CHAPTER-6
MUCK MANAGEMENT PLAN

6.1 INTRODUCTION

A large quantity of muck is expected to be generated as a result of tunneling operations, construction of roads, etc. 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. The muck disposal sites cause increased sedimentation in the rivers (though insignificant compared to natural sedimentation) and totally spoils the visual aesthetics of the area. It is of prime importance that these sites will have to be rehabilitated as soon as the disposal sites are full.

6.2 MUCK GENERATION

Based on the geological nature of the rocks and engineering properties of the soil, a part of the muck generated can be used as construction material. The balance needs to be suitably disposed. Normally, muck is disposed in low-lying areas or depressions. Trees, if any, are cut before muck disposal, however, shrubs, grass or other types of undergrowth in the muck disposal at sites perish. The muck disposal sites will be suitably stabilized on completion of the muck disposal.

- Muck disposal can lead to impacts on various aspects of environment. Normally, the land is cleared before muck disposal. During clearing operation trees are cut, but undergrowth perishes as a result of muck disposal.
- In many of the sites, muck is stacked without adequate stabilization measures. In such a scenario, the muck moves along with runoff and creates landslide like situations. Many a times, boulders/large stone pieces enter the river/water body, affecting the benthic fauna, fisheries and other components of aquatic biota.
- The increased vehicular movement near muck disposal sites lead to adverse impacts on ambient air quality as well. However, increase in vehicular traffic is not significant to cause major impact on ambient air quality.
- Normally muck disposal is done at low lying areas, which gets filled up due to stacking of muck. This can sometimes affect the natural drainage pattern of the area leading to accumulation of water or partial flooding of some area which can provide ideal breeding habitat for mosquitoes.

Thus, it is necessary to develop a proper muck disposal plan for amelioration of above referred impacts.

6.3 MUCK DISPOSAL SITES

The total excavation quantity likely to be generated at the project will be around 2.56 lakh cum. Approximately 30% of generated muck will be used as construction material and remaining 2.50 lakh cum (including 40% swelling factor and over break) will be disposed off at six muck disposal sites. However, the capacity of the six dumping sites is 4.09 lakh cum. The details of Muck generation from various project components are given in Table-6.1. Likewise, the details of muck disposal sites are given in Table-6.2.

TABLE-6.1
Muck Generation from Project Components of JSHEP

S. No.	Project Component	Total Muck (m^3)
1	Excavation of Coffer Dam & Pipe alignment	4498
2	Barrage Excavation	7949
3	Power intake Excavation	930
4	Adit-1(to desilting tank) Excavation	3868
5	Excavation of Desilting Basin (Underground)	26917
6	Intake Tunnel Excavation	3081
7	Adit-2 (to Head Race Tunnel) Excavation	6460
8	Adit-3 (to Head Race Tunnel) Excavation	5970
9	Adit-4 (to Head Race Tunnel & surge shaft) Excavation	3525
10	Face-1 (from Desilting Side) Excavation	7670
11	Face-2 (Construction Adit-2 Upstream) Excavation	7670
12	Face-3 (Construction Adit-2 Downstream) Excavation	16725
13	Face-4 (Construction Adit-3 Upstream) Excavation	16725
14	Face-5 (Construction Adit-3 Downstream) Excavation	15830
15	Face-6 (Construction Adit-4 Upstream) Excavation	15830
16	Face-7 (Construction Adit-4 Downstream) Excavation	817
17	Surge Shaft Excavation	2773
18	Pressure shaft & Penstock Excavation	6344
19	Valve House Excavation	1000
20	Power House Cavern Excavation	46009
21	Main Access Tunnel Excavation	12500
22	Ventilation Tunnel Excavation	7328
23	Cable Tunnel Excavation	1656
24	Tail Race Tunnel Excavation	4863
25	Pothead Yard Excavation	29172
Total Muck generation		**256110**
Swelling factor @ 40%		**358554**
Muck to be utilized@ 30%		**107566**
Muck to be dumped		**250988**

TABLE-6.2
Details of Muck Disposal Sites

S. No.	Dumping Sites	Location	Area (ha)	Capacity (m^3)	Muck to be dumped (m^3)	Distance from HFL (m)
1	D-1	Near D/s of Barrage Site on the Left Bank of Supin River	0.4182	65646	33110	30
2	D-2	Adjacent to Dhara Village i.e. Near Adit-2	2.598	129734	50944	200
3	D-3	Near Adit-3	0.829	22857	21364	240
4	D-4	Near Junction of Main Road and Powan Malla Road	1.874	64187	19107	250
5	D-5	Between colony location and MAT portal	1.178	107857	65500	85
6	D-6	Near Surge Shaft and Adit-4	0.746	18769	60963	520
Total			**7.6432**	**409050**	**250988**	

The cross-sections & topographical contour map of various dumping sites are given in Figure-6.1 to 6.12 respectively. The cross section of retaining wall is shown in Figure-6.13.

6.4 MANAGEMENT MEASURES

As mentioned earlier, a large quantum of muck is expected to be generated. 30% of muck is proposed to be utilized as a construction material for various project appurtenances. The balance is proposed to be disposed at the designated site.

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. In the hilly area, dumping is done after creating terraces thus usable terraces are developed. The overall idea is to enhance/maintain aesthetic view in the surrounding area of the project in post-construction period and avoid contamination of any land or water resource due to muck disposal.

Suitable retaining walls shall be constructed to develop terraces so as to support the muck on vertical slope and for optimum space utilization. Loose muck would be compacted layer wise. The muck disposal area will be developed in a series of

terraces of boulder crate wall and masonry wall to protect the area/muck from flood water during monsoons. In-between the terraces, catch water drain will be provided. The terraces of the muck disposal area will be ultimately covered with fertile soil and suitable plants will be planted adopting suitable bio-technological measures.

The basic aim and objectives of the muck management plan are to:

- protect these areas from soil erosion
- develop these areas by afforestation
- develop them into parks, gardens etc.
- utilize the maximum quantity of muck for development of infrastructure of the project
- develop these areas in harmony with the landscape of the project area.

Various activities proposed as a part of the management plan are given as below:

- Land acquisition for muck dumping sites
- Civil works (construction of retaining walls, boulder crate walls etc.)
- Dumping of muck
- Levelling of the area, terracing and implementation of various engineering control measures e.g., boulder, crate wall, masonry wall, catchwater drain.
- Spreading of soil
- Application of fertilizers to facilitate vegetation growth over disposal sites.

For stabilization of muck dumping areas following measures of engineering and biological measures have been proposed

Engineering Measures

- Wire crate wall
- Boulder crate wall
- R.C.C
- Catch water Drain

Biological Measures

- Plantation of suitable tree species and soil binding species
- Plantation of ornamental plants
- Barbed wire fencing

Muck generally lacks nutrients and therefore, are difficult to re-vegetate. However, if no attempts to vegetate the slopes are made, the muck could slide lower down during rain and may eventually wash off the check dams also. Since, top soils are not available in large quantities in Himalayas, it may not be possible to apply a thin layer of soil over the muck. Bio-fertiliser technique developed by National Environmental Engineering Research Institute (NEERI) can be adopted in the proposed project. NHPC has successfully used this technique in Uri hydroelectric

project. Similar approach can be utilized in the proposed project as well. In this process, the unused excavated material is piled and stacked with proper slopes at the designated muck disposal sites. The slopes are broken up by creating benches across them. This is done to provide stability to the slopes and also to provide ample space for planting of trees that would further help in holding and consolidating biotechnological approach. The traditional methods of afforestation of these areas would be supplemented with the use of fungus, i.e. Vesicular Arbuscular Mycorrizae (VAM) and nitrogen fixing bacteria that form partnership with plant roots. These grow on plant roots and provide water and nutrition especially phosphorus to plants at faster rate. The seeding of plants would be inoculated with VAM and nitrogen fixing bacteria before planting. It has been found that plants inoculated with bio-fertilizers grow at faster rate especially in the medium where the soil/rock is devoid of nutrients.

The afforestation with suitable plant species shall be done. About 1000-1200 trees/ha shall be planted. The tentative list of plant species suggested for afforestation is as follows:

Botanical Name

Trees

- *Alnus nepalensis*
- *Leucaena leucocephala*
- *Myrica esculenta*
- *Grevillea robusta*
- *Pinus roxburghii*

Shrubs

- *Jatropha carcus*
- *Berberis asiatica*
- *Berberis lyceum*
- *Desmodium elegan*

Grasses

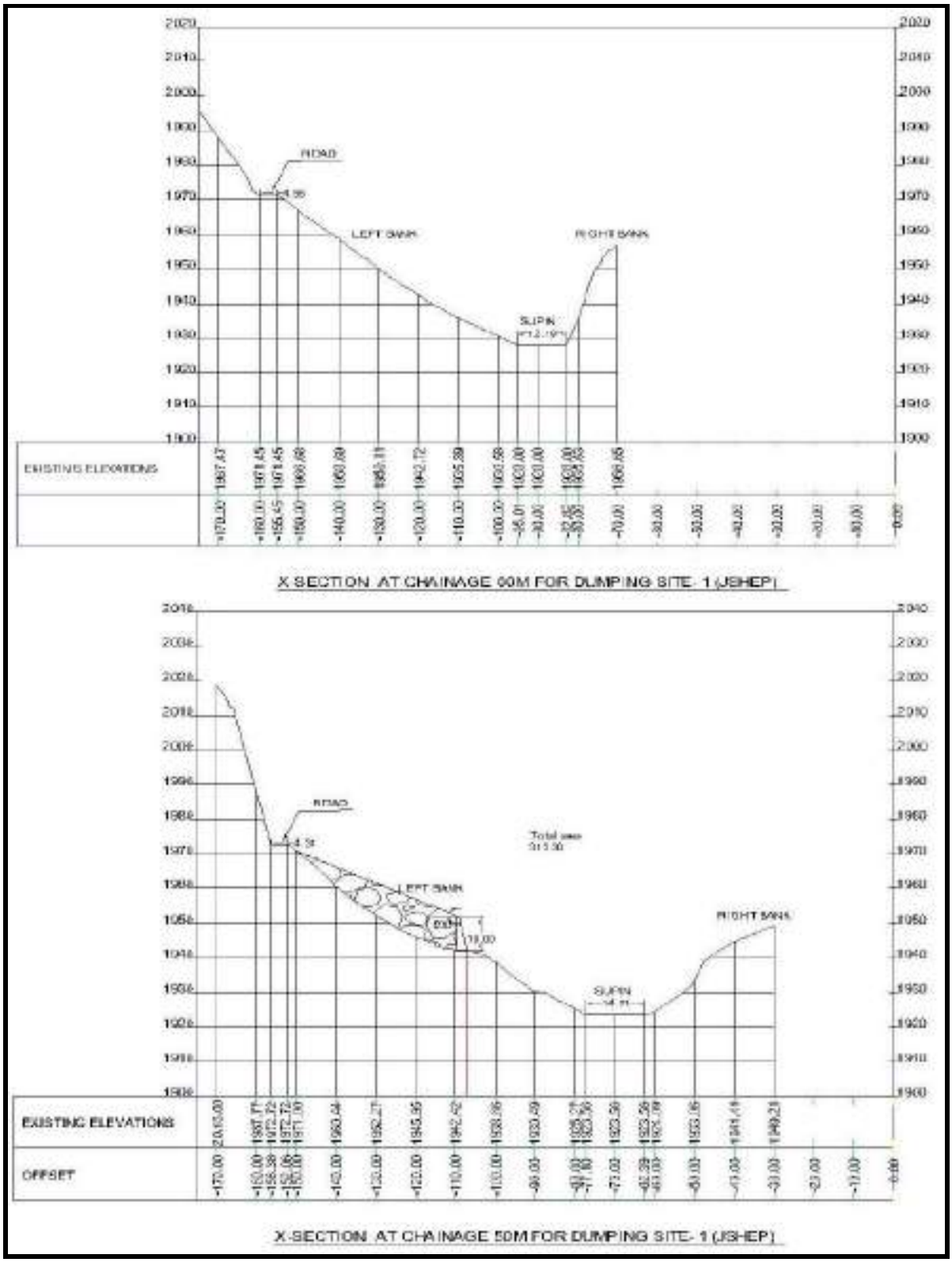
- *Arundinella nepalensis*
- *Agrimonia pilosa*
- *Alexandrium folium*
- *Cynodon dactylon*
- *Geranium ocellatum*
- *Solanum nigrum*

6.5 BUDGET

A provision of Rs.42.1 million has been earmarked for stabilization and restoration of muck disposal site. The details are given in Table-6.4.

