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 Yaval Taluka of Jalgaon District

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CENTRAL REGION, NAGPUR

जुलाई - 2016 / July - 2016

ARTIFICIAL RECHARGE PLAN AT A GLANCE

1.	Total Geographical Area of the Yaval Block (Taluka)				925.60 km^2	
	❖ Area occupied by Hard Rock (Basalt)				312.70 km^2	
	❖ Area occupied by Soft Rock (Alluvium &Bazada)				612.90 km^2	
2.	Major land use pattern				Agriculture particularly banana growing area	
3.	Average Annual Rainfall (mm)				738 mm	
4.	Major Drainage				Tapi 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)*				654.00 km^2	
6.	Overall quality of groundwater				Suitable for domestic, industrial and irrigation use	
7.	Availability of Surplus surface runoff (MCM)				15.61 MCM	
8.	Surplus runoff considered for planning (MCM) *(70% of surplus surface runoff)*				10.93 MCM	
9.	Runoff for RWH in Urban Household				0.191 MCM	
10.	Sub-surface storage potential available (MCM)				703.76 MCM	
11.	Proposed Artificial Recharge & Water Conservation Plan					
	Item	**Perco-lation Tank**	**Check Dam**	**Recharge shaft**	**Water Conser-vation Structure**	**Roof Top Rain Water Harvesting (for 10% houses)**
	❖ Proportionate Allocation of surplus runoff MCM)	0.26	0.09	10.56	0.02	0.191
	❖ Feasible number of structures	1	3	176	1	6078
	❖ Unit cost of structures (crores)	0.70	0.07	0.025	0.0025	0.0008
	❖ Estimated Cost (Crores)	0.70	0.21	4.40	0.0025	4.86
	❖ Expected Recharge (MCM) (considering 85 % efficiency)	0.22	0.08	8.98	0.017	0.16
12.	Total estimated cost (Crores)	10.17 crores				

Artificial Recharge Plan for the Over Exploited Yaval Taluka of Jalgaon 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 Yaval taluka of Jalgaon district which will form the base for the future strategy.

2. LOCATION

Yaval taluka is located in the northern part of Jalgaon district and covers geographical area of 925.60 sq.km. It is located between the North latitude 21° 03'00" & 21° 24' 00" and East longitude 75° 31' 25" & 75° 53' 22" and is covered in the Survey of India topographical sheet numbers 46 O/7, 46 O/11, 46 O/12, 46 O/15, 46 C/16. It is bounded by the State of Madhya Pradesh in the north, Raver taluka in the east, Chopda taluka in the west and Jalgaon and Bhusawal taluka in the south. Yaval town is the tehsil headquarter of Yaval taluka and is well approachable by all weathered metalled road from Bhusawal, Chopda and Raver talukas of Jalgaon district **(Fig 1a and 1b)**.

