भारत सरकार
जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय
केन्द्रीय भूमि जल बोर्ड

GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION

CENTRAL GROUND WATER BOARD

Artificial Recharge Plan for the Over Exploited Morshi Taluka of Amravati District

मध्य क्षेत्र, नागपुर

CENTRAL REGION, NAGPUR

जुलाई -2016 / July-2016

ARTIFICIAL RECHARGE PLAN AT A GLANCE

1.	Total Geographical Area of the Morshi Block (Taluka)	809.10 km^2
	❖ Area occupied by Hard Rock (Basalt)	729.91 km^2
	❖ Area occupied by Soft Rock (Alluvium)	79.19 km^2
2.	Major land use pattern	Agriculture especially orange cultivation
3.	Average Annual Rainfall (mm)	961 mm
4.	Major Drainage	Wardha & Purna River
5.	Area identified for Artificial Recharge *(considering average decadal (2005-14) post-monsoon water level more than 5 m bgl, long term post-monsoon water level trend, depth of weathering and lineaments)*	525.55 km^2
6.	Overall quality of groundwater	Suitable for domestic, industrial and irrigation use
7.	Availability of Surplus surface runoff (MCM)	13.802 MCM
8.	Surplus surface runoff considered for planning (MCM) *(70% of surplus surface runoff)*	9.66 MCM
9.	Runoff for RWH in Urban Household	0.173 MCM
10.	Sub-surface storage potential available (MCM)	30.77 MCM
11.	Proposed Artificial Recharge & Water Conservation Plan	

Item	Percolation Tank	Check Dam	Recharge Shaft	Water Conservation Structure	Roof Top Rain Water Harvesting (for 10% houses)
❖ Proportionate Allocation of surplus runoff (MCM)	6.50	2.32	0.37	0.46	0.173
❖ Feasible number of structures	32	77	6	31	4245
❖ Unit cost of structures (crores)	0.70	0.07	0.025	0.0025	0.0008
❖ Estimated Cost (Crores)	22.4	5.39	0.15	0.077	3.40
❖ Expected Recharge (MCM) (considering 85 % efficiency)	5.52	1.97	0.31	0.39	0.147

12.	Total estimated cost (Crores)	31.41 crores

Artificial Recharge Plan for the Over Exploited Morshi Taluka of Amravati District

1. INTRODUCTION

Groundwater being most dependable source of water supply is under tremendous stress to meet the ever increasing demand of irrigation, industrial and domestic sector. The over exploitation of this resource has resulted in to decline in water levels in many part of the Country and many of the water assessment units are thus categorised as over-exploited blocks. The state of Maharashtra also faces the problem of groundwater over- development in some of the areas. Many talukas have been identified as Critical / Over-Exploited based on the ground water resources estimation based on GEC-97 Methodology. As per the latest groundwater resource assessment as on March 2011, 10 talukas have been identified as Over-Exploited.

Immediate remedial measures are therefore required to be taken up for converting these talukas into Critical / Semi-critical / Safe categories. The present artificial recharge plan has been prepared for the Morshi taluka of Amravati district within this objective and which will form the base for the future strategy.

2. LOCATION

Morshi Taluka covers an area of about 809.10 sq.kms and located in the NE part of Amravati district of Maharashtra and lies between North latitude 21° 14' 16" to 21°25' 23"and East longitude 77°07' 44" to 77°53'24" (**Fig.1a and 1b)**. The population of the taluka is 1,82,484 persons as per 2011 census. There are 112 villages in the taluka. The taluka is known for its orange cultivation.

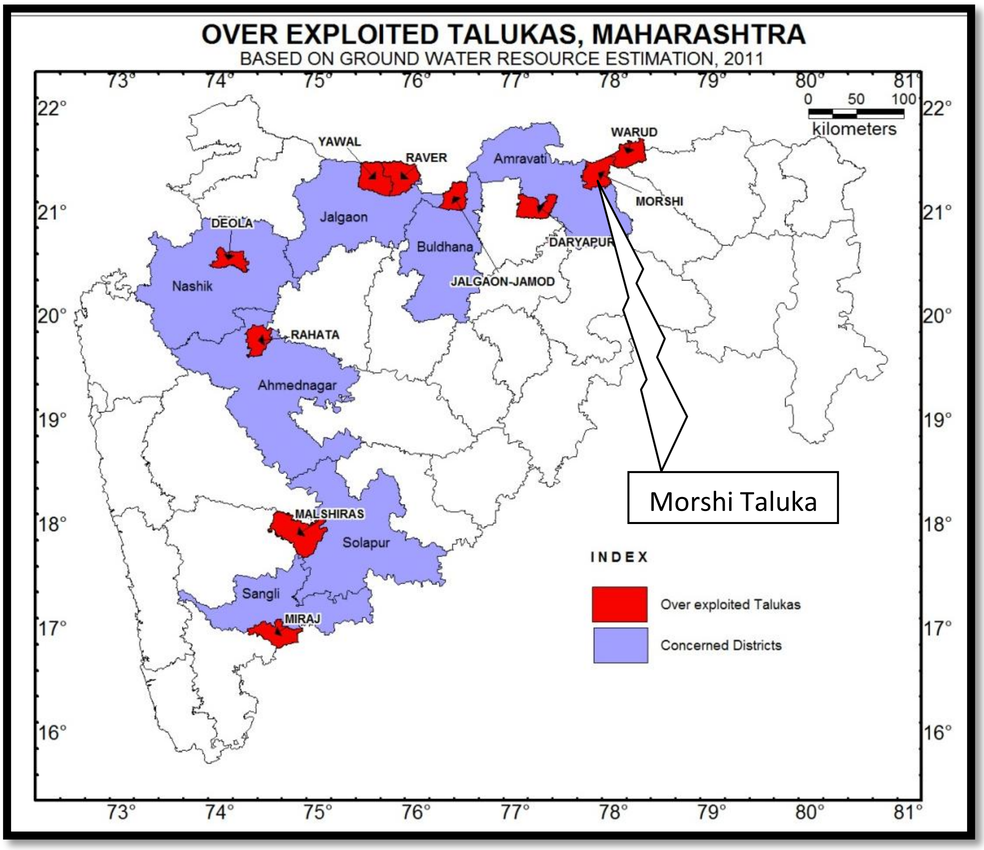


Figure 1a: Location of Morshi taluka, Amravati District, Maharashtra

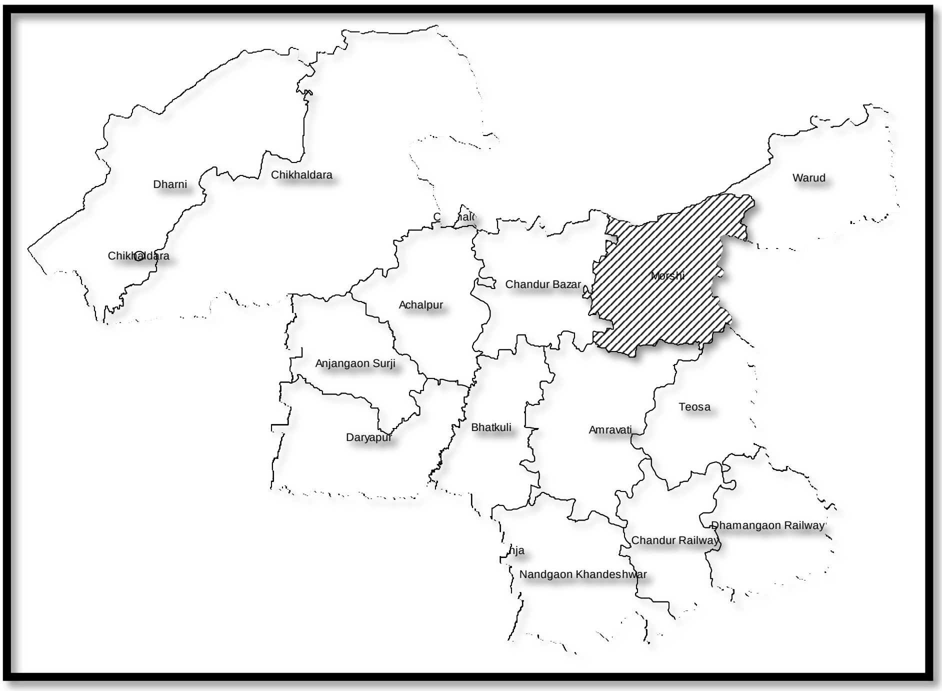


Figure-1b: Location of Morshi Taluka, Amravati District

3. PHYSIOGRAPHY & DRAINAGE

The taluka can be broadly divided into two physiographic units i.e., the Melghat Hill range and the plain area of the Paynghat. The Melghat hills are made up of Gawilgarh hills, which are a part of the Satpura hill ranges. The taluka is mainly drained by Wardha and Purna rivers (**Fig. 2a**).A digital elevation model of Morshi taluka indicating the village boundaries is shown in **figure 2b.**