TABLE-6.4
Cost estimate for stabilization of muck disposal sites

S. No.	Works	Quantity	Unit	Rate (Rs.)	Cost (Rs.million)
A. Engineering Measures					
1.	Boulder Crate Wall	8000	m^3	1000	8.0
2.	Masonry Wall	3000	m^3	4000	12.0
3.	Catch Water Drain	2000	m^3	4000	8.0
4.	Levelling including spreading of soil		LS		1.0
	Sub-Total (A)				**29.0**
B. Biological Measures					
1.	Plant sapling procurement			LS	0.1
2.	Plantation			LS	4.0
3.	Fencing			LS	4.0
4.	Biological fertilizer procurement			LS	2.0
5.	Watch and ward				3.0
	Sub Total (B)				**13.1**
	Total (A+B)				**42.1**



X SECTION AT CHAINAGE 00M FOR DUMPING SITE- 1 (JSHEP)

X-SECTION AT CHAINAGE 50M FOR DUMPING SITE- 1 (JSHEP)

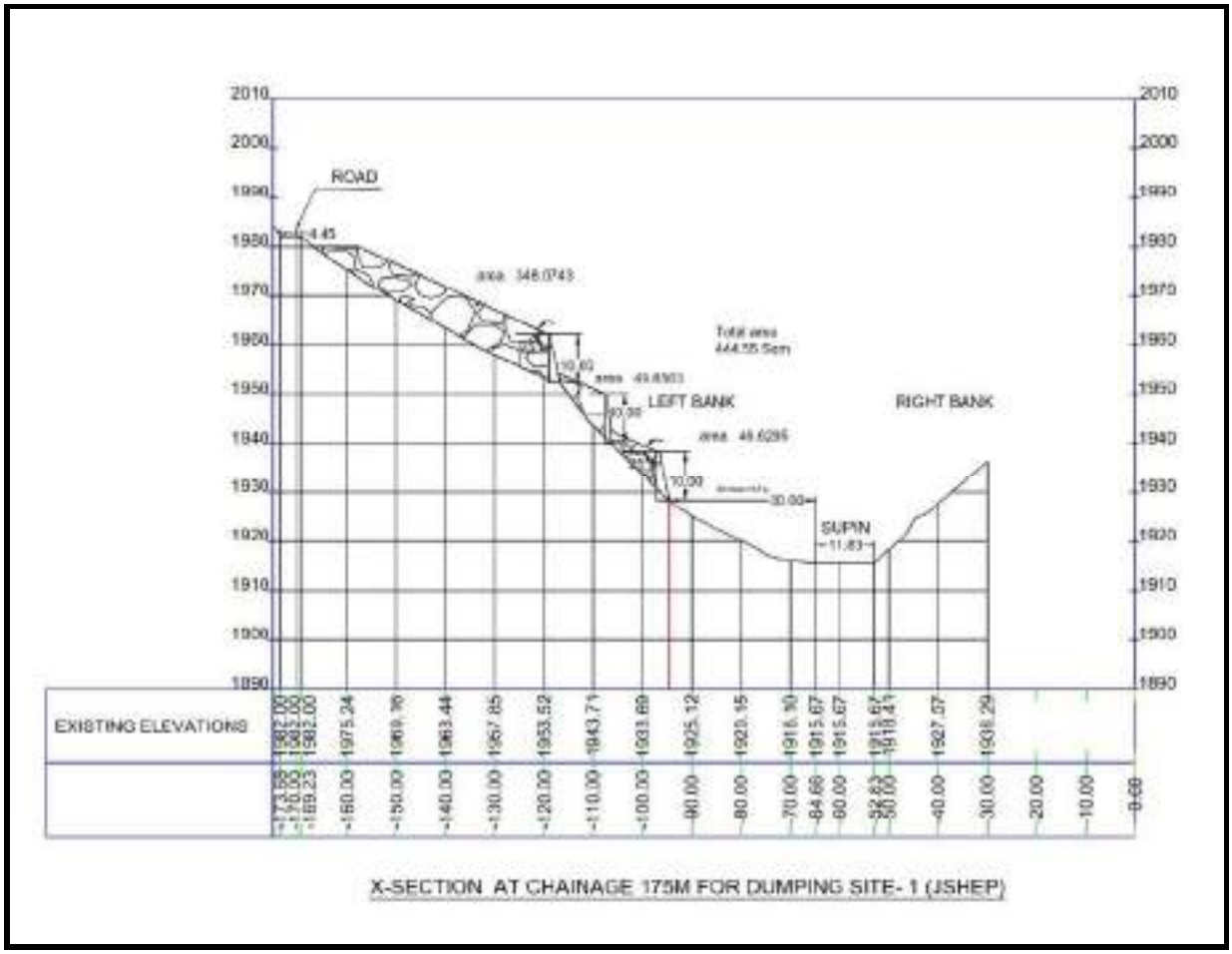


Figure-6.1 Cross-sections of Dumping site-1

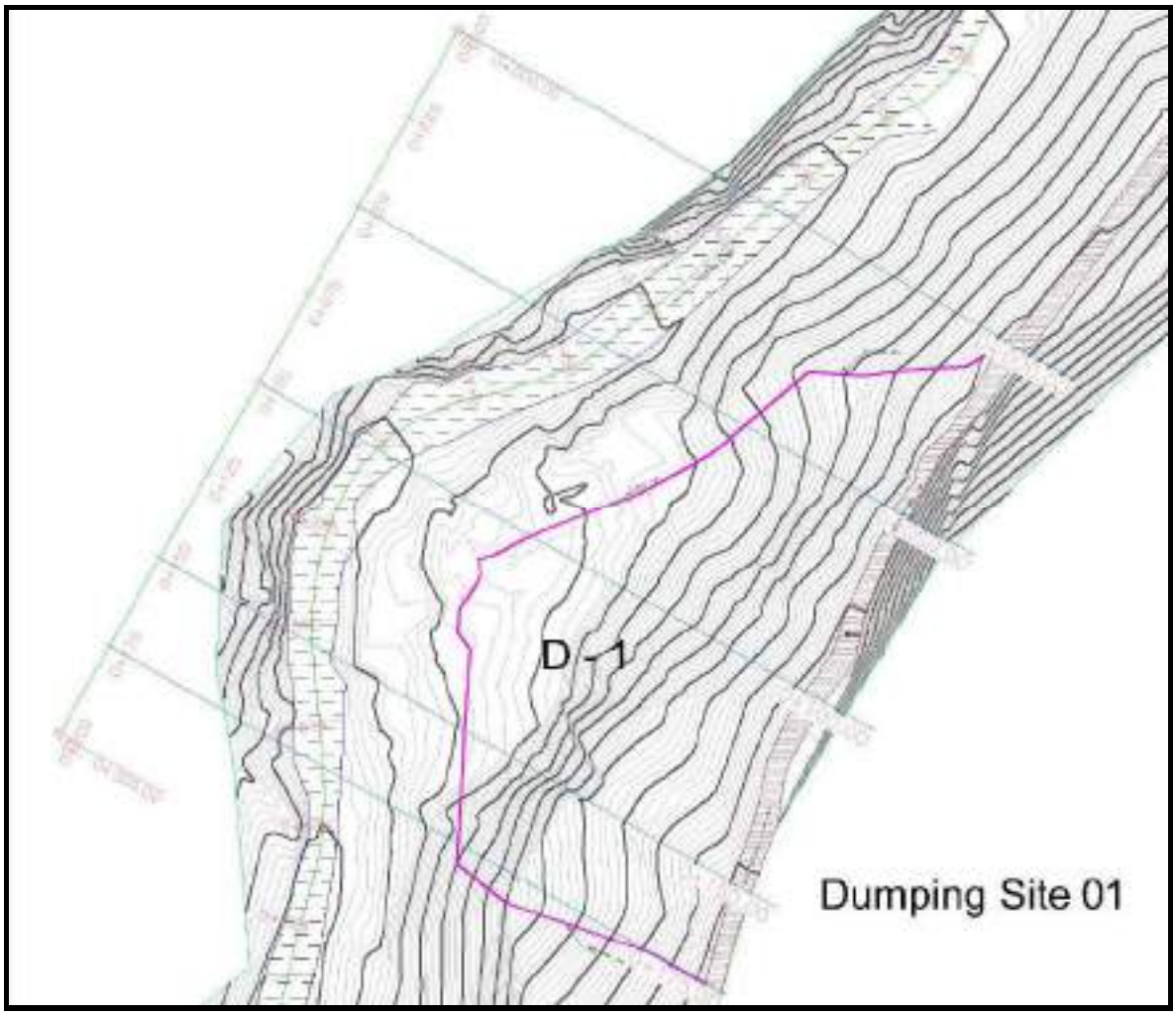
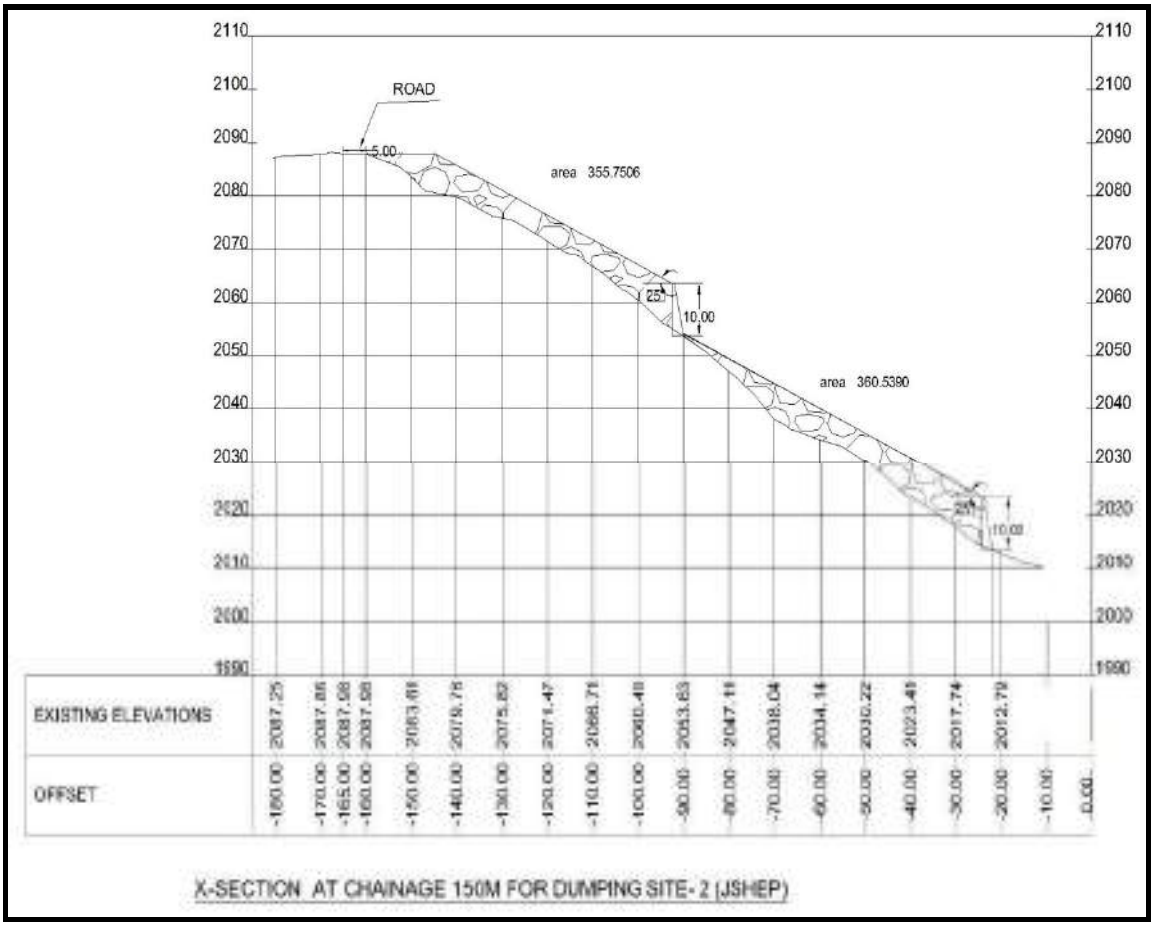