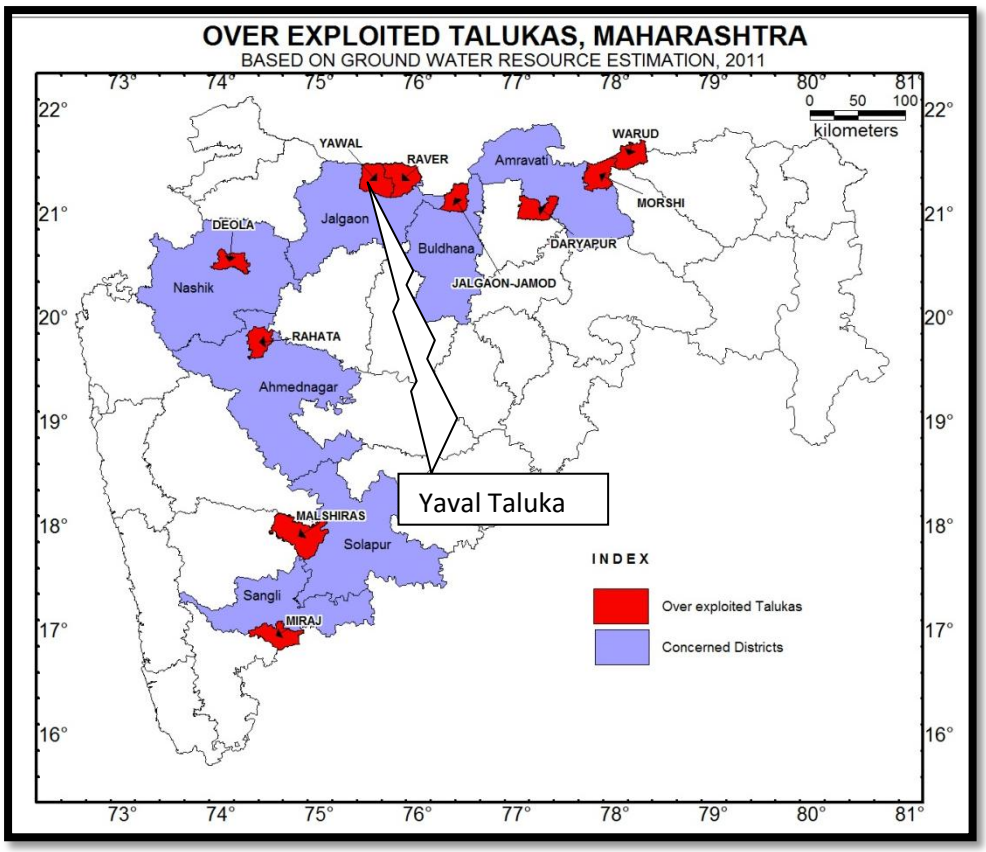


Figure1a: Location of Yaval Taluka, Jalgaon District, Maharashtra

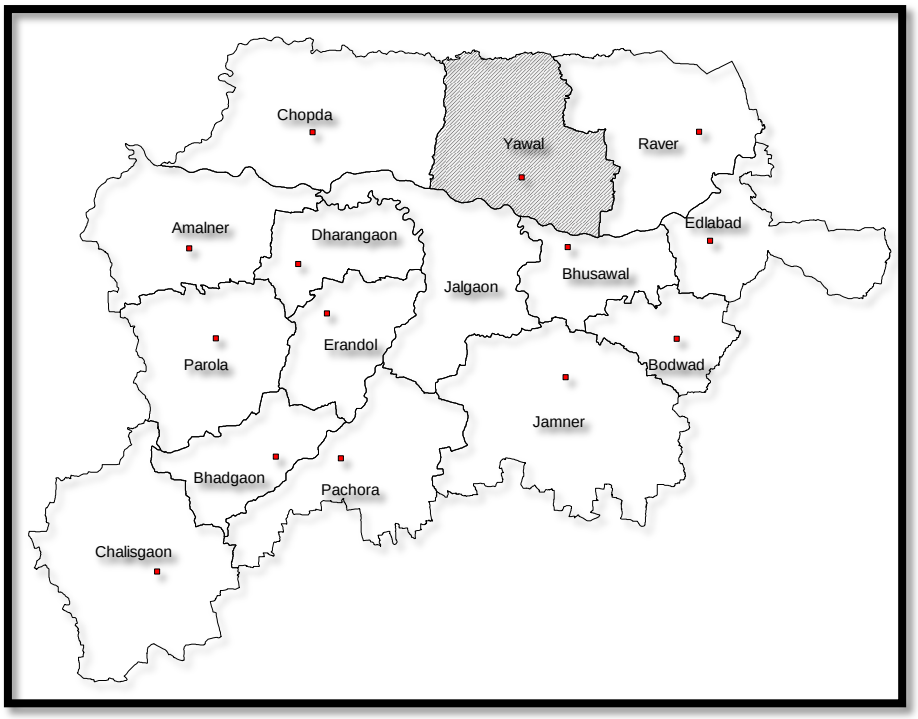


Figure1b: Location of Yaval Taluka, Jalgaon District

3. PHYSIOGRAPHY & DRAINAGE

Yaval taluka is broadly divided in to two physiographic units viz, the foot hills of Satpura in the north and the Tapi alluvial plains in the central & southern part. The taluka is mainly drained by the Tapi river that flows from east to west and its tributaries **(Fig 2a)**. A digital elevation model of Warud taluka indicating the village boundaries is shown in **Fig. 2b**.