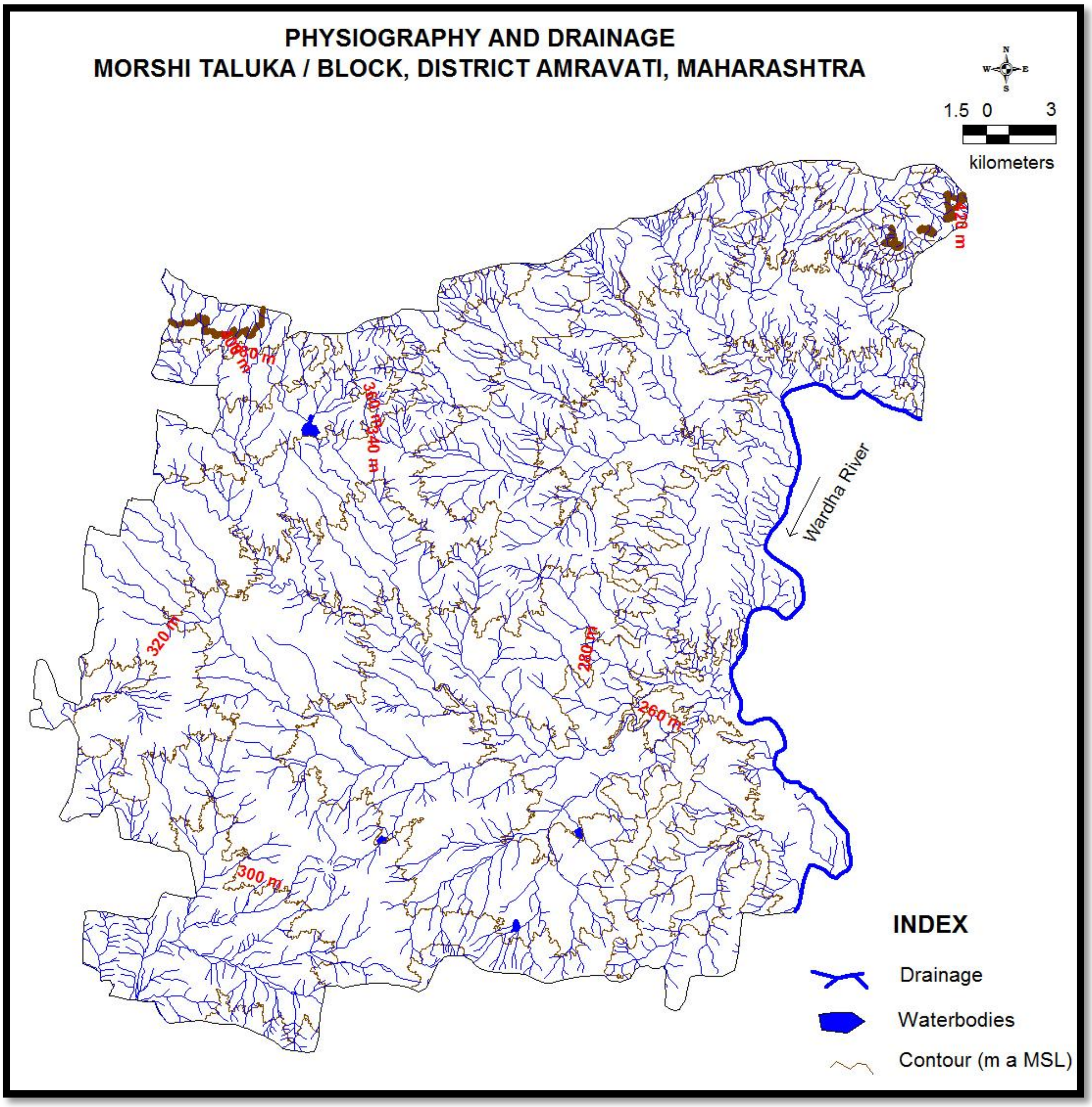


Figure2a: Physiography and Drainage, Morshi Taluka

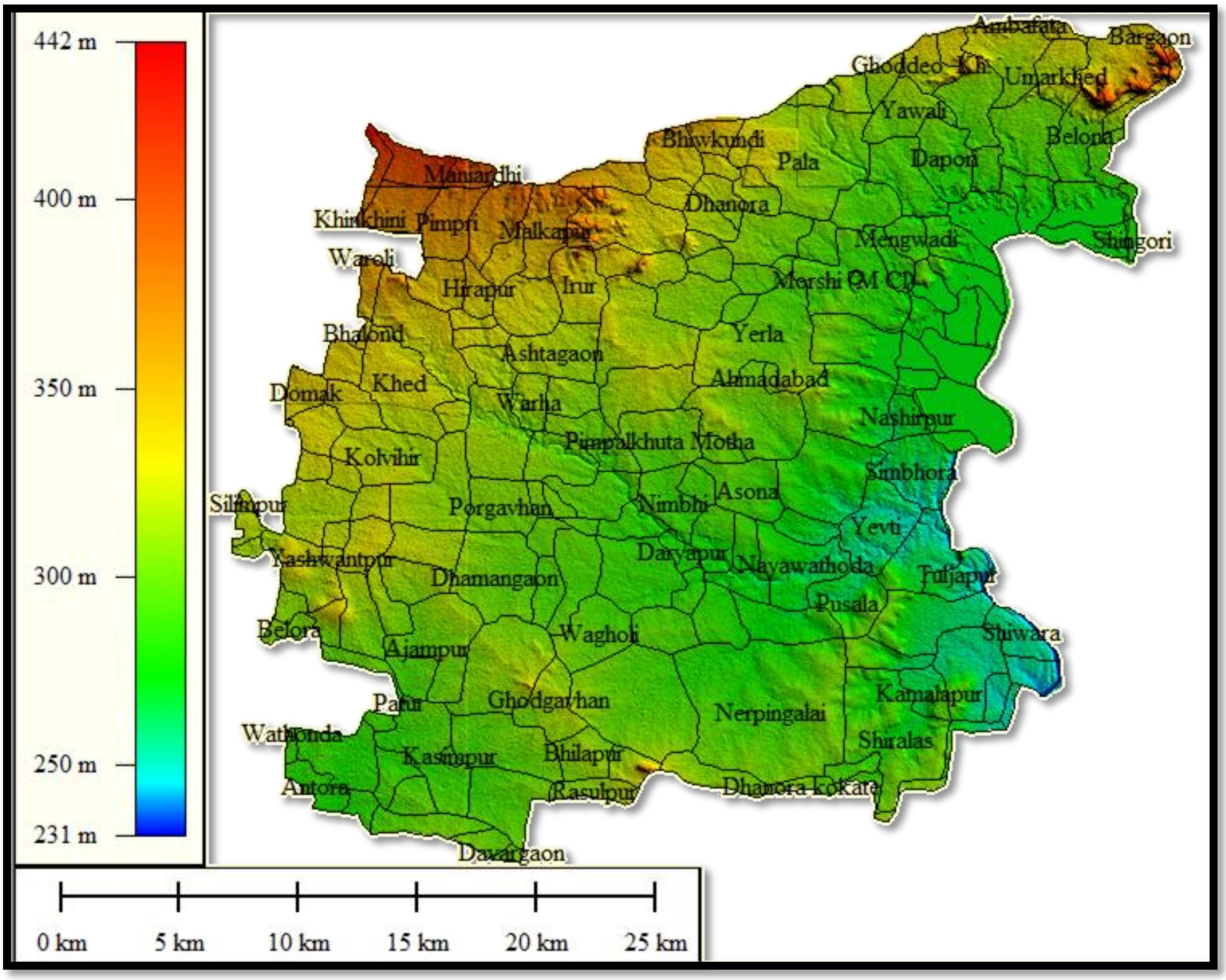


Figure2b: Digital Elevation Model, Morshi Taluka

4. RAINFALL

The area receives rainfall due to the south-west monsoon and about 90% of the rainfall takes place during the months of June to September. The Taluka has a long-term normal rainfall of 961 mm with a coefficient of variation of 28%.

5. LAND USE PATTERN

The land use pattern of the area prominently reflects significance of agriculture activity, with isolated scattered patches of notified forest area and unmodified hilly forest. The double-crop (Kharif and Rabi) area is evenly distributed in the entire taluka while the horticultural activity (orange orchards) is significantly noticed and evenly distributed in the entire area of the taluka. Triple cropped (Kharif, Rabi and Summer) area is prominently observed along the major streams.

6. HYDROGEOLOGY

About 730 sq.km area of Morshi taluka is covered by the Deccan Trap Basaltbelonging to upper Cretaceous to lower Eocene age. Local alluvium covers an area of about 79 sq.km and occurs along the Wardha and Purna river. In Deccan Trap Basalt, ground water potential is not uniformly distributed due to inherent heterogeneity of the formation **(Fig. 3)**.