Figure-6.2: Topographical Contour Map of Dumping Site-1



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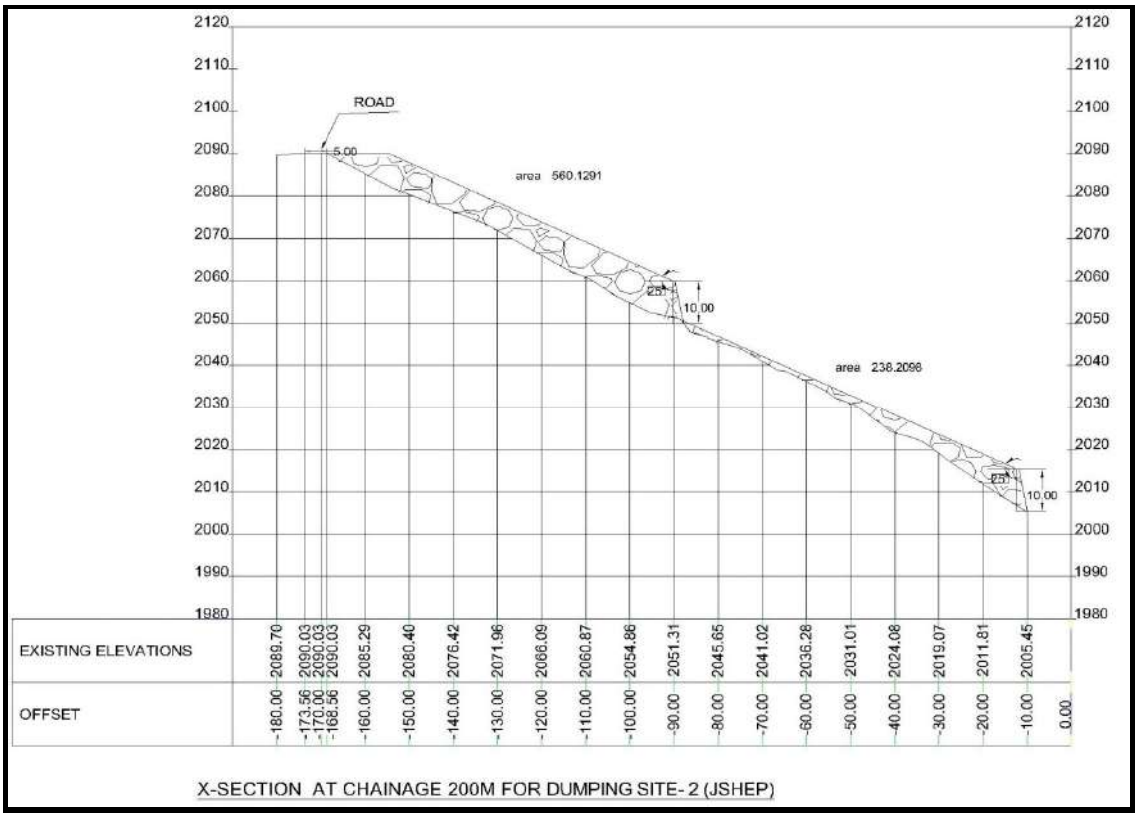

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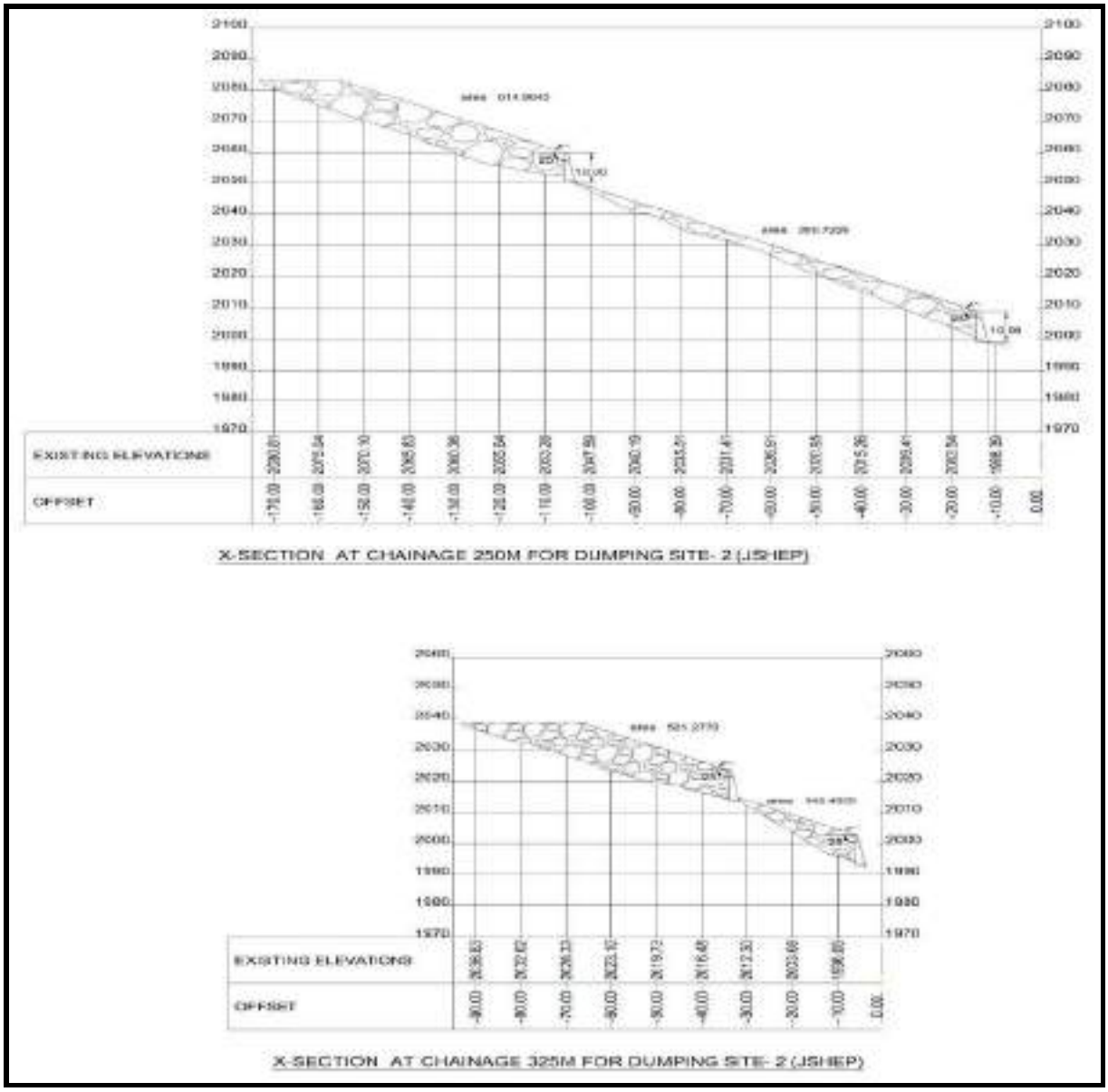