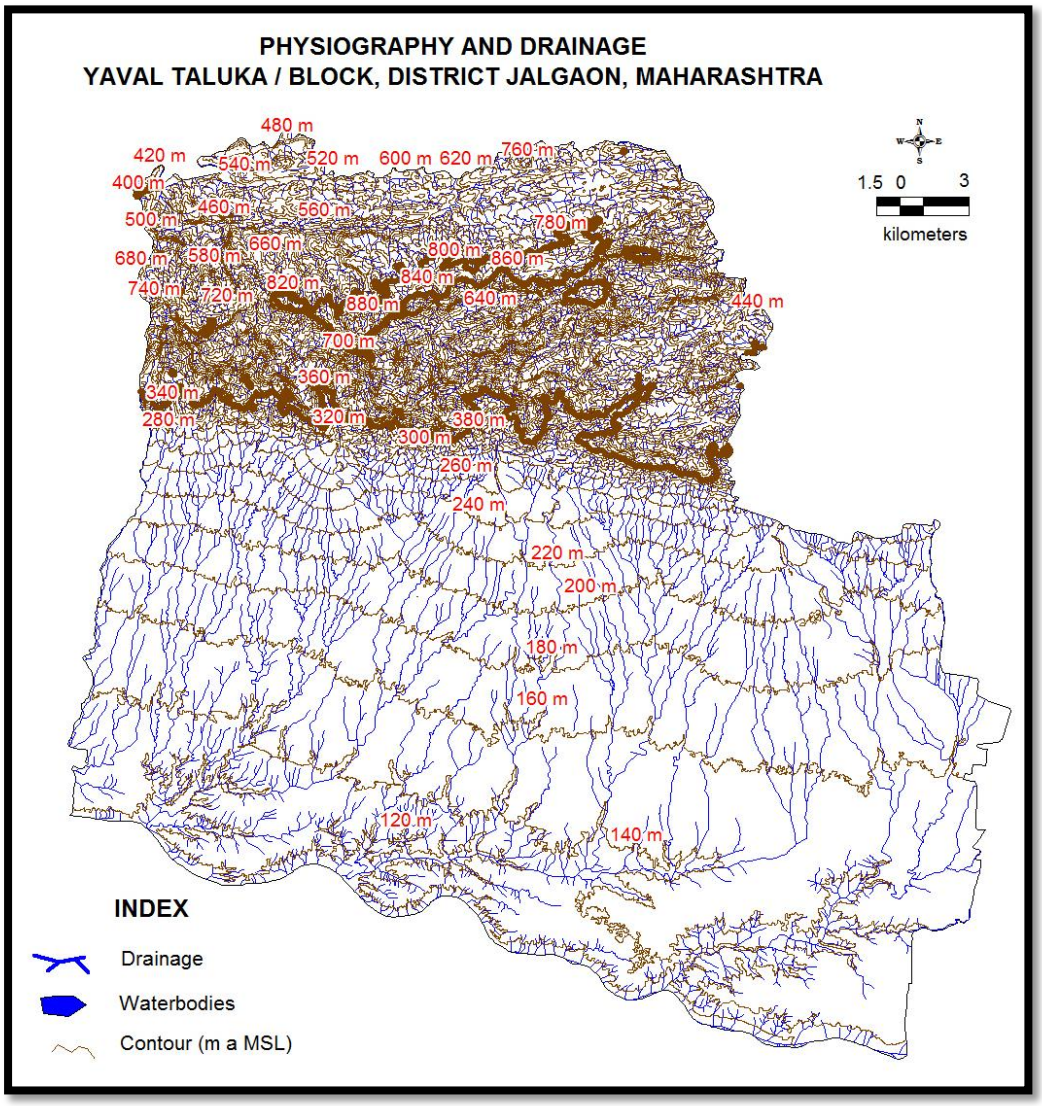


Figure 2a: Physiography and Drainage, Yaval Taluka

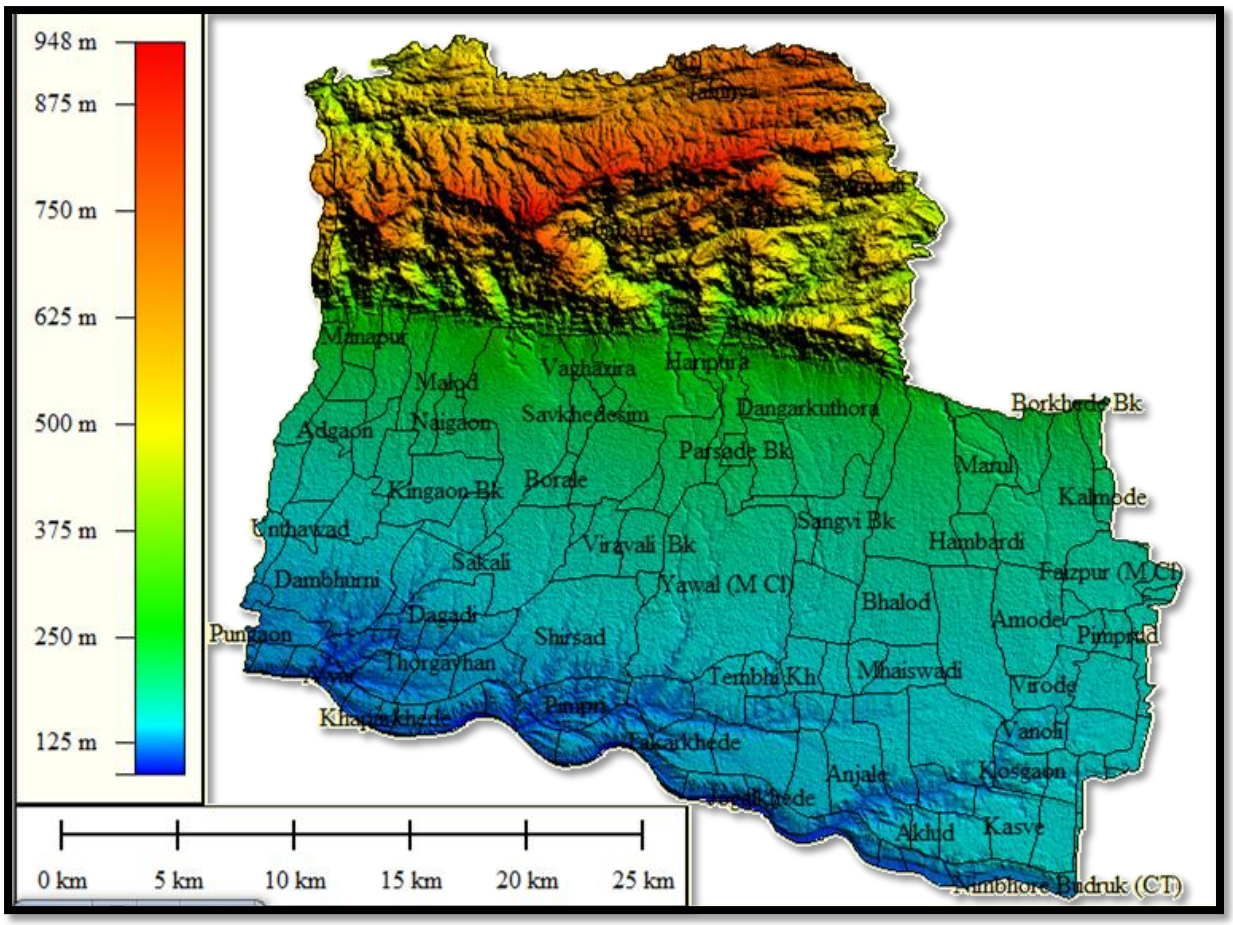


Figure2b: Digital Elevation Model, Yaval Taluka

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 receives normal rainfall of 738 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 pockets 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 (banana orchards) is significantly noticed and evenly distributed in entire alluvial area of the taluka.

6. HYDROGEOLOGY

Deccan Trap Basalt belonging to upper Cretaceous to lower Eocene age occurs in the northern part of the taluka where the ground water potential is not uniformly distributed due to inherent heterogeneity of the formation. Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 20-25 m depth. At places potential zones are encountered at deeper levels in the 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 (**Fig. 3**).