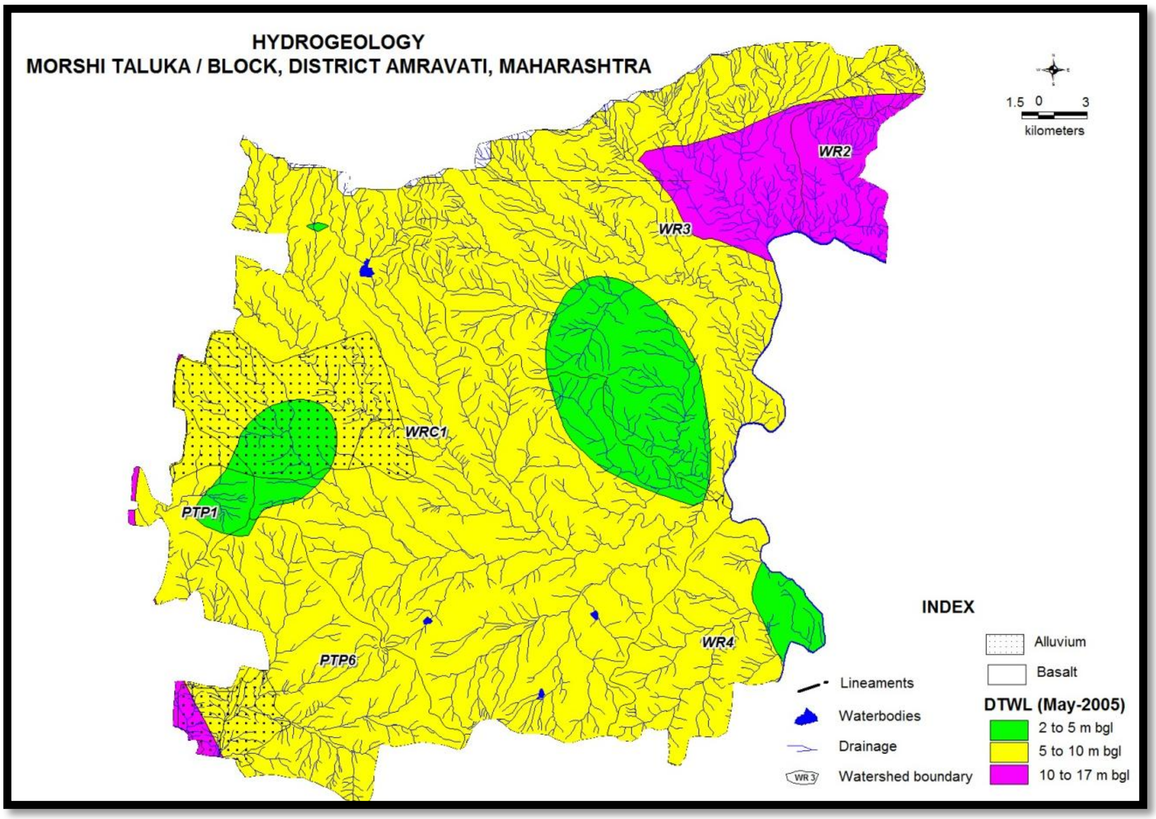
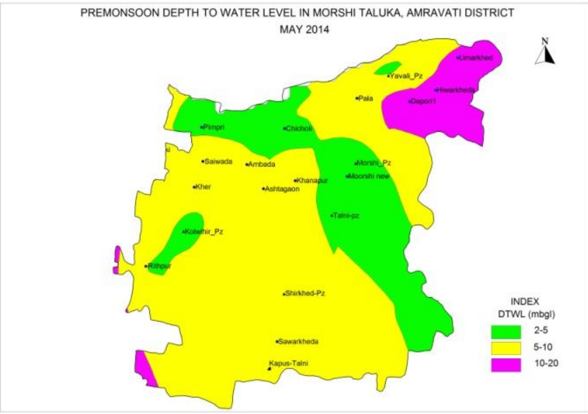


Figure 3: Hydrogeology, Morshi Taluka

The northern part, i.e., Shekdari-Satnur-Wai-Mahendri-Nimkarda belt is hilly and rugged terrain where basalt does not form potential aquifer due to limited thickness of weathered mantle. Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 15-20 m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones. The upper weathered and fractured parts form phreatic aquifer and ground water occurs under water table (unconfined) conditions. At deeper levels, the ground water occurs under semi-confined conditions. The alluvial deposits are restricted along the course of Wardha and Purna River and does not form potential aquifer due to its limited horizontal and vertical extent.

7. GROUND WATER LEVEL SCENARIO

CGWB regularly monitors ground water levels in the taluka 4 times in a year during May, August, November and January through its network of Ground Water Monitoring Wells (GWMW). The water levels recorded during the pre-monsoon season in May (2014) ranges from 3.00 to 13.60 m bgl. Shallow water levels within 10 m bgl are observed in major parts of the taluka covering northern and central parts. Moderately deeper water levels between 10-20 m are observed in NE parts of area **(Fig 4)**. The water levels recorded in post-monsoon season (Nov. 2014) are ranging from 2.10 to 11.00 m bgl. Shallow water levels within 10 m bgl are observed in major parts of the taluka. Moderately deeper water levels between 10-20 m are observed in NE parts of area **(Fig 5)**.



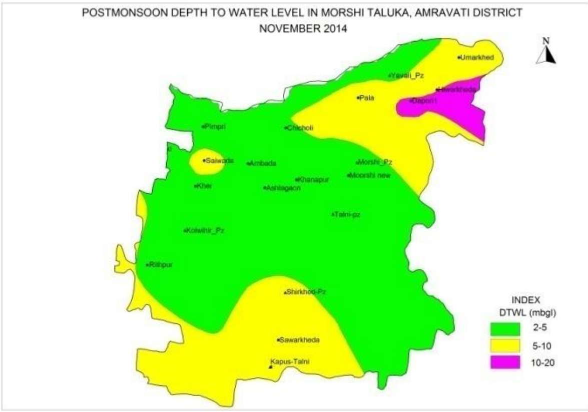


Fig 4 and 5: Pre and Post-monsoon (2014) Depth to Water Level, Morshi Taluka

8. DYNAMIC GROUND WATER RESOURCE

Ground Water Resources Assessment for the year 2011 indicates Net Annual Ground Water Availability of 8683.32ham, draft for all uses is 8792.47 ham with irrigation being the major consumer withdrawing 8473.15 ham and stage of ground water development is also high about 101.26% **(Table 1)**. The taluka is categorised as Over Exploited. The comparison of 2009 and 2011 ground water resource assessment indicates that the stage of ground water development has decreased from 117.91% in 2009 to 101.26% in 2011. So far none of the taluka has been notified by CGWA/SGWA for ground water regulation.

Table 1: Dynamic Ground Water Resources of Morshi Taluka (As on March 2011)

S. No	Particulars	GW Resources (Ha.m)
1.	Net Annual Ground Water Availability	8683.32
2.	Existing Gross Ground Water Draft for irrigation	8473.15
3.	Existing Gross Ground Water Draft for domestic and industrial water supply	319.33
4.	Existing Gross Ground Water Draft for All uses	8792.47
5.	Provision for domestic and industrial requirement supply to 2025	471.20
6.	Net Ground Water Availability for future irrigation development	1265.91
7.	Stage of Ground Water Development	101.26 %
8.	Category of the Assessment Unit	Over Exploited

9. NEED FOR ARTIFICIAL RECHARGE AND CONSERVATION MEASURES

Morshi taluka is major orange growing area in Vidarbha region of Maharashtra. For cultivation of orange, huge amount of groundwater is required. This has led to over-exploitation of groundwater resources from both the shallow and deeper aquifers in the taluka. These practices are being continued since last few decades therefore the stage of groundwater development in the taluka even exceeded more than 100 % of its natural recharge which lead to heavy depletion of ground water level. The over development of ground water has brought the taluka in over exploited category. Therefore there is an urgent need for taking up various artificial recharge and water conservation measures in the area.

10. JUSTIFICATION OF THE ARTIFICIAL RECHARGE PROJECT

The various State Government Agencies like department of Agriculture, Irrigation, Forest have already taken up some water conservation / artificial recharge measures in Morshi taluka. However, a robust consolidated plan for artificial recharge measures are also required for converting the entire Over-Exploited Morshi taluka into Critical / Semi-critical / Safe category.

11. FEASIBLE AREA FOR ARTIFICIAL RECHARGE OR CONSERVATION

The feasible area for artificial recharge to groundwater in Morshi taluka has been identified based on the following criteria's.

1. Long term average decadal post-monsoon depth to water level (2005-2014)
2. Long term post-monsoon water level trend (2005-14)
3. Depth of weathering in the taluka
4. Lineaments in the area

Thematic layers are prepared for all the above mentioned four criteria's and are superimposed on one another to generate the integrated map for identification of the feasible area for artificial recharge.

The long term average water level data reveals the deepest water level of 17 m bgl. Water level contour map is prepared wherein 3 categories of observed water levels are made i.e. less than 5 m bgl, 5 to 10 m bgl and more than 10 m bgl **(Fig. 6)**. Area having depth to water level less than 5 m bgl is not recommended for artificial recharge to ground water since it may lead to water logging and leaching of salts problems.

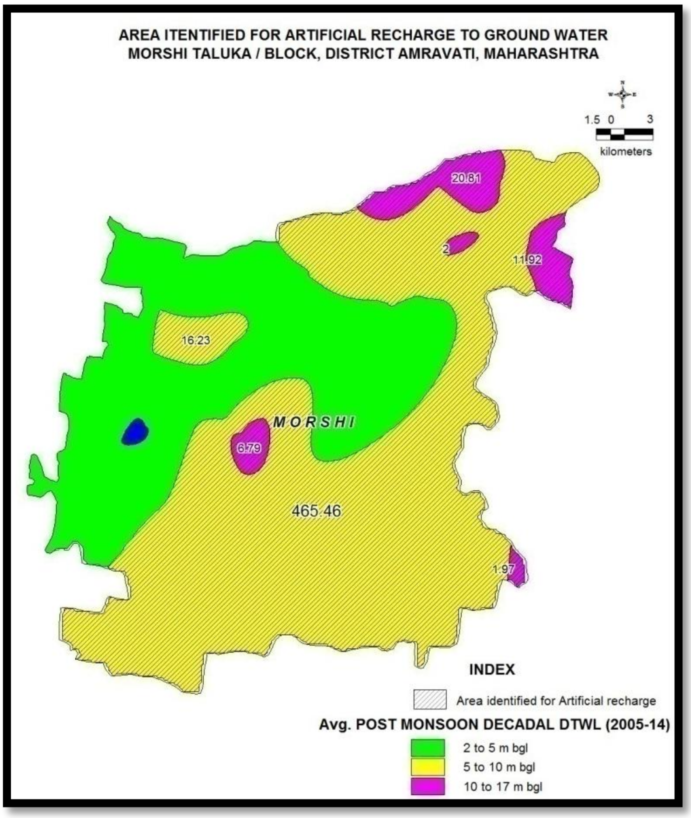


Fig 6: Average Decadal Post-monsoon depth to water level, Morshi Taluka

Depth to Water level (DTWL) map of the Morshi taluka reveals that an area of 505.47 sq.km occupied by the Deccan trap basalt has depth to water level more than 5 m bgl. Similarly in the area underlain by the alluvium, an area of about 20.08 sq.km has depth to water level of more than 5 m bgl. Thus, based on water level data, an area of 525.55 sq.km has depth to water level more than 5 m.