Figure-6.3 Cross-sections of Dumping site-2

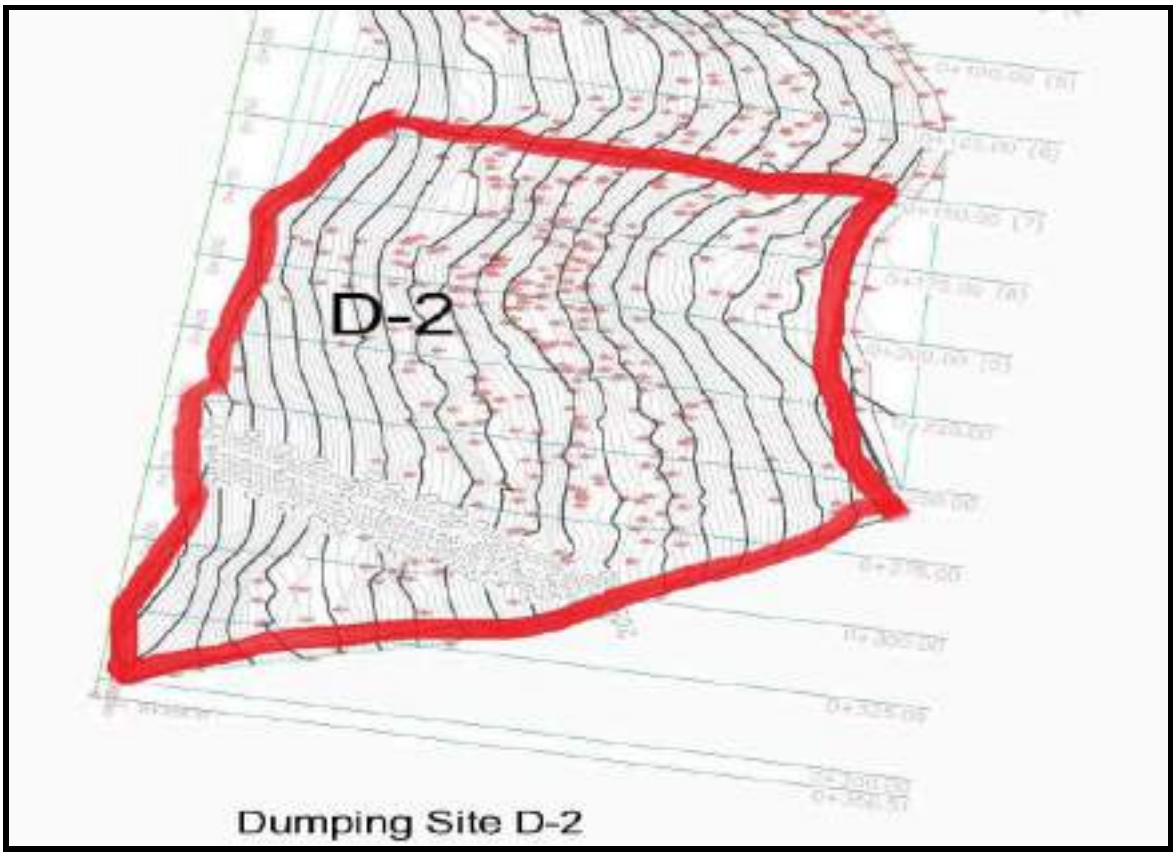
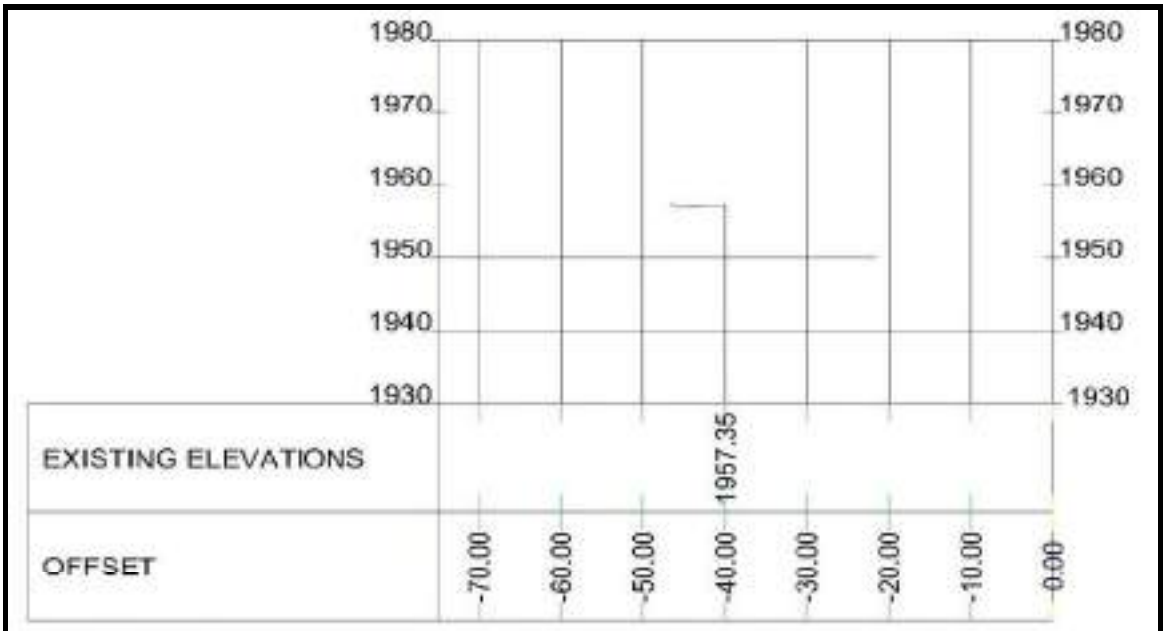
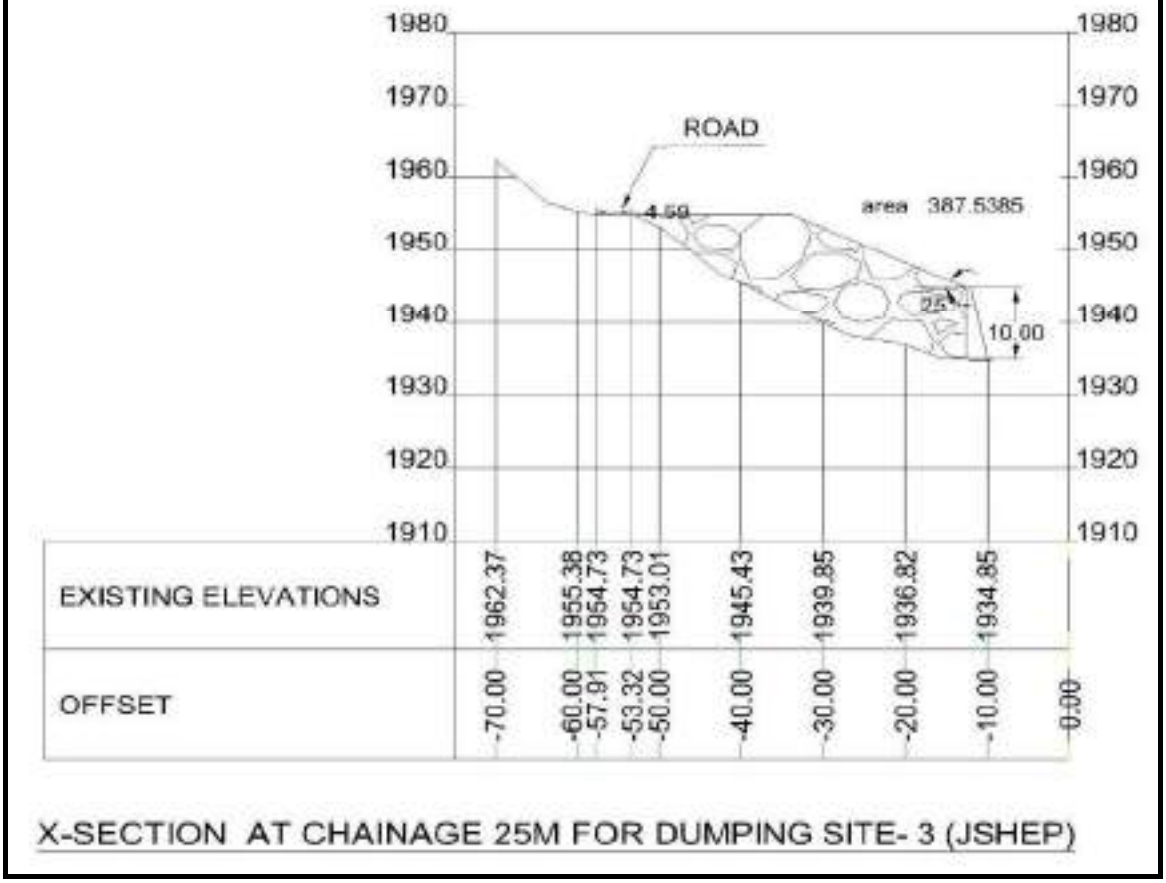


Figure-6.4 Topographical Contour Map of Dumping Site-2 (D-2)



X-SECTION AT CHAINAGE 00M FOR DUMPING SITE- 3 (JSHEP)



X-SECTION AT CHAINAGE 25M FOR DUMPING SITE- 3 (JSHEP)