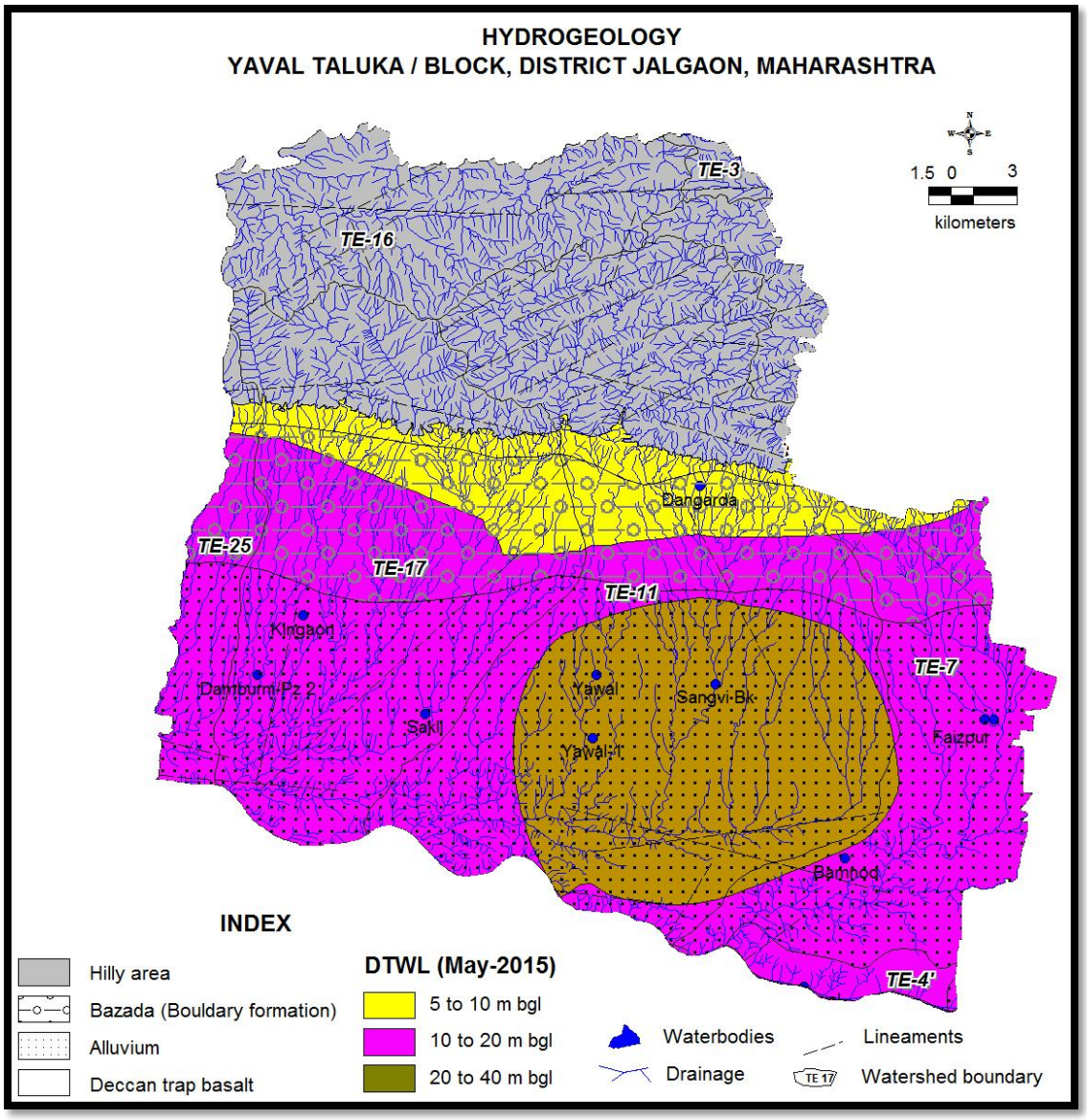


Figure 3: Hydrogeology, Yaval Taluka

Central and Southern part of the taluka is underlain by Tapi Alluvium which can be subdivided into two sub units, i.e., the upper younger alluvium extending down to 70-80 m depth and the deeper older alluvium attaining a maximum depth of 318 m. However, only upper 70-80 m of younger alluvium, having 2 to 5 layers of granular zones of sand and gravel ranging in thickness from 2 to 20 m, forms the potential aquifer. At deeper levels the alluvium is mostly clayey and does not form potential aquifer. Ground water in alluvium occurs under water table, semi-confined and confined conditions.

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), ranging from 17.92 to 53.01 m bgl. In major part of the taluka pre-monsoon water levels are observed between the range of 20 to 40 m bgl. Deeper water levels of more than 40 m are observed in southern eastern parts of area covering parts of Yawal and Faizpur areas **(Fig 4).**

The water levels recorded in post-monsoon season (Nov. 2014) are ranging from 11.95 to 56.00 m bgl. In major part of the taluka water levels are ranging between 10 and 20 mbgl. Deeper water levels of 20-40 and more than 40 m bgl are observed in SE parts of taluka around Yaval and Faizpur areas **(Fig 5).**