The long term water level trend map for the period 2005-2014 has been prepared and is shown in **Figure 7**. Both the rising and falling water level trend are classified into 2 units i.e. 0.0 to 0.2 m/year and 0.2 to 0.4 m/year. The area showing rising water trend has been excluded for taking up artificial recharge measures in the area and the area showing falling water level trend is only considered and recommended for artificial recharge to groundwater in Morshi taluka **(Fig 7).**

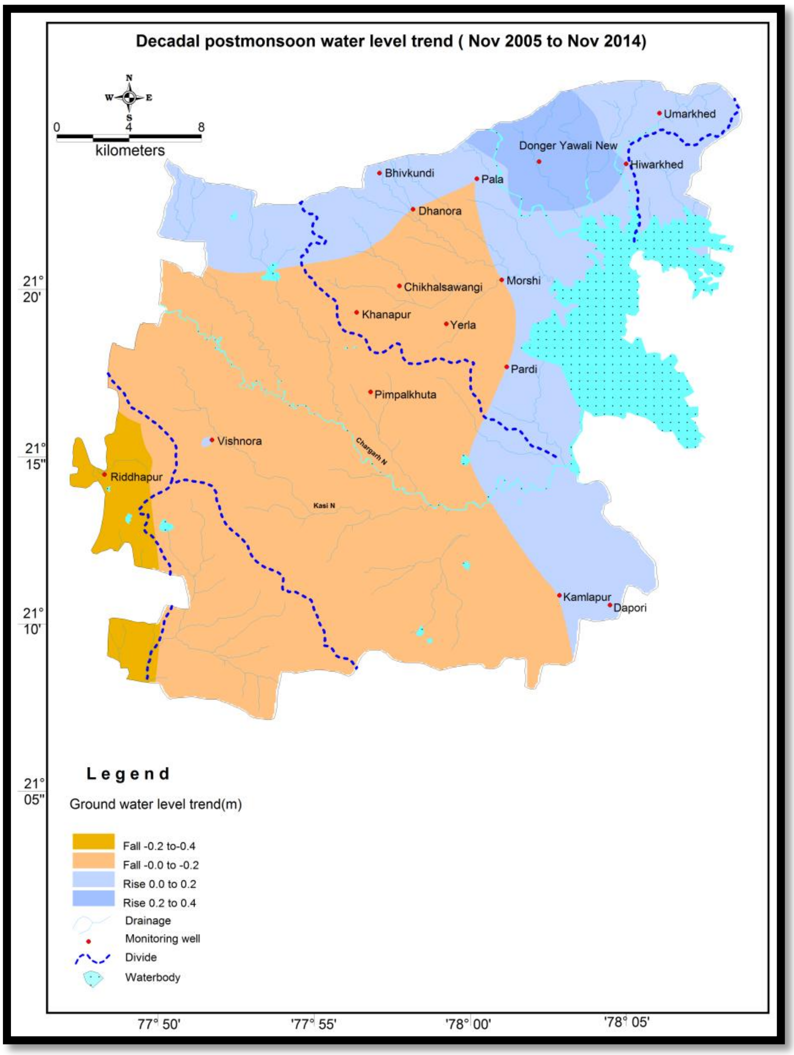


Figure 7: Map showing long term post monsoon water level trend (2005-14)

Based on the data available on depth of weathering form key wells established during the various hydrogeological studies in the area and also groundwater exploration data, a map showing area under various categories of depth of weathering has been prepared and considered for preparation of artificial recharge plan **(Fig. 8)**. The map reveals that most of the area of Morshi taluka is having sufficient thickness of weathered zone varying from 10 to 35 m and therefore found feasible for artificial recharge to groundwater. Some of the area of Morshi taluka in its northern part is also traversed by few lineaments (**Figure 9)** indicating promising scope for artificial recharge in that area.

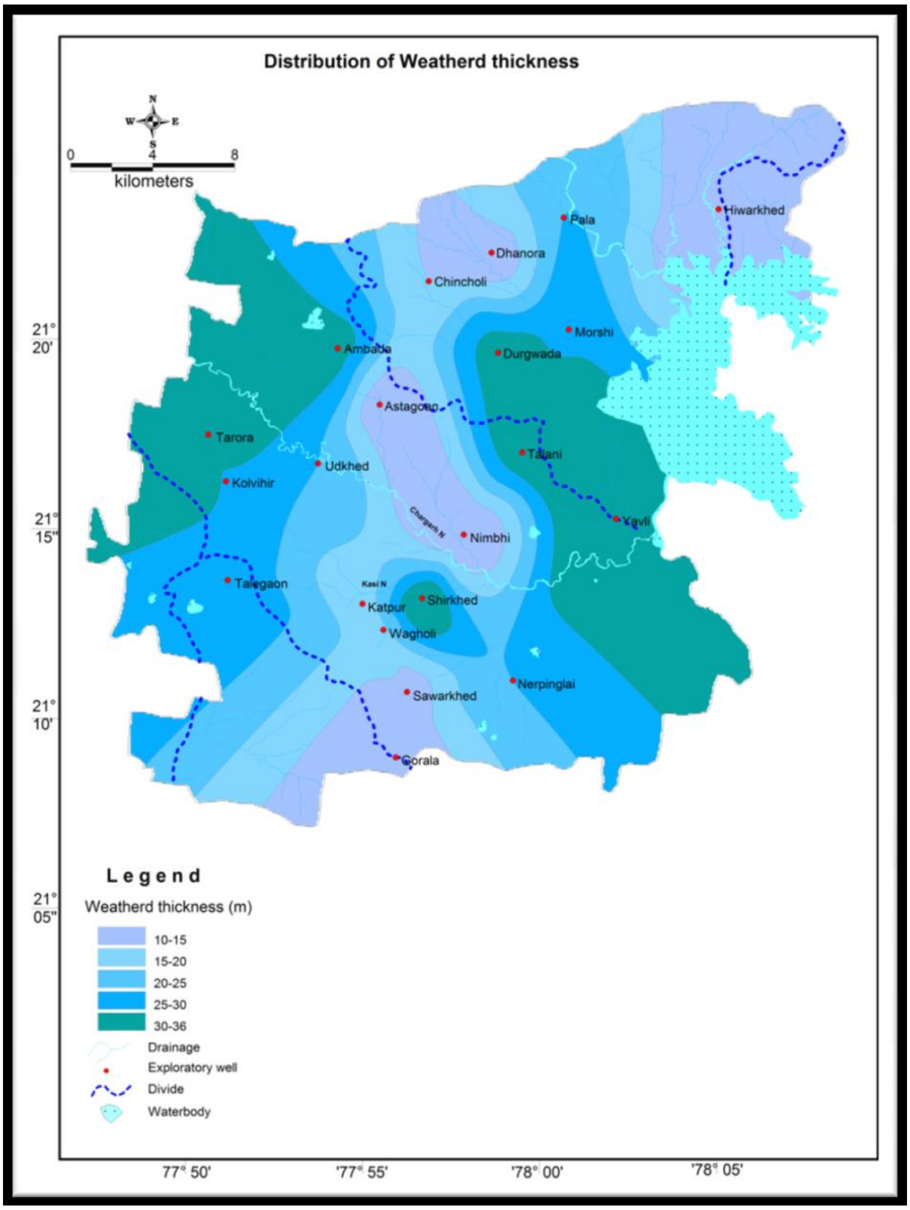


Figure 8: Map showing weathered thickness in Morshi taluka

An integrated map containing all the layers i.e. depth to water level, water level trend and weathered thickness, lineaments is prepared and is shown in **Figure 9**. The map indicates that an area of 525.55 sq.km is identified for artificial recharge to groundwater.