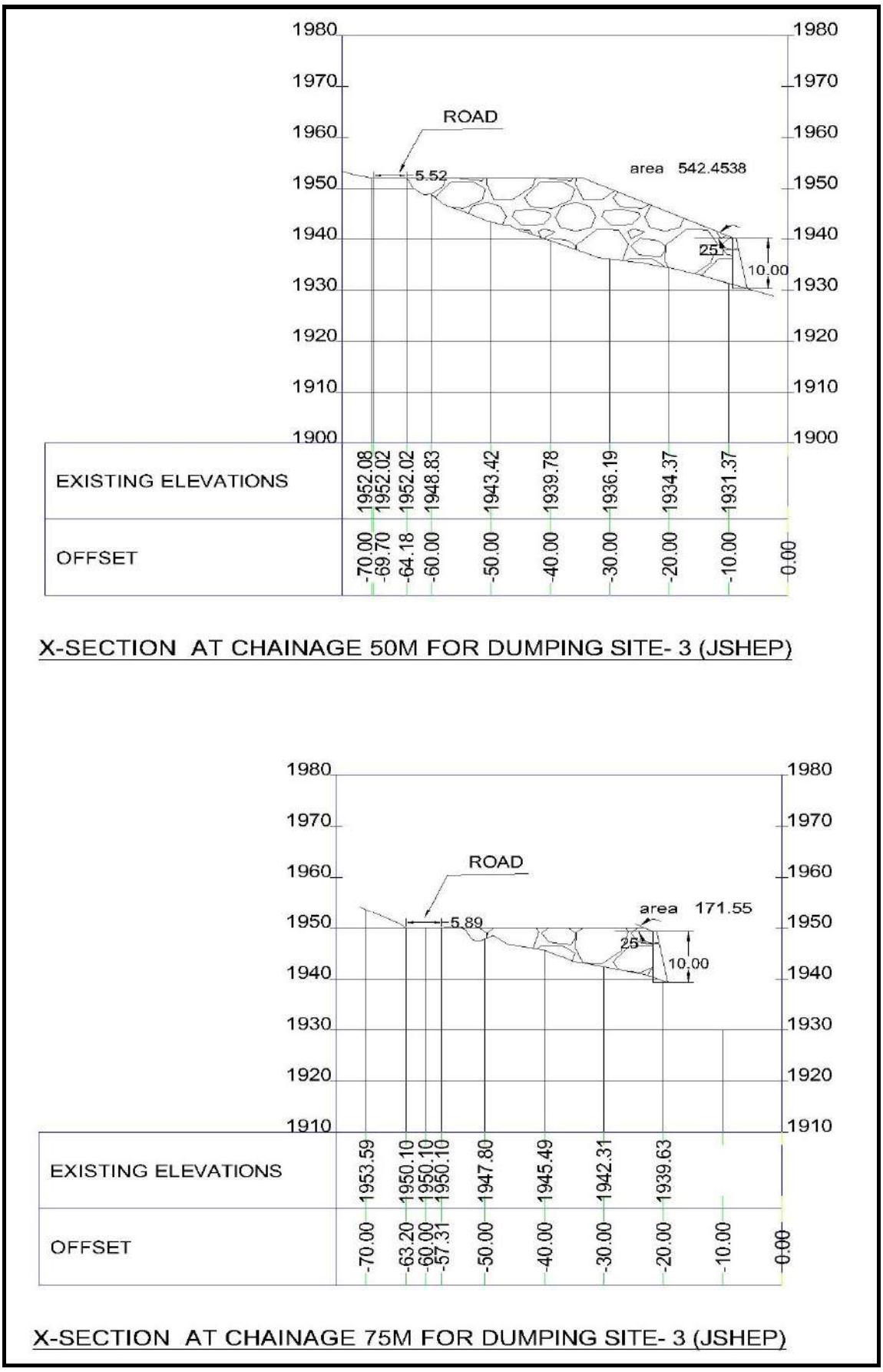


Figure-6.5 Cross-sections of Dumping site-3

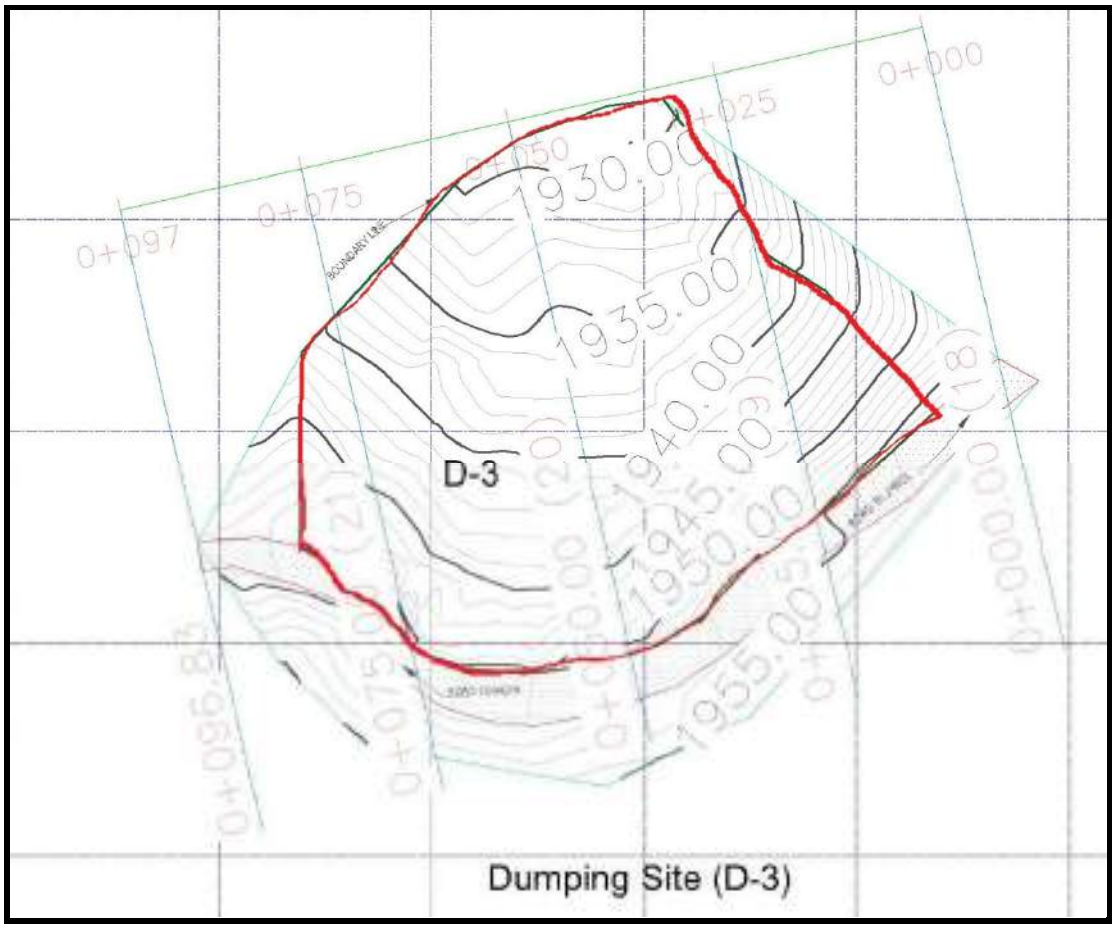
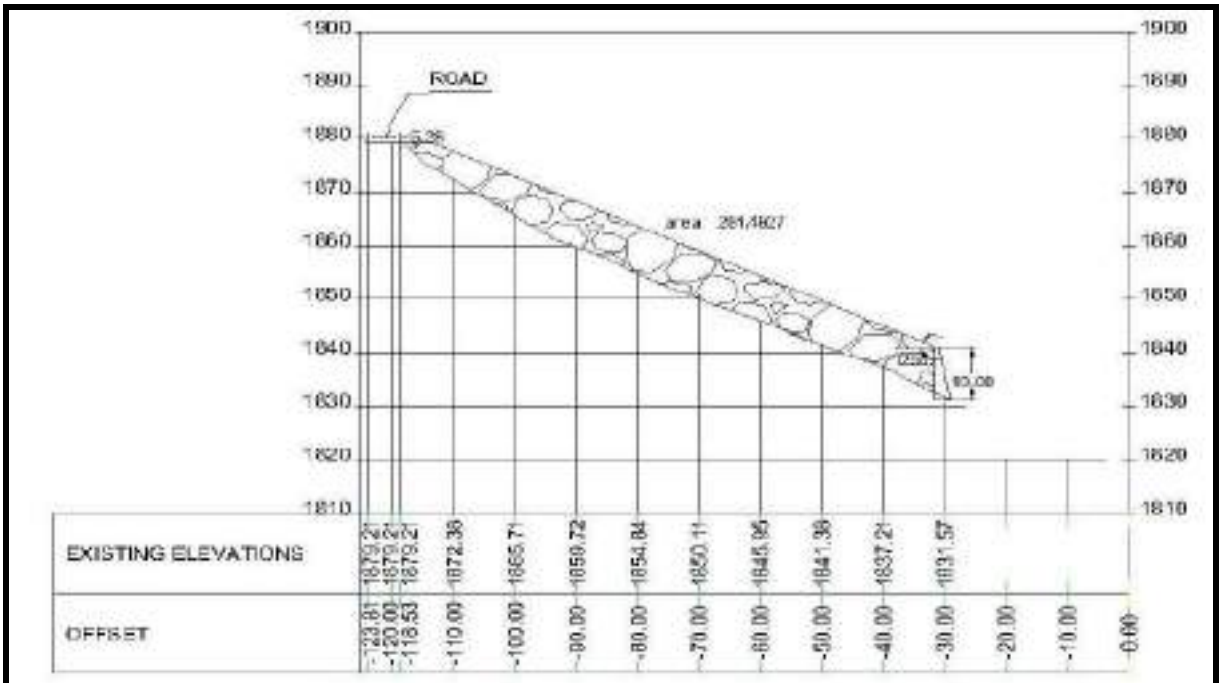


Figure-6.6: Topographical Contour Map of Dumping Site-3 (D-3)



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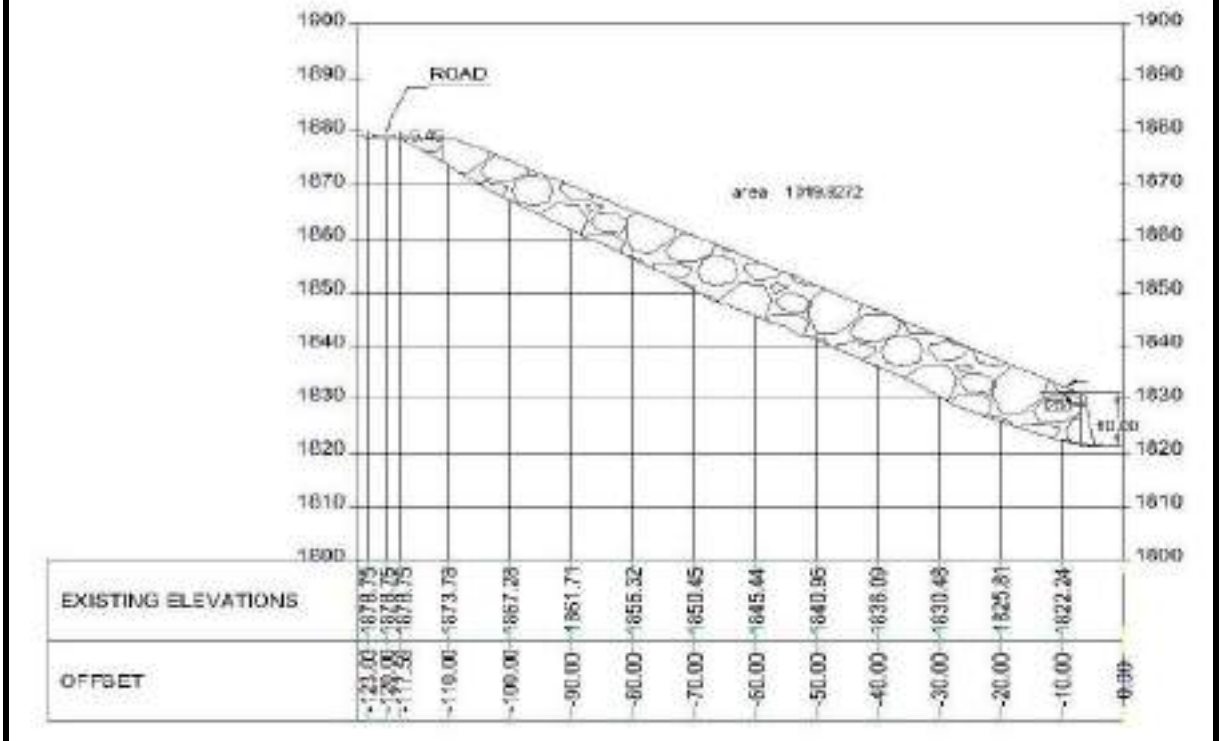

