CHAPTER 9
RESTORATION PLAN FOR QUARRY AREAS

9.1 QUARRY SITES

Three rock quarries namely DBR-1, DBR-2 and DBR-4 located within 5 Km upstream of dam axis have been explored. The possibility of utilising excavated muck likely to be generated during excavation from dam abutments, powerhouse and tunnels (DBR-3, DBR-5 & DBR-6) was also explored to minimize quarrying from rock quarries.

Three shoals / fan deposits namely DBG-1, DBG-2 &DBG-3, located within 13.5 km downstream of dam axis have been identified and explored extensively to establish the suitability of the same for use as coarse and fine aggregate for concrete.

To meet the requirement (0.26 lakh cum) of impervious material, out of the three soil borrow areas identified, investigated and tested for suitability, one (i.e. Munli camp impervious soil deposit – DBC-1) located within a distance of 1 km upstream of dam axis has been selected. Epali impervious soil deposit (DBC-2) is proposed to be kept as reserve.

The requirement of 0.74 lakh cum of shell material shall be met from the excavated material from left side of Dam abutment (DBR-5).

The materials from these borrow areas/rock quarries were tested for their suitability as shell and impervious material, coarse and fine aggregate. The materials were tested in North Eastern Hydraulic and Allied Research Institute, Guwahati for physical and index properties. In addition, for evaluation of concrete aggregate for alkali aggregate reactivity potential, the representative samples from various borrow areas were tested in National Council of Buildings, Ballabhgarh using Mortar bar test. The location, distance with respect to dam axis and quantity available from these borrow areas/rock quarries / impervious is given in Map 9.1.

Table 9.1 showing proposed borrow areas/excavated rock material for dam & underground structures, to be utilized is placed below.

Table 9.1: Proposed borrow areas/excavated rock material for dam & underground structures

Sl. No.	Location	Index No.	Distance from Dam axis	Available qty.	Remarks
Shoal/Fan deposit					
1.	Aya Korong fan deposit.	DBG-1	8.5	190.00	To be utilized for coarse aggregate & crushed sand.
2.	Eme river fan deposit	DBG-2	10.5	75.00	To be utilized for natural & crushed fine sand.
3.	Nizam Ghat shoal & Sirki river/ fan deposit	DBG-3	13.5	130.00	To be utilized for coarse & crushed sand.
Rock Quarry excavated material					
4.	Right bank Ilu Pani rock quarry (u/s)	DBR-1	5.0	100.00	Material suitable for coarse aggregate only.
5.	Left bank Ilu Pani rock quarry (u/s)	DBR-2	5.5	111.00	- Do-
6.	Excavated material of power house cavern	DBR-3	0.5	3.00	To be utilized for coarse & fine aggregate.
7.	Airi Pani rock quarry	DBR-4	2.5	163.50	Material suitable for coarse aggregate only.

8.	Excavated material from left side of Dam abutment	DBR-5	0	16.00	To be utilized for coarse aggregate and shell material only.
9.	Excavated material from right side of Dam abutment	DBR-6	0	16.00	To be utilized for coarse and fine aggregate.
Impervious borrow area					
10.	Munli camp impervious soil deposit	DBC-1	1.0	0.28	To be utilized for core material
11.	Epali impervious soil deposit at Epali area	DBC-2	13.5	2.50	To be kept as reserve
12.	Yagang impervious soil deposit at Yangang area	DBC-3	30.0	14.00	–

Coarse & fine aggregate

For the construction of concrete dam, power house and other allied civil structure of the project about 193 lakh cum of coarse aggregate and 96.5 lakh cum fine aggregate will be required for the production of concrete. Coarse, crushed sand and fine aggregate sample collected from river bed/fan deposit and rock quarry were tested for physical parameters. Based on the test result, borrow areas and rock quarries have been selected and short listed for meeting the requirement of coarse and fine aggregate.

(A) Availability of concrete aggregate from Rock quarries

The total requirement of 193 lakh cum of coarse aggregate can be met from DBR-1, DBR-2 & DBR-4 located 5.0, 5.5 and 2.5 kms upstream of dam axis, containing estimated quantities of 100, 111 & 163 lakh cum respectively. However, all efforts shall be made to maximize the utilization of suitable excavated material from dam, powerhouse and HRT (DBR-3, DBR-5 & DBR-6) for coarse & fine aggregate.

It is pertinent to mention here that detailed tests reveal that material from major quarries viz. DBR-1, DBR-2 & DBR-4 located upstream of dam axis are not found suitable for use as fine aggregate and eventually the same shall have to be transported from the major downstream quarries viz.DBG-2 & DBG-1.