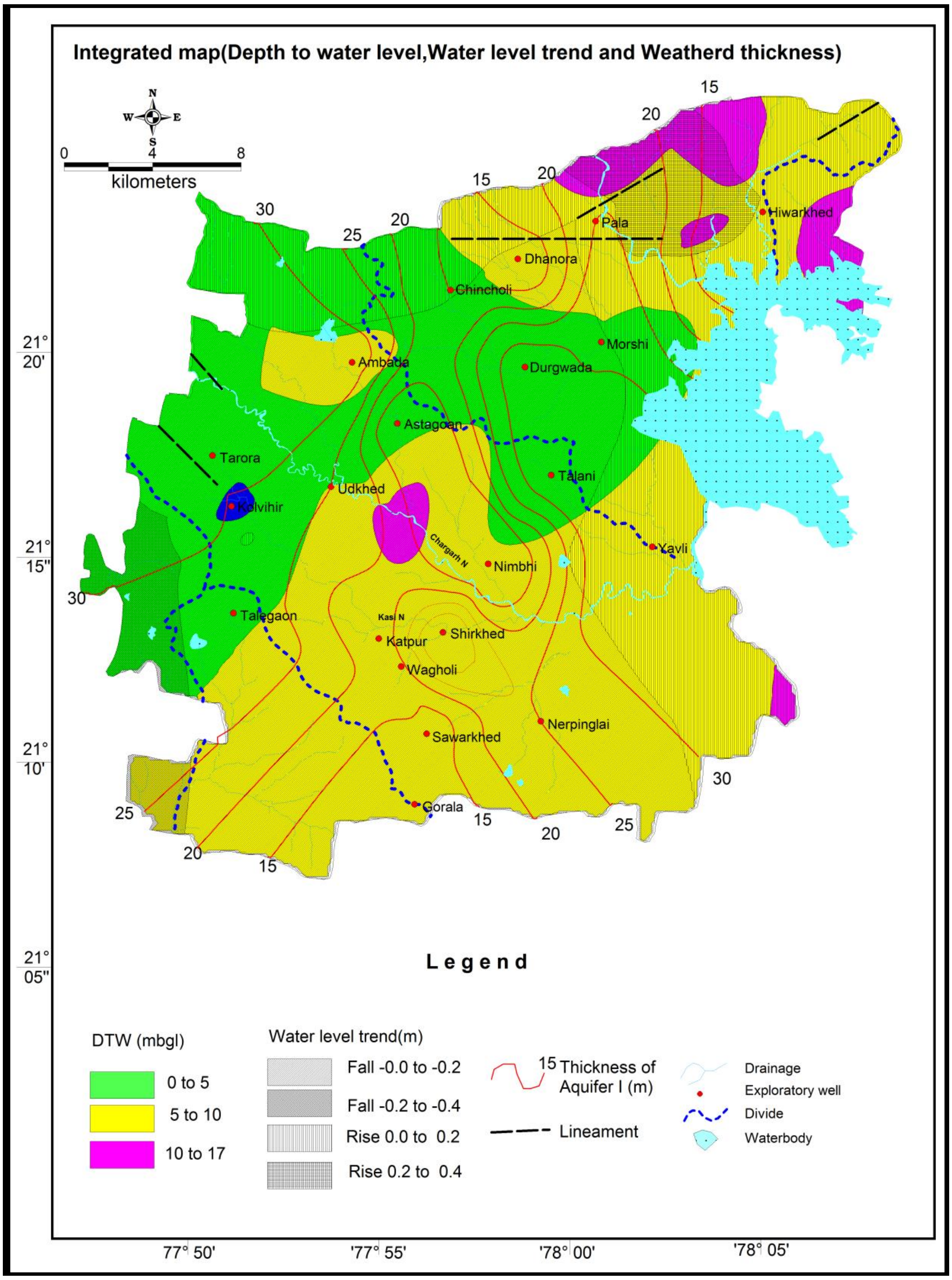


Figure 9: Integrated Map showing feasible area for artificial recharge to groundwater in Morshi taluka

12. AVAILABILITY OF SURPLUS SURFCE WATER FOR ARTIFICIAL RECHARGE OR CONSERVATION

The availability of non-committed surplus runoff as source water is one of the main requirements for any artificial recharge scheme. In India in general and Maharashtra in particular, the monsoon rainfall is the chief source of water which can be utilized for artificial recharge. Normally the surplus / non-committed monsoon runoff can be utilized as source water for artificial recharge scheme.

The rainfall received during northwest monsoon between June and September is the principal source of water in the state of Maharashtra. The actual availability of surface water in the area depends upon the rainfall incidences, climate, Physiography, land use and hydrogeology. These components vary drastically in space and time and is not uniform in the state of Maharashtra. Therefore basin and sub-basin wise availability of water and its utilization status is considered to depict the realistic scenario of source water availability. For this purpose the hydrological data available with the state government was collected and compiled basin wise for Godavari, Krishna and Tapi basins.

Morshi taluka of Amravati district falls in Godawari river basin. The data collected from Irrigation Department, Government of Maharashtra reveals that Morshi taluka falls in Upper Wardha sub-basin i.e. G-8. The total geographical area of G 8 sub-basin is 20821 sq. km and it has the surplus surface runoff of 3992.69MCM. Of this, about 1371.30 MCM water is committed for the completed projects and about 2074.44 MCM water will be utilised in the ongoing projects. Thus total 34345.74 MCM water has already being utilised. The balance left over water for future utilisation in the entire G8 sub-basin is 546.95 MCM and the per sq. km availability in the G8 sub-basin comes out to be 0.0263 MCM. Thus the proportionate surplus surface water availability for the identified area for recharge of Morshi taluka which forms part of G 8 sub-basin comes out to be 13.275 MCM in the hard rock area of Deccan trap basalt and 0.527 MCM in the area underlain by alluvium. For estimation of volume of water to be utilised for recharge, 70% of surplus water availability has been considered. Thus total 9.66 MCM of runoff water can be considered for planning of artificial recharge plan in Morshi taluka. Out of 9.66 MCM, about 9.28 MCM surplus surface water is apportioned for preparation and implementation of master plan for artificial recharge in hard rock area and 0.37 MCM for alluvium occupied area of Morshi taluka The estimated availability on surplus surface runoff in Morshi taluka is finalised in consultation with the State Government and hence confirmed for taking up artificial recharge measures in the taluka.

13. FEASIBLE ARTIFICIAL RECHARGE / CONSERVATION STRUCTURES

Hydrogeology, Physiography, climatic conditions and source water availability are the major factors which affect the selection of site, dimension of the artificial recharge scheme. The surface spreading techniques consisting of percolation tanks and cement plug/bund/check dam are most appropriate techniques in areas occupied by hard rocks. In alluvial areas i.e. alluvial part of Tapi and Purna basin, the percolation tanks in mountain fronts and recharge shaft in alluvial/bazada zone are the most feasible structures. Accordingly these structures have been recommended for artificial recharge to groundwater. Other structures like continuous contour trenches, gabion structures, nala bunds, village ponds etc. may also be taken up side by side which would be more appropriate for soil and moisture conservation. The underground bandharas or sub surface dykes are ground water conservation structures and hence can be taken up a site specific location to conserve the ground water. Beside this roof top rain water harvesting and storm water harvesting in public parks, play grounds are the most appropriate techniques as in urban areas most of the nala / river carries domestic sewage and non-availability of land for submergence.

Various artificial recharge studies on carried out by CGWB so far in the State of Maharashtra and the findings of the artificial recharges schemes implemented under Central Sector Scheme are highly helpful is preparation of plan for artificial recharge for any given area. The findings of these studies / schemes are considered in formulating the artificial recharge plan and are mentioned below.

- ❖ A percolation tank of 100 Thousand Cubic Metre (TCM) capacity (single filling) will actually store 200% more due to multiple fillings during monsoon. This will have gross storage capacity of 200 TCM. However, desilting of percolation tank on regular basis in 1-2 year before the onset of monsoon should be carried out for effective infiltration of stored water into the sub-surface.
- ❖ A check dam / cement plug of 10 TCM capacity (single filling) will actually store 300 % more due to multiple fillings in monsoon. This will provide gross storage of 30 TCM for check dam. However, it is also required to be desilted to maintain the storage capacity and recharge efficiency.

- A recharge shaft on an average will recharge 1 TCM/day with 60 operational days during monsoon and post-monsoon.
- Unlike various water conservation schemes, percolation tank and check dam provide about 85% recharge to ground water out of total storage.
- With regard to the amount of surface water considered for planning the artificial recharge, it can be considered that 70 % storage would be through percolation tank and remaining by check dam and recharge shafts.

The number of recharge structures required to store and recharge the ground water reservoir have been worked out as follows.

$$\text{No. Of structures} = \frac{\text{Total surface water considered}}{\text{Average gross capacity of Percolation Tank/Check Dam (considering multiple fillings)}}$$

Based on the above field findings, it is proposed to allocate about 70 % of the surplus water for construction of percolation tanks, about 25 % surplus water for construction of check dam in the hard rock area. The remaining 5 % surplus available water is proposed for allocation for construction of various water conservation structures like loose boulder structures, gabbion structures etc. The average recharge efficiency of artificial recharge structure is considered as 85% on safer side.

The tentative locations of proposed artificial recharge structures are shown in **Figure 10** and the location of sites are listed in **Annexure – I**. The design of percolation tank, check dam, recharge shaft and other water conservation structures are presented as **Annexure-II.** However, the final design of the individual structures will be site specific and will be prepared based on the hydrogeological survey in consultation with the implementing agency.