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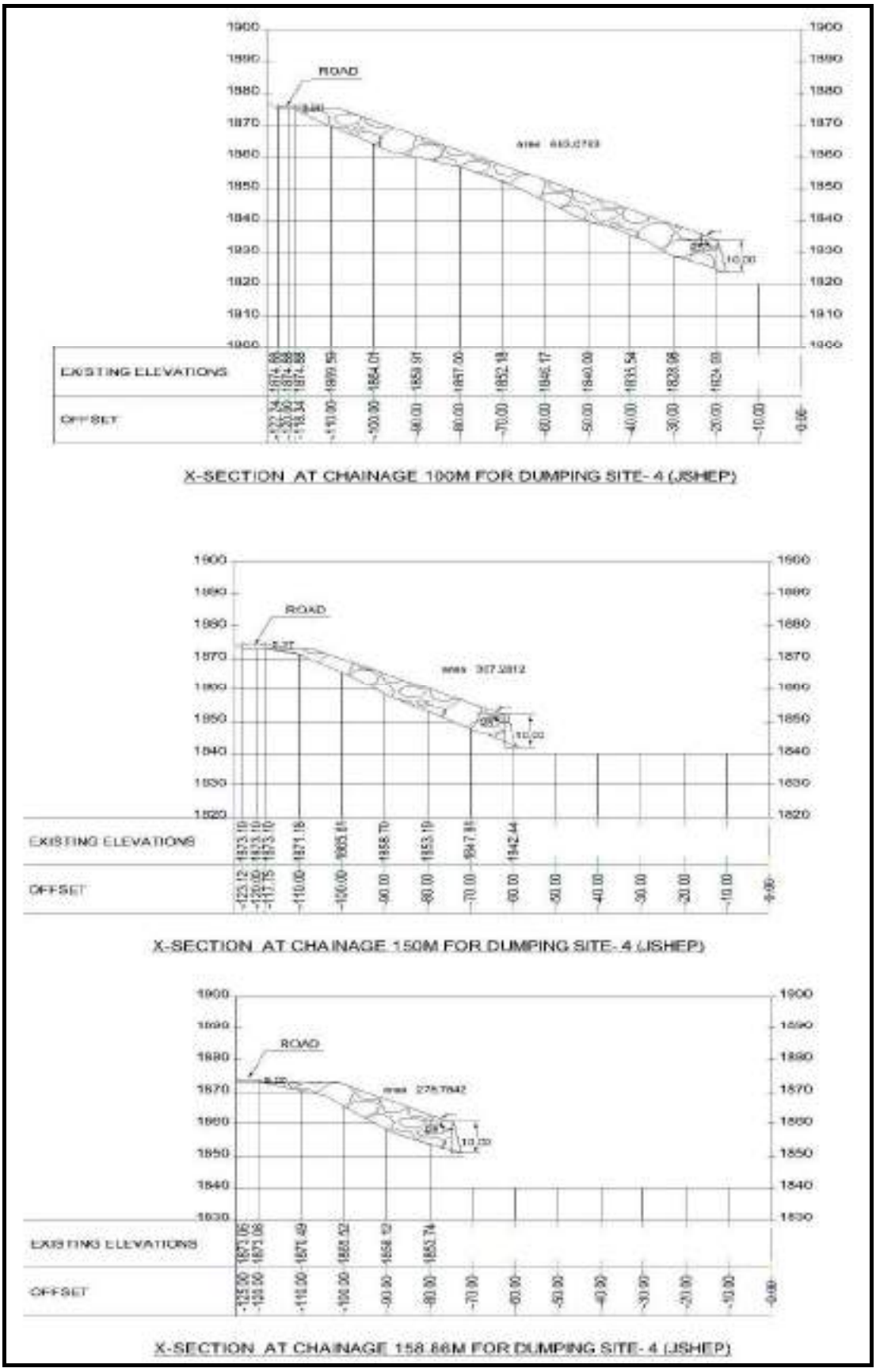


Figure-6.7 Cross-sections of Dumping site-4

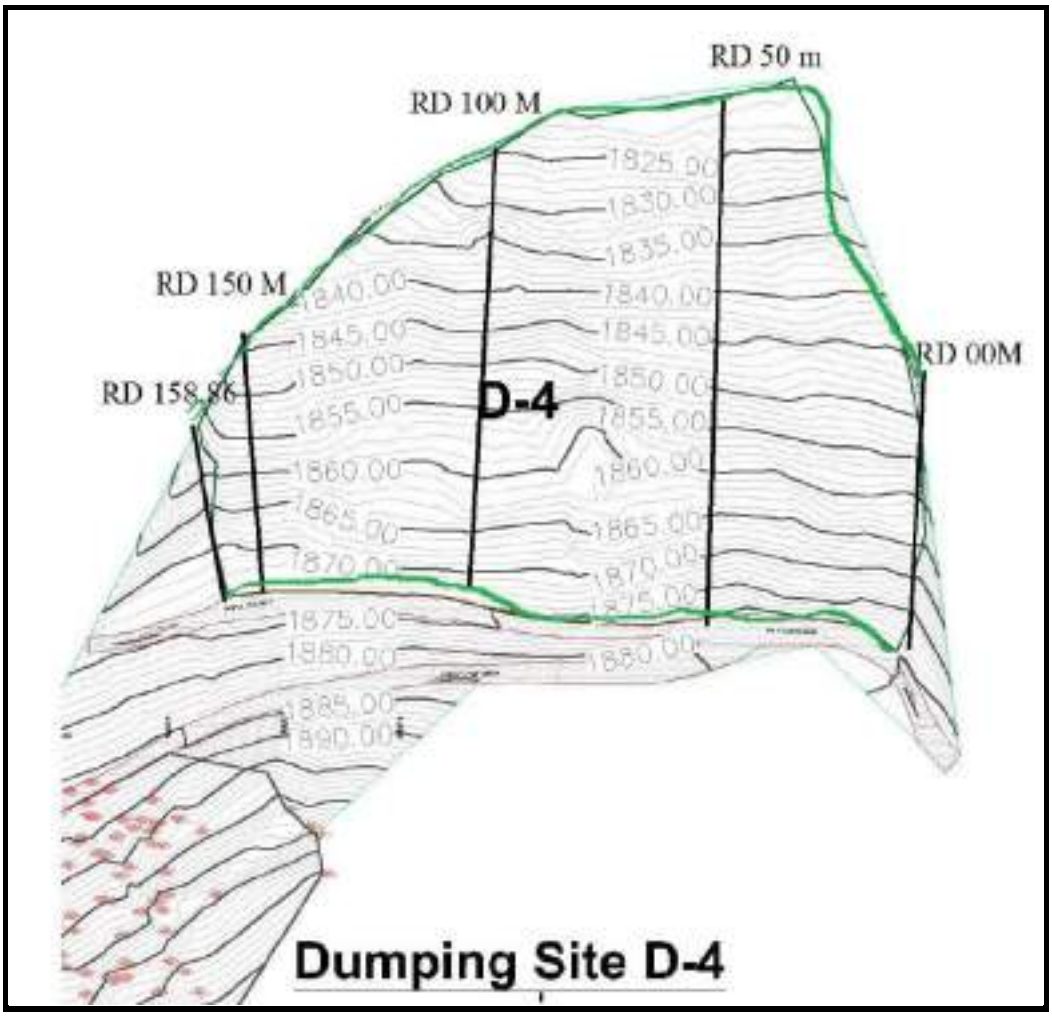
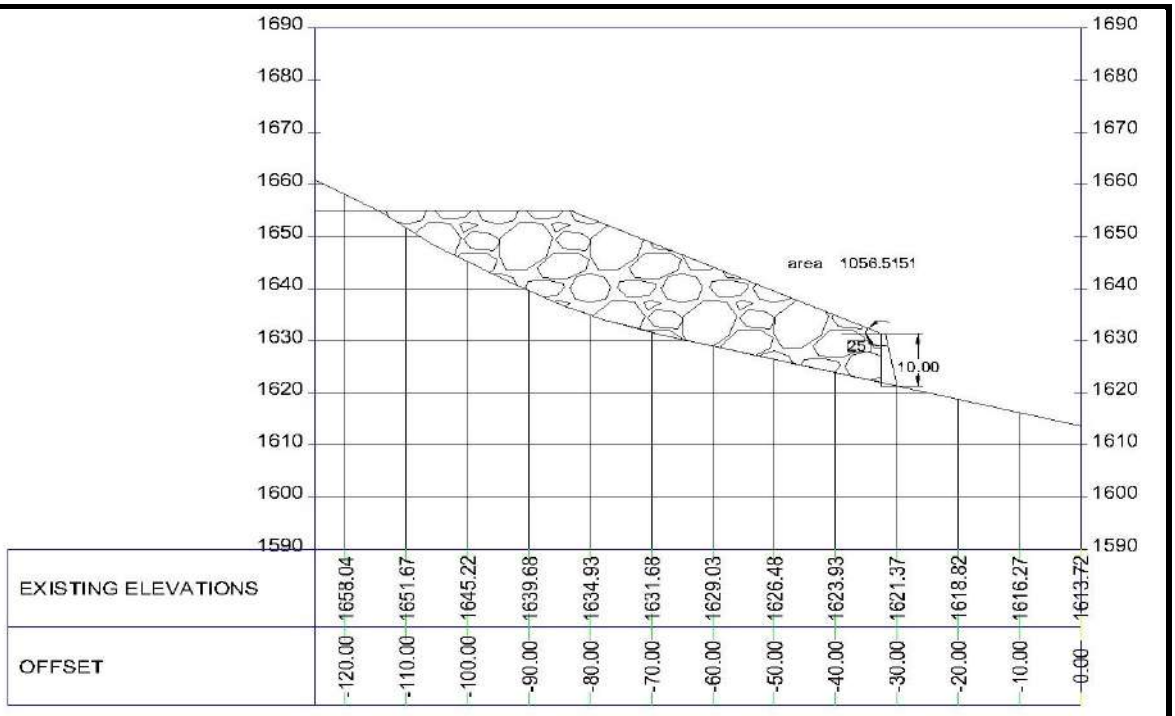
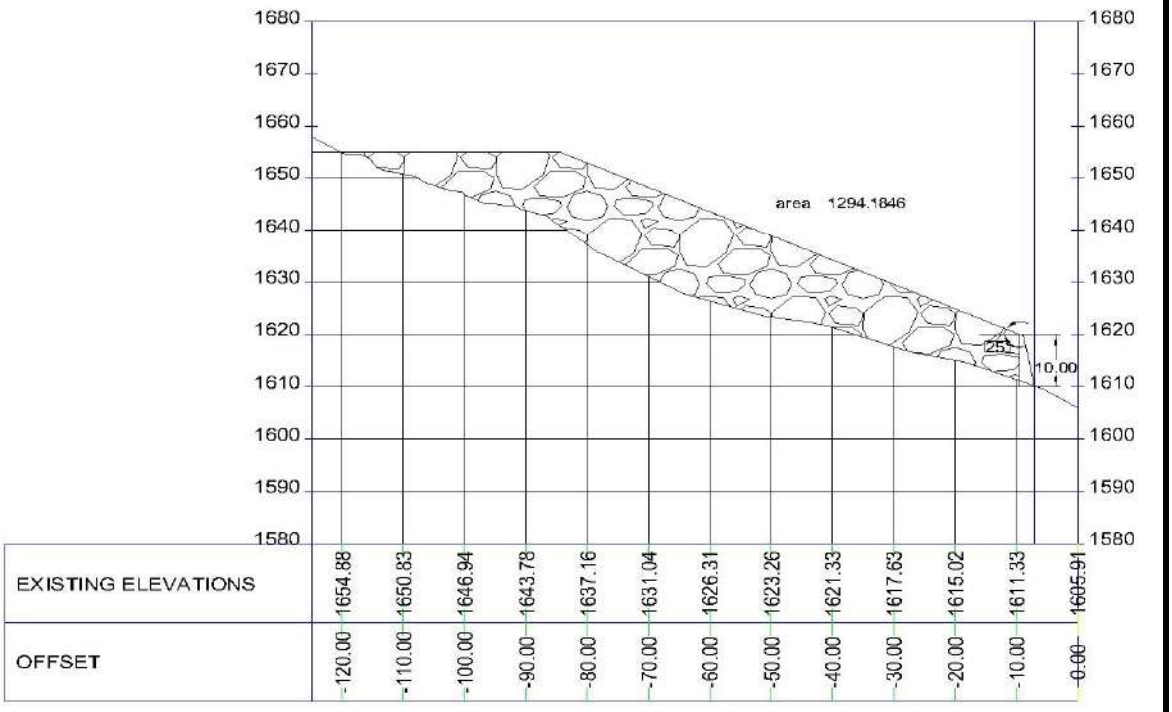