The entire rock quarries that are investigated for establishing the availability of suitable construction material are located within 5 km upstream of the dam defined by steep rocky escarpment within submergence. In view of steep gradient, large-scale mining of the rock by blasting may cause instability problem around the reservoir rim, which is observed to be infested with number of active slides. Furthermore, as a sizable (40%) of the identified quarry material shall not be usable due to its weak nature and therefore generate a large volume of muck which needs to be dumped away from the reservoir, and that may cause environmental hazard. In view of above and economic consideration, not withstanding the proximity of these quarries vis-a-vis main structures, quarrying from these sources are not favoured.

(B) Availability from riverbed/fan deposit

Against the total requirement of 193 lakh cum coarse aggregate for the various structure, 168.5 lakh cum and 24.5 lakh cum of suitable coarse aggregate has been proposed to be utilized from DBG-1 and DBG-3 respectively, located down stream of dam axis.

Against the requirement of 96.5 lakh cum of fine aggregate, 75.0 lakh cum consisting of 20 lakh cum of suitable natural sand & 55 lakh cum suitable

crushed sand have been estimated to be available from Eme river bed deposit (DBG-2). The balance 21.5 lakh cum suitable coarse material shall be made available for production of crushed fine aggregate from Aya Korang deposit (DBG-1).

It is observed that during rainy season the active local nala such as Eme & Sirki brings down a large volume of riverine/nallah fan material each year and replenish the area. However, such additional quantity has not been considered at present while estimating available quantity of construction material.

It is pertinent to mentioned here that these borrow areas are formed due to a continuous draining of loose nallah fan material derived from the in situ rock occupying higher levels. Being distantly away from the active river channel, utilization of this material is not likely to affect the existing river dynamics adversely. On the contrary removal of the loose material from the up slope would possibly reduce spilling over of this material towards the river during rains when all the local nallahs are active. Therefore, it would invariably reduce the possibility and intensity of flash flood due to the sudden chocking of the river caused by local blockages and thus large scale damage to the environment shall be minimized. Keeping in view of this and suitability of the material utilization of river borne/fan deposit from DBG-1, DBG-2 & DBG-3 has been proposed.

Impervious Soil

Three identified borrow areas namely DBC-1, DBC-2 & DBC-3 were considered for investigation exploration keeping in view the location, distance from the dam axis and availability of quantities. Impervious soil samples collected from these borrow area are tested for engineering and index properties for its suitability. Against the requirement of 0.26 lakh cum for the construction of embankment of cofferdams, 0.28 lakh cum suitable material is proposed to be used from munli camp borrow area (DBC-1) located at 1.0 km upstream of dam axis. DBC-2 is proposed to be kept as reserve.