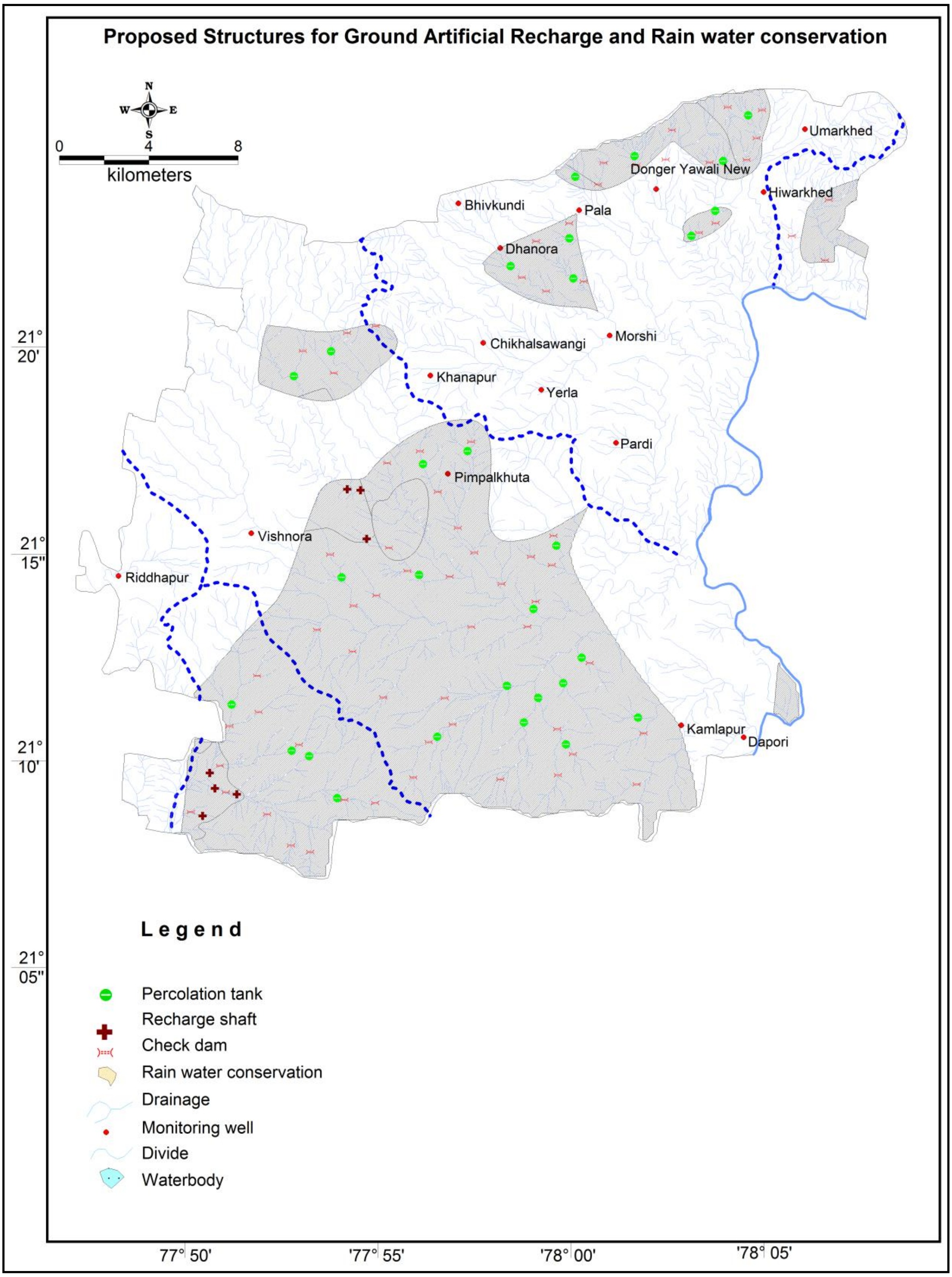


Figure 10: Tentative sites of Percolation Tank, Check Dam, Recharge Shaft and Water Conservation Structures, Morshi Taluka

14. TENTATIVE COST ESTIMATES

For estimating the tentative cost for construction of various types of artificial recharge and water conservation structures, schedule of rates **(**SOR) of Government of Maharashtra available for the year 2011 have been considered. In the state of Maharashtra, SOR of each district vary marginally from each other. It is estimated that the total expenditure to be incurred for construction of various water conservation and recharge structures will be Rs. 31.41 crores (As per 2011 SOR). However, it is likely that the actual cost will vary depending upon the actual period of construction and location of sites which will be finalised after detailed hydrogeological consultation and survey by the implementing agencies.

Percolation Tanks

To recharge the allocated surplus water to the tune of 6.50 MCM, it is estimated that about 32 percolation tanks will be required to be constructed in Morshi taluka. Considering the recharge efficiency of 85%, it is expected that about 5.52 MCM of surface water shall be recharged. As per the SOR available for the year 2011, it is estimated that for construction of one percolation tank with average gross capacity of 200 TCM, Rs. 70 lakh will be required. Therefore the total expenditure involved for construction of 32 percolation tanks will be Rs. 22.40 crores. For enhancing the ground water recharge, it is proposed to utilise the stored water of the percolation tanks for irrigation of the surrounding areas.

Check Dams

It is estimated that about 2.32 MCM of surplus was can be made available for construction of check dams. Hence it is estimated that about 77 check dams can be constructed to recharge the proportionate allocated surplus water of 2.32 MCM. Considering the recharge efficiency of 85%, it is expected that about 1.97 MCM of surface water shall be recharged into sub-surface. The SOR available for the year 2011 indicate that for construction of one check dam with average gross capacity of 30 TCM, Rs. 7 lakh will be required. Therefore the total expenditure involved for construction of 77 check dams will be Rs. 5.39 crores.

Water Conservation Structures

After the allocation of surplus runoff water for the major structures like percolation tanks and check dams in hard rock area of Morshi taluka, the remaining quantum of surplus water can be taped by means of feasible water conservation structures for soil and water conservation. Thus about 0.46 MCM of surplus water can be made available for water conservation structures. The feasible water conservation structures in the area are loose boulder structure and gabbion structures. It is estimated that about 31 number water conservation structures will be required to conserve the 0.46 MCM of surplus runoff water of which about 0.39 MCM of surplus water can be conserved / recharged considering efficiency of 85%. These structures can be constructed on lower order streams i.e. streams of 1^{st} and 2^{nd} order. As per the SOR 2011, an approximate expenditure of Rs. 25000 will be required for construction of one water conservation structure. Therefore the total expenditure involved for construction of 31 water conservation structure will be Rs. 0.077 crores.

Roof Top Rain Water Harvesting

In this first phase, it is proposed to take up roof top rain water harvesting measures in the urban households of Morshi Taluka. As per census 2011, there are about 42454 households in Morshi taluka. It is assumed that about 10 % of the households i.e. 4245 households may have the average roof area of about 50 sq.m. Therefore, considering the average annual rainfall of 961 mm and the average roof area of 50 sq.m, and runoff coefficient of 0.85, about 0.173 MCM rainwater harvesting potential can be generated in the urban households of Morshi taluka.

For taking up roof top rain water harvesting and artificial recharge through individual household, it is proposed to recharge roof top runoff through a recharge pit having dimension of size 1m X 1m and having a depth of 1.50 m. The top 0.6 m portion of the pit will be open for pouring the harvested rainwater whereas the bottom portion of 0.90 m depth shall be filled with boulder, gravel and sand each having a thickness of about 0.30 m.

It is anticipated that about 85% of the harvested water shall be recharged. Thus about 0.147 MCM shall be recharged through adoption of rainwater harvesting in the urban households.

Recharge Shaft

The area underlain by the soft rock i.e. alluvium and identified for artificial recharge is 13.37 sq.km. It is estimated that the total surface water availability for artificial recharge in alluvium area is 0.37 MCM. Considering the recharge efficiency of 85%, about 6 nos. recharge shafts will be required which can recharge about 0.31 MCM of runoff water. All the proposed recharge shafts shall be constructed either in the stream / nala bed or on its bank for getting the continuous water supply to the recharge shaft. The SOR available for the year 2011 indicate that for construction of one recharge shaft 2.5 lakh will be required thus the total estimated cost for construction of 6 recharge shafts will be Rs 0.15 crores.

15. TIME SCHEDULE

After the release of funds, the proposed plan can be implemented within a stipulated time of 2-3 years by the implementing agency of concerned State Department, Government of Maharashtra.

Time schedule	Activity to be carried out
0 To 3 months	Finalization of sites for construction of artificial recharge / water conservation structures by the Implementing Agency
4 To 6 months	Finalization of designs / specifications and budget Estimation as per the Schedule of Rates by the Implementing Agency
7 To 20 months	Implementation of the project by the Implementing Agency
20 To 24 months	Preparation of report and report submission by the Implementing Agency
25 To 36 months	Impact Assessment by the Implementing Agency

Annexure - I

Tentative Locations of Proposed Artificial Recharge Structures in Morshi Taluka of Amravati District

