP @ 100 kg/ha and MOP @ 50 kg/ha) be applied in the furrow then mixture of manure (FYM @ 20 t/ha) and bio-fertilizer (VAM @ 30 kg/ha) should be applied in the same furrow. After this furrow should be closed with pouring top soil collected from nearby area.
- Now the dump is ready to apply geojute of desired specifications. Proper stitching of geo-jute strips and anchoring to surface through nailing are must to get the desired results.

Geojute: Also called as 'soil saver' is a natural geotextile used as mulch. This is essentially a jute matting with an open mesh of 2 to 5 mm thick jute yarn having 10 mm apertures and is biodegradable. It has been successfully tried for stabilization of landslides, mine-spoils and steep slopes. The technique of geojute application includes (a) spreading of geojute by overlapping and joining adjacent widths (b) driving wooden sticks to a depth of 0.5 to 1.0 m to secure matting in place (c) planting rooted slips of local grasses and shrubs in openings between the geojute strands at close spacing.

- Slips of chrysopogon which is a native and hardy grass species or any other suitable grass can be planted at 30 cm spacing in the above mentioned furrow after application of geo-jute.
- Most suitable plant tree is alnus for such conditions. This tree is naturally growing in this project area. This tree is a non-leguminous nitrogen fixing plant which is the first tree colonizer of such situations that prevails at the muck dumps created in this project. This tree can be planted in the above mentioned furrow at spacing of 3x3 m.

List of Plant Species Suggested for Plantation

Grasses and Herbs

Chrysopogon fulvus (Dhaloo), *Vetiveria zizanioides* (Khus or Khas), *Rumex hastatus* (Churki or Malori), *Artemisia parviflora* (Majtari), *Themeda tremula* (Kangaroo Grass) and other local grass species.

Shrub Species

Rosa moschata (Ban Gulab), *Rubus ellipticus* (Raspberry or Hir), *Indigofera heterantha* (Kaithi), *Berberis lycium* (Kashmal), *Zanthoxylum alatum* (Timar), *Hypericum oblogifolium* (Choli Phulya), *Dabregeasia hypoleuca* (Siharu), *Coriaria nepalensis* (Masuri) etc.

Trees Species

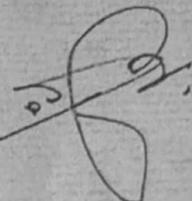
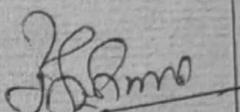
Alnus nitida (Alder or Kosh), *Pyrus pashia* (Kainth), *Pinus wallichiana* (Kail), *Prunus cerasoides* (Pazza), *Robinia pseudoacacia* (Robinia or Pahari kikar), *Pinus roxburghii* (Chirpine) etc.

B. Recommendation for Completed Muck Dumps

Out of five muck disposal sites identified in Tapovan – Vishnugad Hydro-electric Power Project, three sites have been completed 3-5 years back. These sites are moderately stabilized and native grasses and shrubs have appeared to provide vegetation cover. Further these sites may be improved with the following measures:

- Damaged toe protection and contour stone walls should be repaired and strengthened with proper engineering design.
- Suitable fencing may be provided to control excess human and animal interference.
- Unattended works of leveling, surface smoothening, removal of unwanted material and spreading of available soil at Tapovan site should be completed.
- Manures and fertilizers may be applied to improve the soil fertility.
- Suitable species of grasses, shrubs and trees, as listed above, may be planted in degraded area.

Expert Committee

S. No.	Name and designation of the Expert	Institute/Organization	Signature
1	Dr D.V. Singh Principal Scientist (Soils)	ICAR-Indian Institute of Soil and Water Conservation (Formerly Central Soil and Water Conservation Research and Training Institute) 218 Kaulagarh Road, Dehradun 248195 (Uttarakhand)	
2	Dr. R K. Verma, Scientist G and Head	Forest Ecology & Climate Change Division, Himalayan Forest Research Institute SHIMLA, Himachal Pradesh	
3	Sh. Sompal Singh, Environment Engineer	Uttarakhand Pollution Control Board, Dehradun (Uttarakhand)	