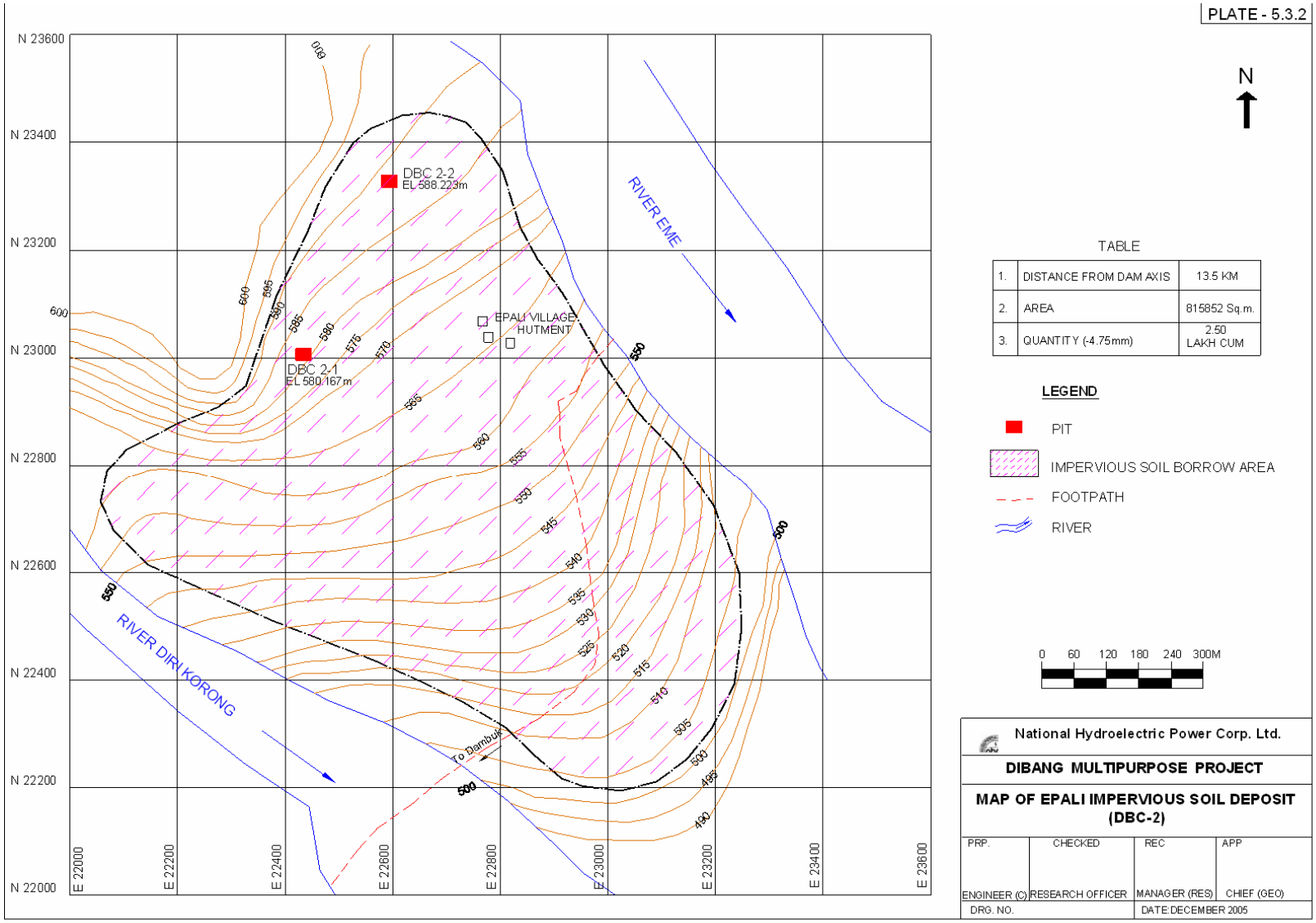
Shell material

The requirement of 0.74 lakh cum of shell material shall be met from the material from left bank (DBR-5).