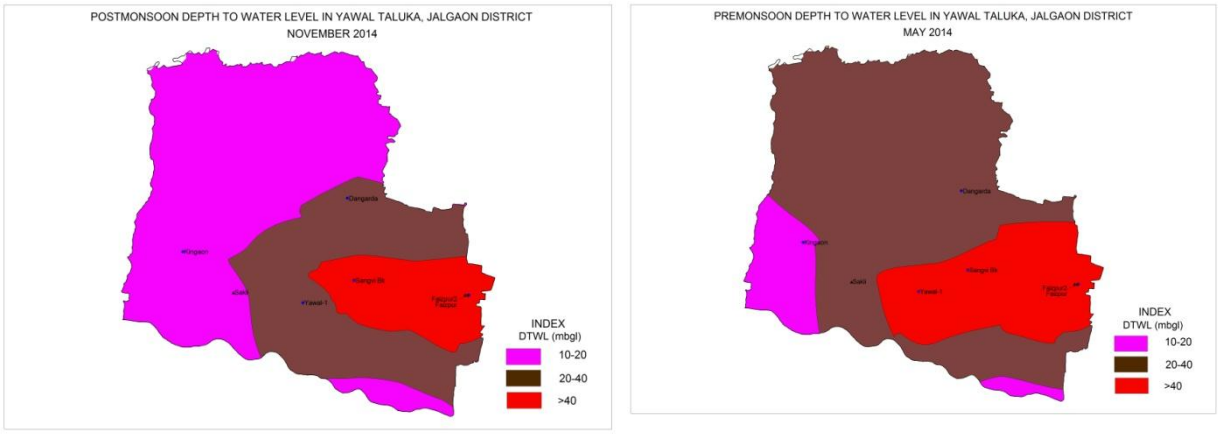


Fig 4 and 5: Pre and Post-monsoon (2014) Depth to Water Level, Yaval Taluka

8. DYNAMIC GROUND WATER RESOURCE

Ground Water Resources Assessment for the year 2011 indicates Net Annual Ground Water Availability of 7648.33 ham, draft for all uses is 10233.54 ham with irrigation being the major consumer withdrawing 8501.98 ham and stage of ground water development is also high about 133.80% **(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 increased from 107.58% in 2009 to 133.80% 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 Yaval Taluka (As on March 2011)

S. No	Particulars	GW Resources (Ha.m)
1.	Net Annual Ground Water Availability	7648.33
2.	Existing Gross Ground Water Draft for irrigation	8501.98
3.	Existing Gross Ground Water Draft for domestic and industrial water supply	1731.56
4.	Existing Gross Ground Water Draft for All uses	10233.54
5.	Provision for domestic and industrial requirement supply to 2025	1813.74
6.	Net Ground Water Availability for future irrigation development	751.94
7.	Stage of Ground Water Development	133.80%
8.	Category of the Assessment Unit	Over-Exploited

9. NEED FOR ARTIFICIAL RECHARGE AND CONSERVATION MEASURES