Figure-6.8: Topographical Contour Map of Dumping Site-4 (D-4)



X-SECTION AT CHAINAGE 00M FOR DUMPING SITE- 5 (JSHEP)



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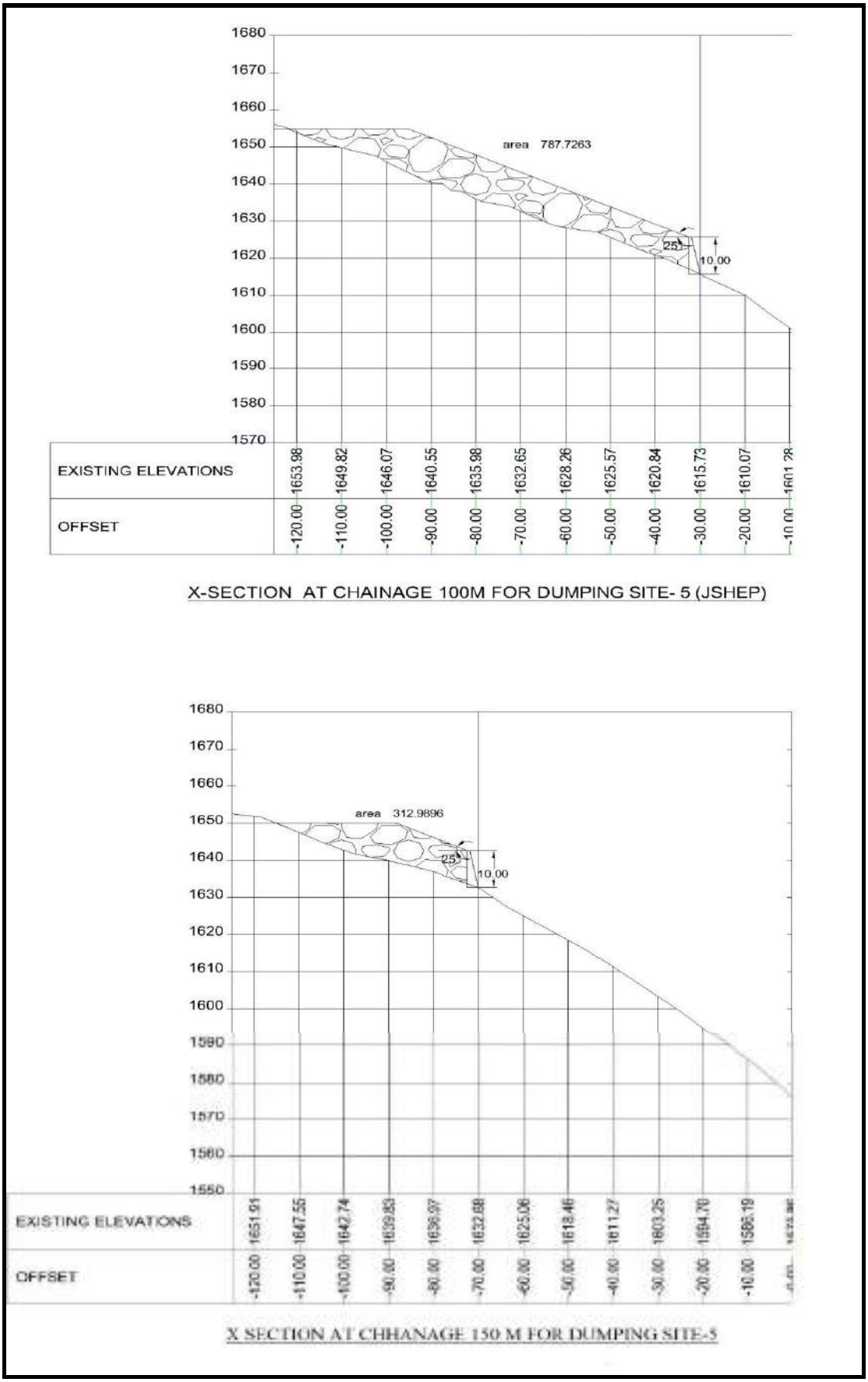


Figure-6.9 Cross-sections of Dumping site-5

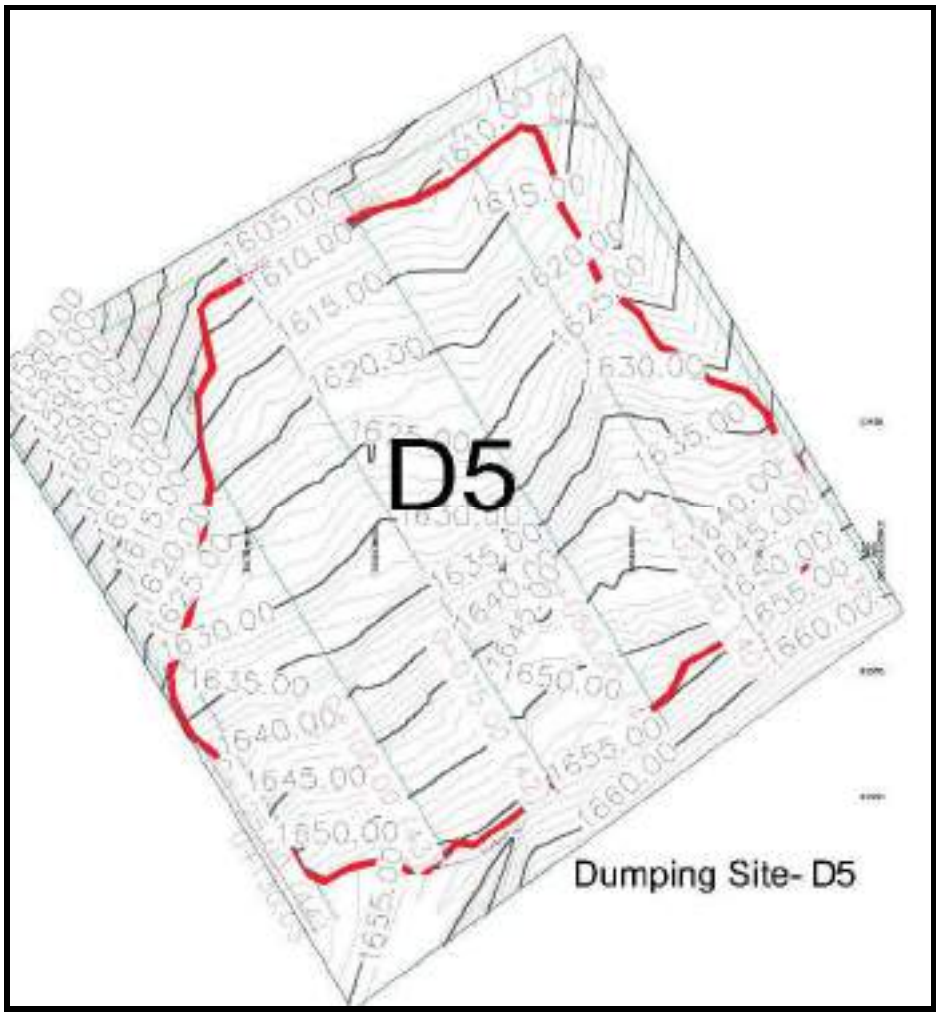
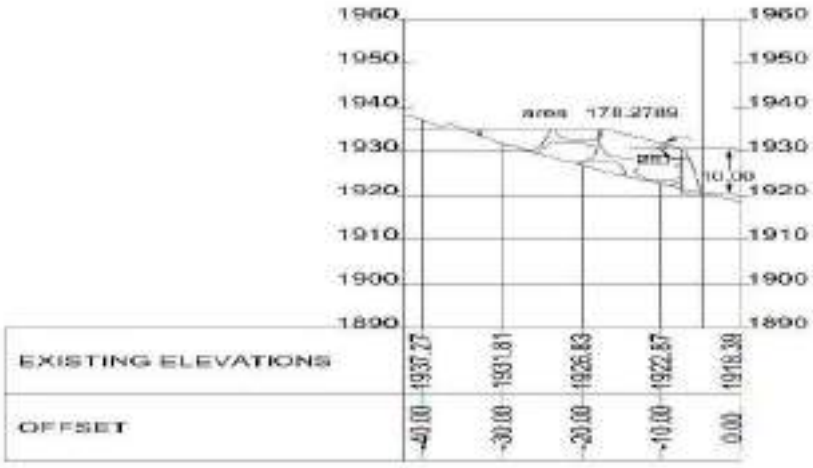


Figure-6.10: Topographical Contour Map of Dumping Site-5 (D-5)



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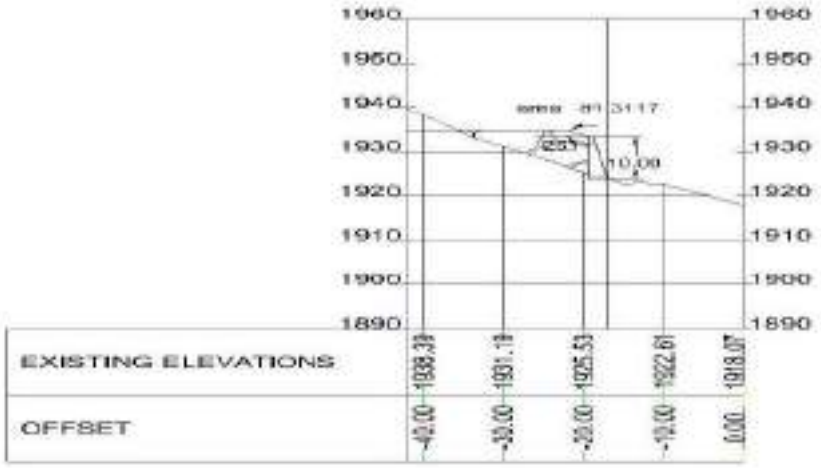

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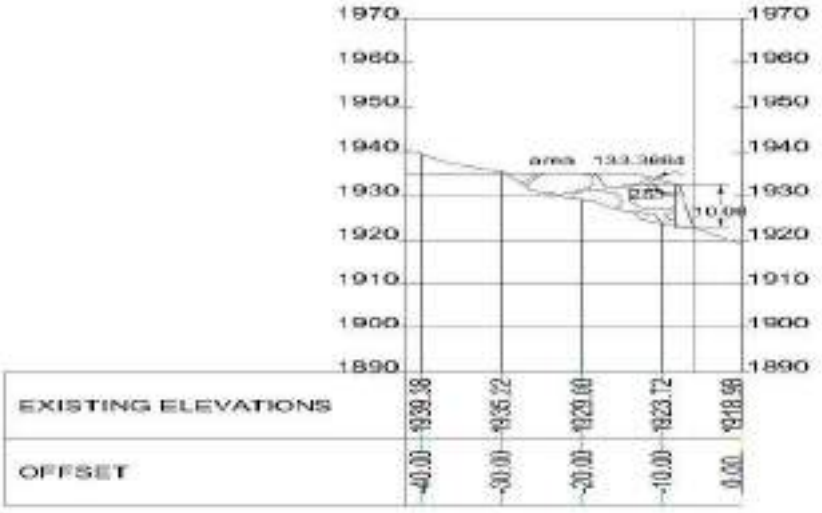