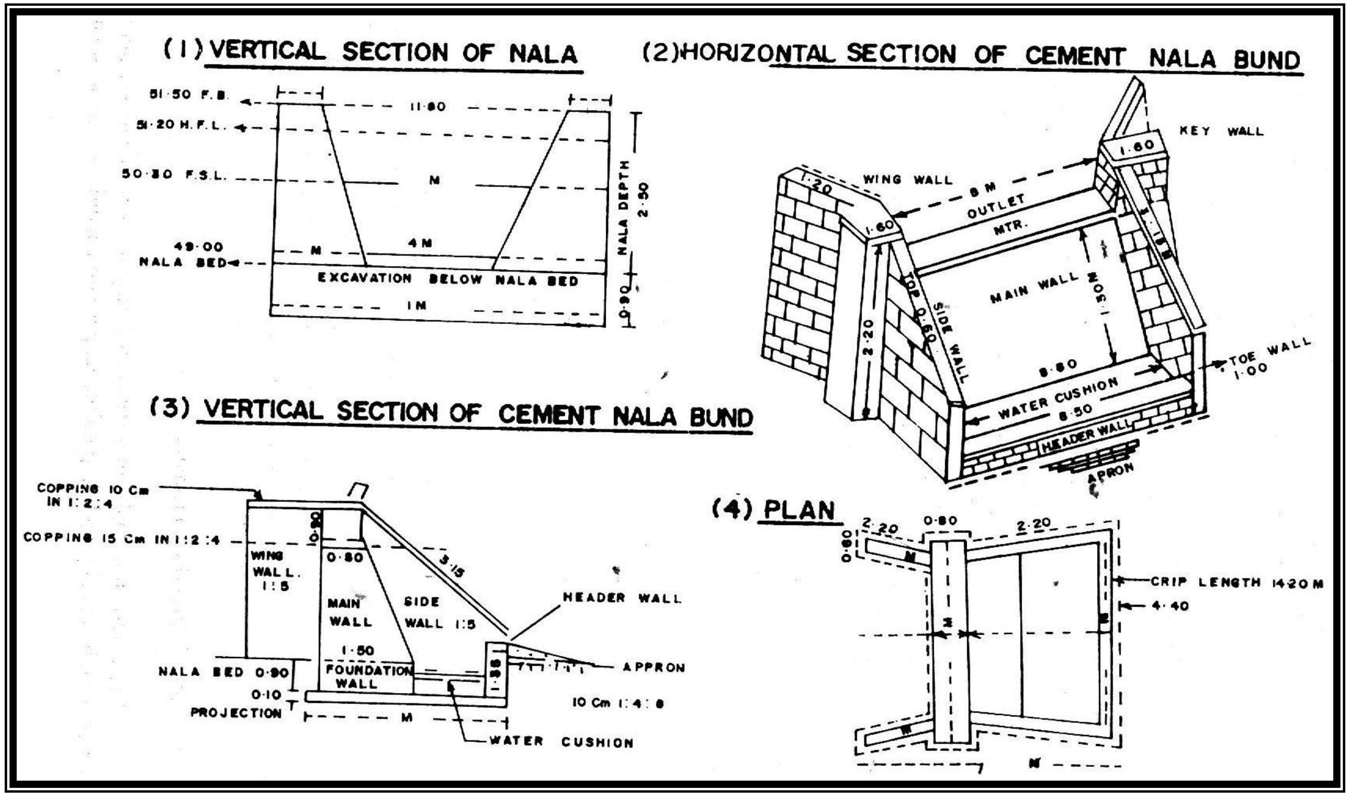
S.No	Village	Longitude	Latitude	Artificial recharge structure proposed
1	Molvan	78.0676	21.4298	Check Dam
2	Jamathi	78.0286	21.4126	Check Dam
3	Pala	78.0117	21.3988	Check Dam
4	Salbardi	78.0141	21.4074	Check Dam
5	Pala	77.9992	21.383	Check Dam
6	Dapori	78.0553	21.3793	Check Dam
7	Sawarkhed	77.985	21.3758	Check Dam
8	Bopalawadi	78.0758	21.4086	Check Dam
9	Nimbhi	77.9512	21.2604	Check Dam
10	Rohnal	77.9569	21.2951	Check Dam
11	Rohnal	77.9349	21.2912	Check Dam
12	Bodna	77.9207	21.2864	Check Dam
13	Khanpur	77.9294	21.2431	Check Dam
14	Ladki	77.9215	21.2524	Check Dam
15	Porgavhan	77.8961	21.2497	Check Dam
16	Dhamangaon	77.8905	21.2192	Check Dam
17	Katpur	77.9057	21.2105	Check Dam
18	Lihida	77.9813	21.2205	Check Dam (Cluster)
19	Munaimpur	77.9848	21.2306	Check Dam
20	Asona	77.9925	21.2572	Check Dam
21	Sawarkhed	77.9489	21.1812	Check Dam
22	Nerpingalai	77.994	21.1793	Check Dam
23	Shiralas	78.0313	21.1776	Check Dam
24	Akhatwada	78.008	21.2059	Check Dam
25	Nerpingalai	78.0009	21.1692	Check Dam
26	Nerpingalai	77.9944	21.1607	Check Dam
27	Salepur	78.0284	21.1571	Check Dam (Cluster)
28	Nerpingalai	77.9695	21.159	Check Dam
29	Sawarkhed	77.9387	21.1741	Check Dam
30	Sawarkhed	77.9456	21.1918	Check Dam
31	Rasulpur	77.9156	21.1495	Check Dam
32	Shirajgaon	77.9023	21.1508	Check Dam
33	Adgaon	77.8689	21.145	Check Dam
34	Mangrul	77.8826	21.173	Check Dam
35	Ajampur	77.8652	21.1863	Check Dam
36	Ajampur	77.8645	21.2008	Check Dam

37	Ghoddeo Kh.	78.0437	21.4206	Check Dam
38	Belona	78.1113	21.3925	Check Dam (Cluster)
39	Bopalawadi	78.0599	21.4076	Check Dam
40	Molvan	78.0825	21.4287	Check Dam
41	Yawali	78.0409	21.4088	Check Dam
42	Molvan	78.0802	21.4174	Check Dam
43	Hiwarkhed	78.0954	21.3779	Check Dam
44	Ahmadpur	78.0055	21.3596	Check Dam
45	Kopara	77.9893	21.3558	Check Dam
46	Surwadi Bk.	78.1096	21.3682	Check Dam
47	Mamdapur	77.916	21.2331	Check Dam
48	Kopara	77.9788	21.3612	Check Dam
49	Dapori	78.0624	21.3831	Check Dam
50	Katpur	77.9062	21.2289	Check Dam
51	Daryapur	77.9477	21.2408	Check Dam (Cluster)
52	Pimpalkhuta	77.9426	21.2749	Check Dam
53	Hashampur	77.9918	21.2454	Check Dam
54	Munaimpur	77.9828	21.2488	Check Dam
55	Shahanawajpur	77.9571	21.2205	Check Dam
56	Inapur	77.9701	21.2377	Check Dam
57	Nimbhi	77.9583	21.2503	Check Dam
58	Ambada	77.9035	21.3389	Check Dam
59	Ambada	77.8977	21.3228	Check Dam
60	Hirapur	77.8843	21.3317	Check Dam
61	Irur	77.9157	21.3417	Check Dam
62	Adgaon	77.8486	21.1646	Check Dam
63	Vitthalpur	77.8511	21.1539	Check Dam
64	Adgaon	77.8527	21.1805	Check Dam
65	Savanga	77.836	21.1459	Check Dam
66	Yawali	77.8875	21.1298	Check Dam
67	Aurangpur	77.8792	21.1324	Check Dam
68	Gorala	77.9319	21.1598	Check Dam
69	Wagholi	77.919	21.1921	Check Dam
1	Ambada	77.8965	21.3316	Percolation tank
2	Molvan	78.0766	21.4267	Percolation tank
3	Bopalawadi	78.0658	21.4083	Percolation tank
4	Indur	77.8805	21.3216	Percolation tank
5	Dapori	78.0623	21.3882	Percolation tank
6	Pala	77.9994	21.3771	Percolation tank
7	Kopara	78.0011	21.361	Percolation tank
8	Dapori	78.052	21.3781	Percolation tank
9	Rohnal	77.9555	21.2914	Percolation tank
10	Pimpalkhuta	77.9363	21.2862	Percolation tank
11	Asona	77.9937	21.2533	Percolation tank