Yaval taluka is major banana growing area of Maharashtra. For cultivation of banana crop, huge amount of groundwater is required. This has led to over-exploitation of groundwater resources in the alluvial area from both the shallow and deeper aquifers. These practices are being continued since last few decades and 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 Yaval taluka. However, a robust consolidated plan for artificial recharge measures are also required for converting the entire Over-Exploited Yaval taluka into Critical / Semi-critical / Safe category.

11. FEASIBLE AREA FOR ARTIFICIAL RECHARGE OR CONSERVATION

The feasible area for artificial recharge to groundwater in Yaval 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 decadal post-monsoon water level for the period 2005 to 2014 reveals the deepest water level of more than 40 m bgl.

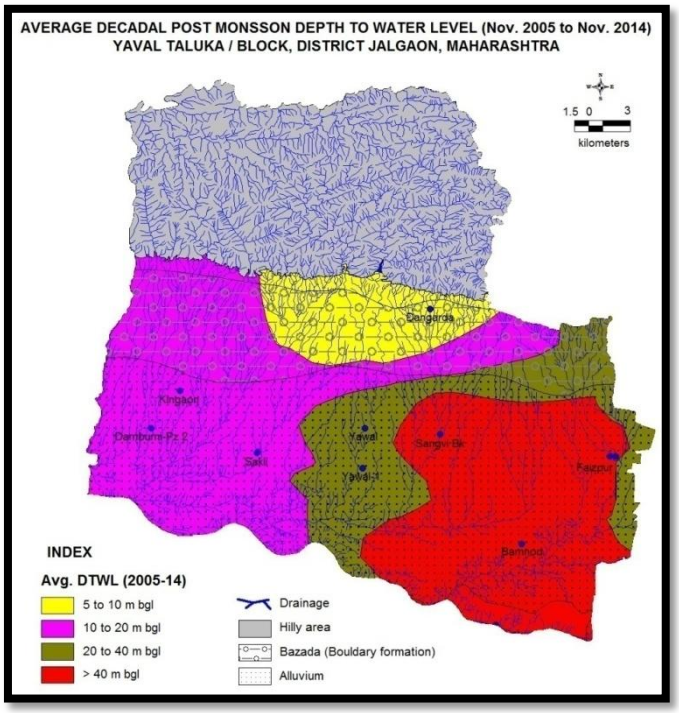


Fig 6: Average Decadal Post-monsoon depth to water level, Yaval Taluka

Water level contour map is prepared wherein 4 categories of observed water levels are made i.e. 5-10 m 10-20 m, 20-40m and more than 40 m bgl **(Fig. 6)**. Based on the depth to water level map, an area of 654 sq.km has been identified for artificial recharge to groundwater.