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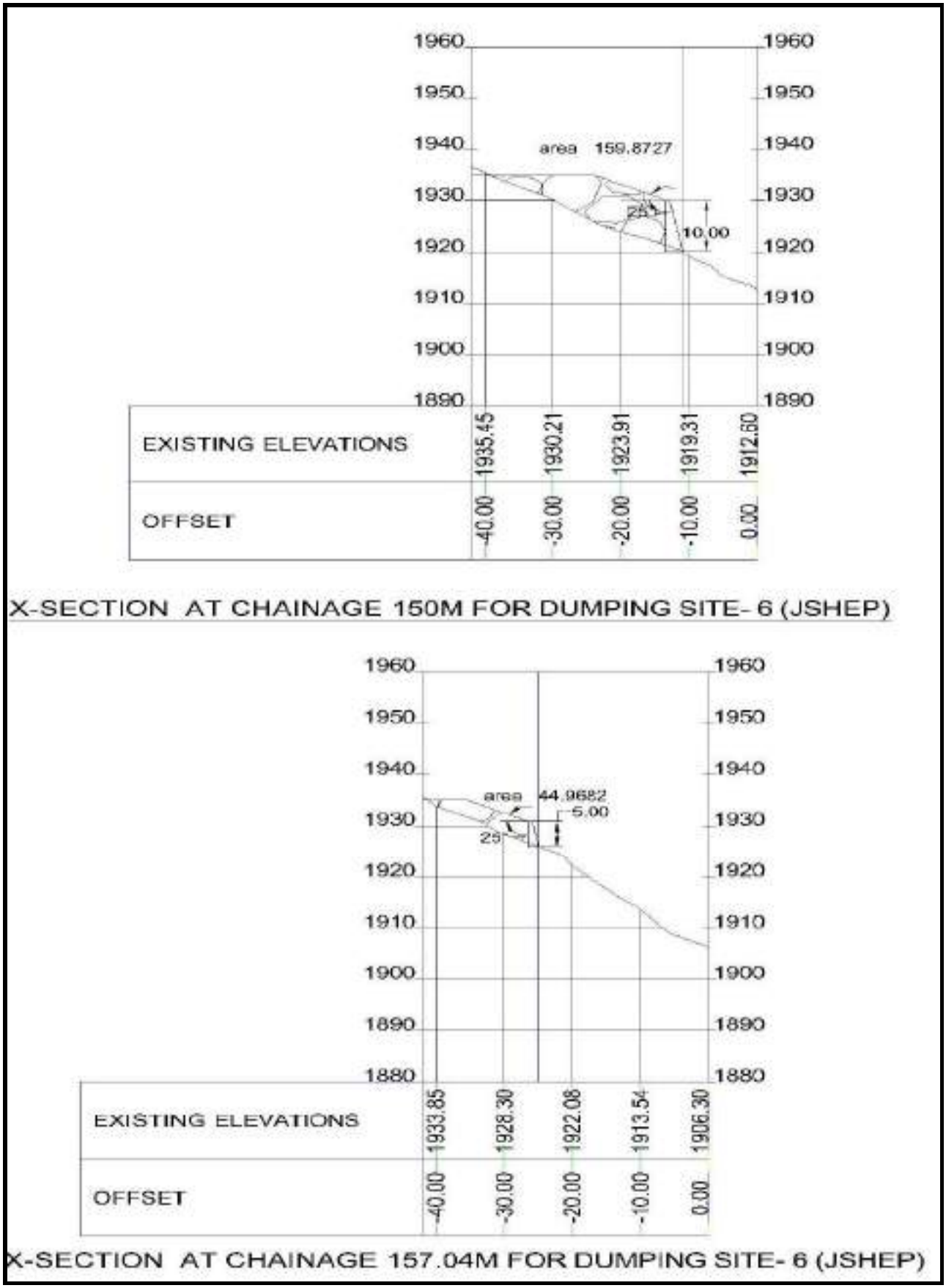

Figure-6.11 Cross-sections of Dumping site-6

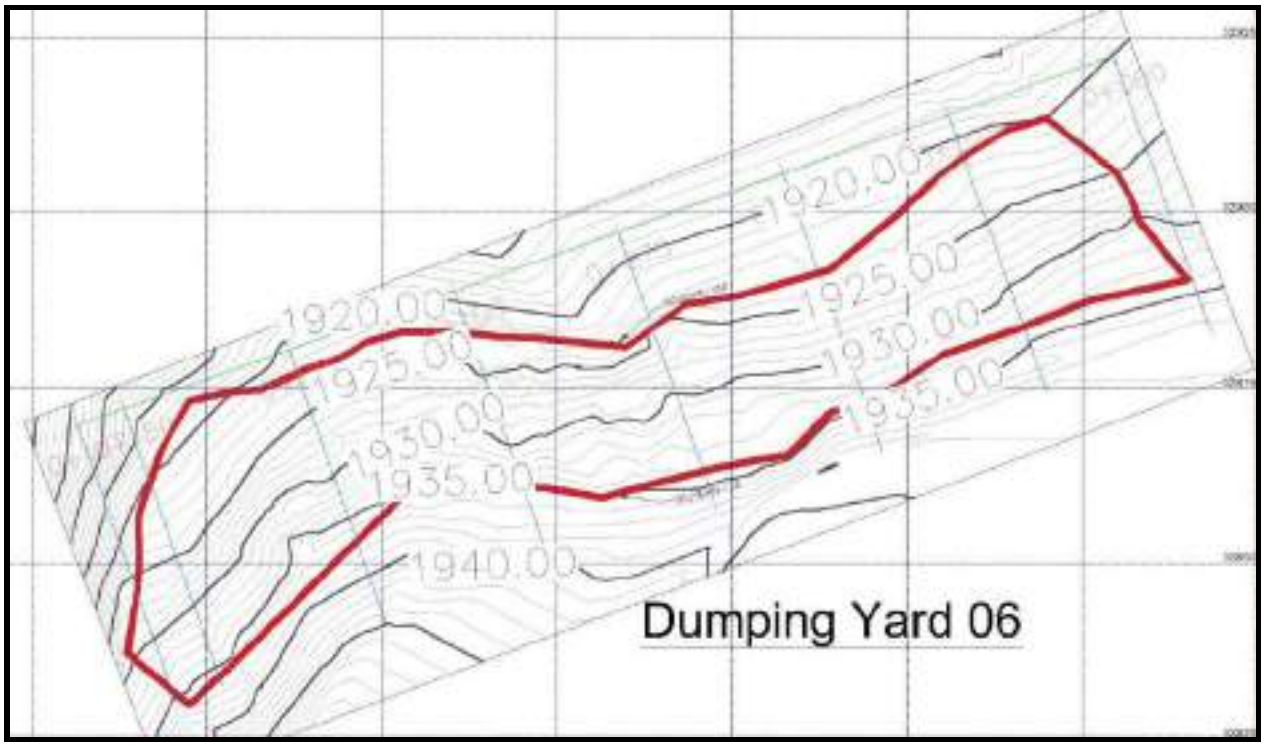

Figure-6.12: Topographical Contour Map of Dumping Site-6 (D-6)

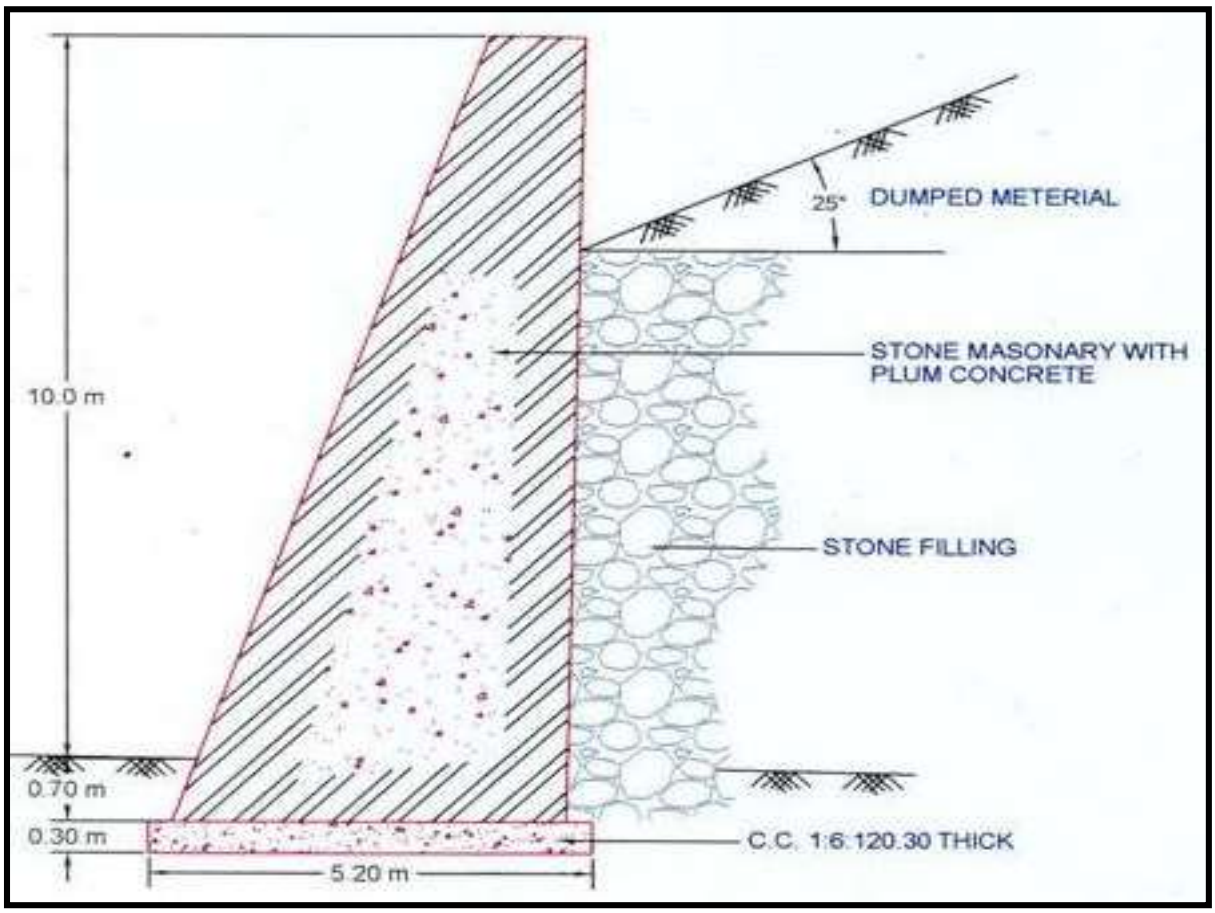

Figure-6.13: Cross section of Retaining Wall