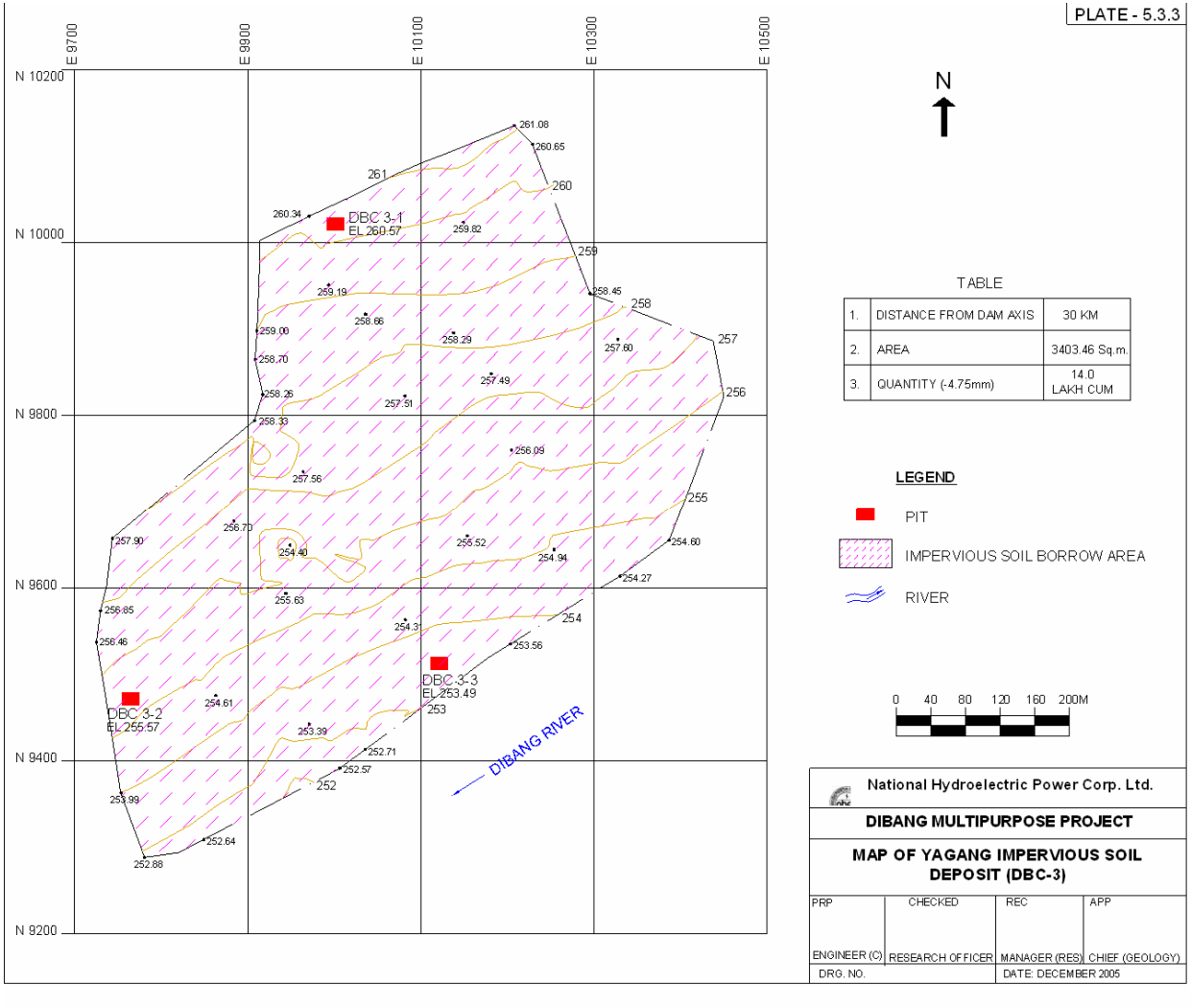
The quarrying operations are semi-mechanized in nature. Normally, in a hilly terrain like Arunachal Pradesh, the quarrying is normally done by cutting a face of the hill. A permanent scar is likely to be left, once quarrying activities are over. With the passage of time, the rock from the exposed face of the quarry under the action of wind and other erosion forces, get slowly weathered and after some time, they become a potential source of landslide. Thus, it is necessary to implement appropriate slope stabilization measures to prevent the possibility of soil erosion and landslides in the quarry sites.

9.2 STABILIZATION OF QUARRY SITES

Most of the quarry sites are located upstream of the Dam which will be submerged after the commissioning of the project. Only two quarry sites i.e. Epali Impervious soil deposit site DBC -2 (located 13.5 km downstream of Dam between Aya Korang fan deposit and Eme river), and Yagang Impervious soil deposit DBC-3 (30km downstream of Dam) will only require restoration (maps 9.2 & 9.3).



Map 9.2: Epali Impervious Soil Deposit



Map 9.3: Yagang Impervious Soil Deposit

The quarry slopes after excavation of the construction material needs to be stabilized. It is suggested that quarry slopes should be maintained at a slope 1:1. The slope should then be covered with topsoil of at least 30 cm. It is suggested that for stabilization, grass, herbs & shrubs should be grown over these slopes. The area to be stabilized is 82 ha.

9.3 PHYTOREMEDIATION OF QUARRY SITES

Afforestation with suitable plant species of high ecological and economic value along with turfing by suitable grass species can be undertaken over the two quarry sites after providing required slope and laying top soil over the slopes. Wherever required, proper engineering measures like construction of retaining wall etc. would also be constructed for proper slope stabilisation.

As stated above, an area of 82 ha. will be required to be restored through engineering and biological measures. The plantation could be proposed over 60% of the quarry area to be restored i.e 49.2 ha or say 49 ha. Remaining area i.e. 33 ha may be taken up for turfing.

9.4 COST ESTIMATES

Table 9.2: Cost estimate for restoration of quarry sites

S. No.	Remedial measures proposed	Rate (Rs.)	Amount (Rs. In lakhs)
1.	Plantation over 49 ha.	40,000 /ha*	19.60
2.	Turfing over 33 ha	30,000/ha**	9.90
3.	Retaining Wall of 15 m each (200 Nos.) i.e 3000 m length	20,000/ 15 m	40.00
4.	Training of slopes including labour cost and laying down of top soil	15,000/ha	12.30
5.	Fencing over quarry areas (4000 rm)	150 / rm	6.00

		Sub total	87.80
5.	Contingency cost (3%)		2.634
Total			**90.434 lakhs say 91 lakhs**

* The rate is inclusive of sapling cost, manure cost, nursery cost, labour cost, tending, weeding, etc.

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