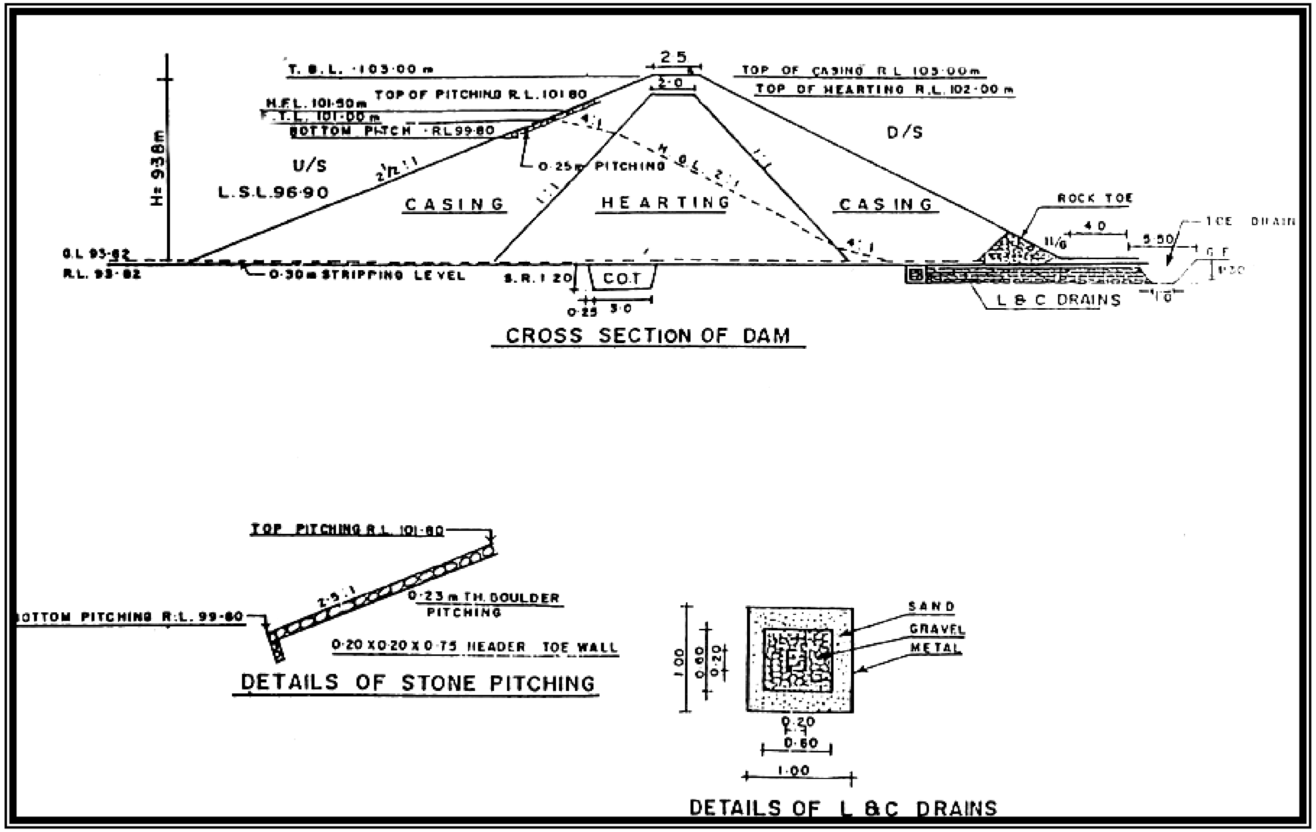
12	Khanpur	77.9346	21.2415	Percolation tank
13	Vichori	77.8616	21.1982	Percolation tank
14	Mangrul	77.8795	21.1707	Percolation tank
15	Mangrul	77.8871	21.1685	Percolation tank
16	Nerpingalai	77.9979	21.1733	Percolation tank
17	Nerpingalai	77.9968	21.1979	Percolation tank
18	Sawarkhed	77.9424	21.1763	Percolation tank
19	Dhanora	77.9741	21.3659	Percolation tank
20	Jamathi	78.0275	21.4103	Percolation tank
21	Pala	78.002	21.402	Percolation tank
22	Lashkarpur	77.9011	21.2406	Percolation tank
23	Nerpingalai	77.9859	21.192	Percolation tank
24	Nerpingalai	77.9724	21.1968	Percolation tank
25	Shirajgaon	77.8991	21.1516	Percolation tank
26	Lihida	77.9839	21.2278	Percolation tank
27	Akhatwada	78.0047	21.2082	Percolation tank
28	Nerpingalai	77.9797	21.1821	Percolation tank
29	Shiralas	78.029	21.1841	Percolation tank
1	Vitthalpur	77.9997	21.2271	Recharge shaft
2	Khopada	77.9035	21.2762	Recharge shaft
3	Adgaon	77.8442	21.1619	Recharge shaft
4	Vitthalpur	77.9902	21.2055	Recharge shaft
5	Vitthalpur	77.972	21.2326	Recharge shaft
6	Khopada	77.9568	21.2403	Recharge shaft

Annexure-II

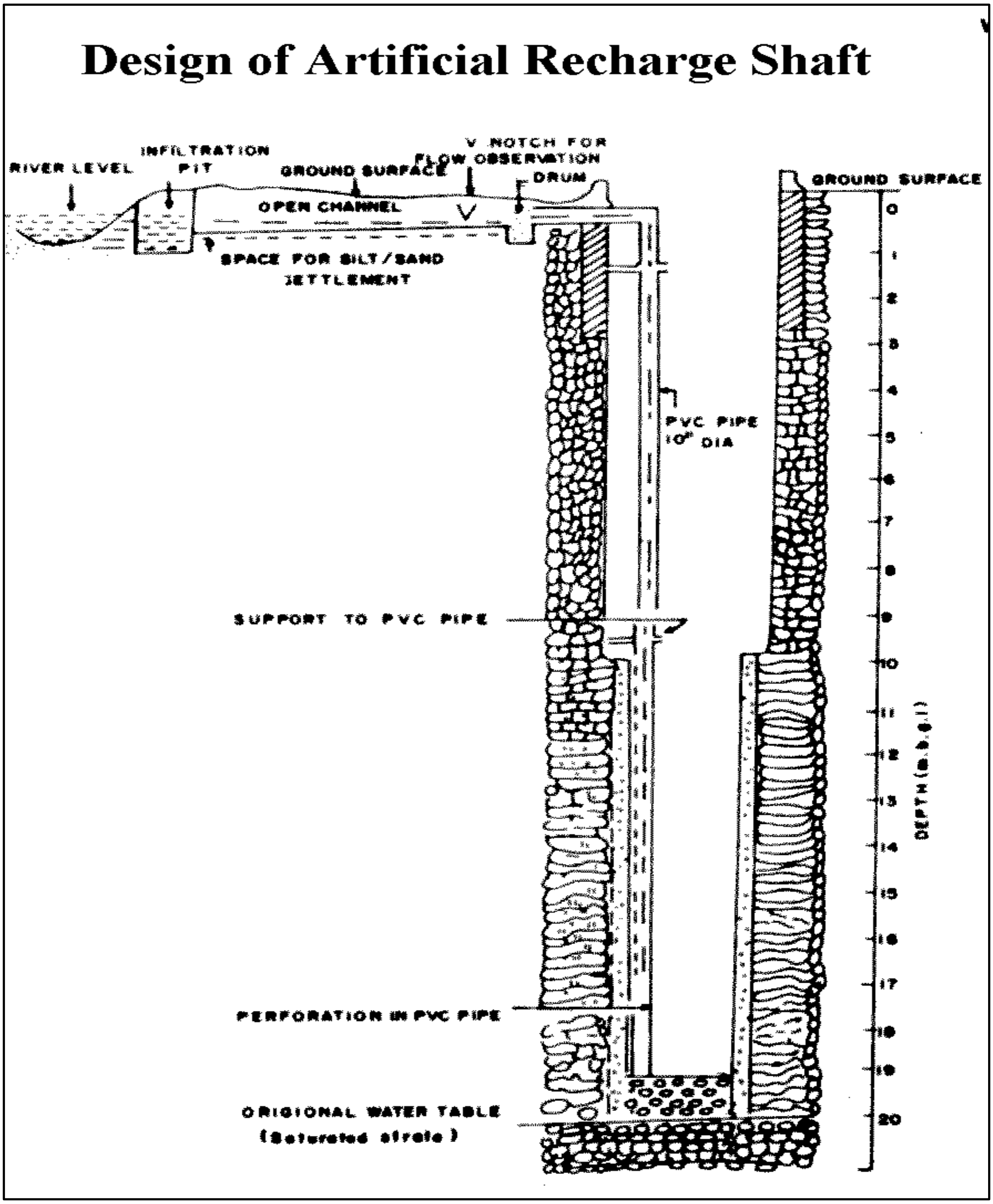
Design of Check Dam



Design of Percolation Tank

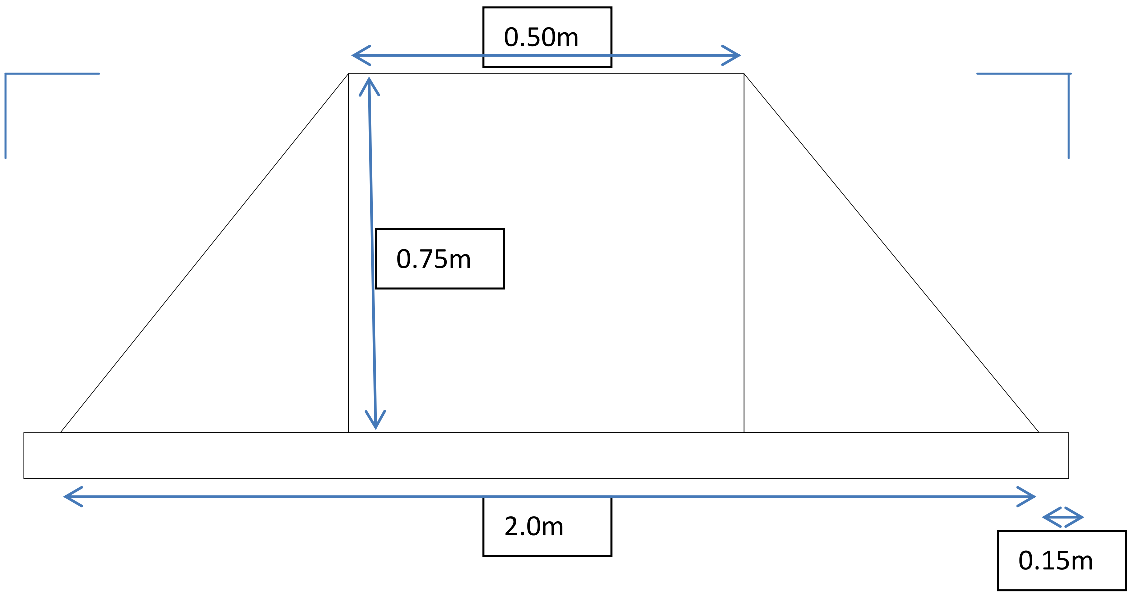


Design of Recharge Shaft



DESIGN OF WATER CONSERVATION STRUCTURE

Cross Section of Loose Boulder Structure



Cross Section of Gabbion Structure