The long term water level trend map for the period 2005-2014 has been prepared and is shown in **Figure 7**. The trend map shows both the rising trend from 0.0 to 0.2 m/year and falling water level trend. 0.0 to 0.6 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 Yaval taluka **(Fig 7).**

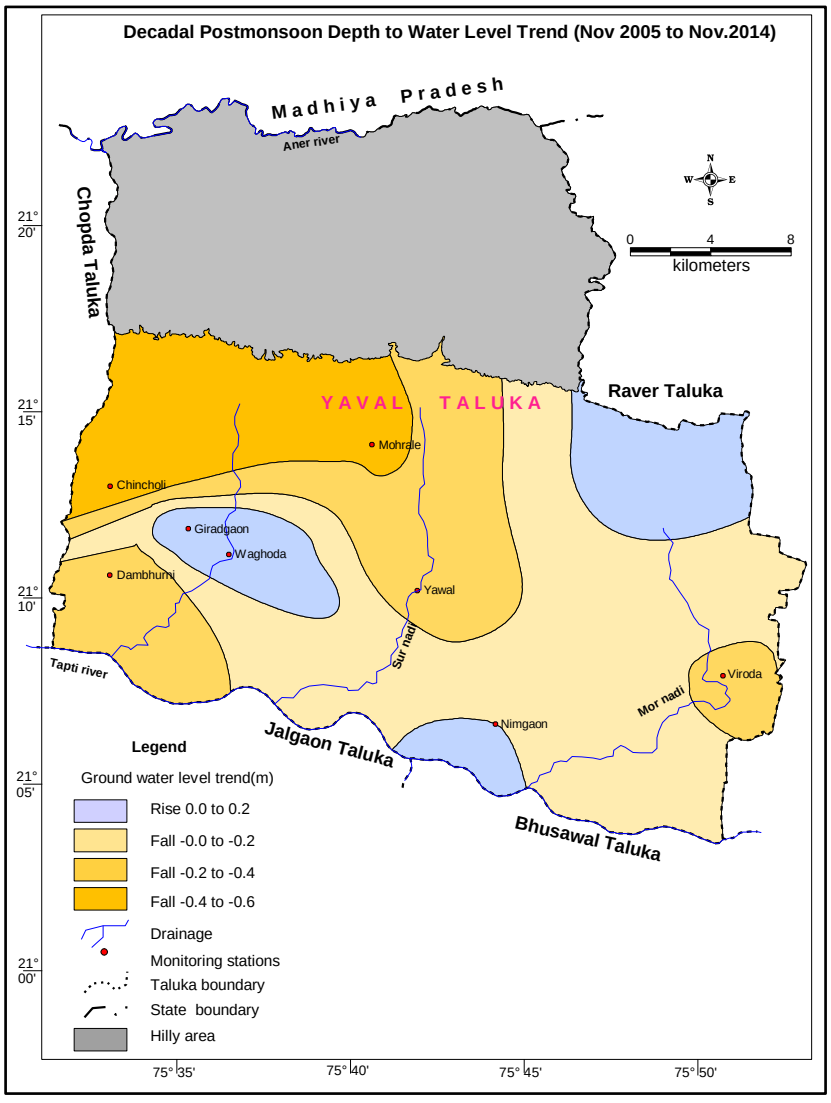


Figure 7: Map showing long term post monsoon water level trend (2005-14)

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 Yaval taluka is having sufficient thickness of weathered zone varying from 30 to more than 60 m and therefore found feasible for artificial recharge to groundwater. Some of the area of Yaval taluka in its southern part is traversed by few lineaments (**Figure 9)** indicating promising scope for artificial recharge in that area.

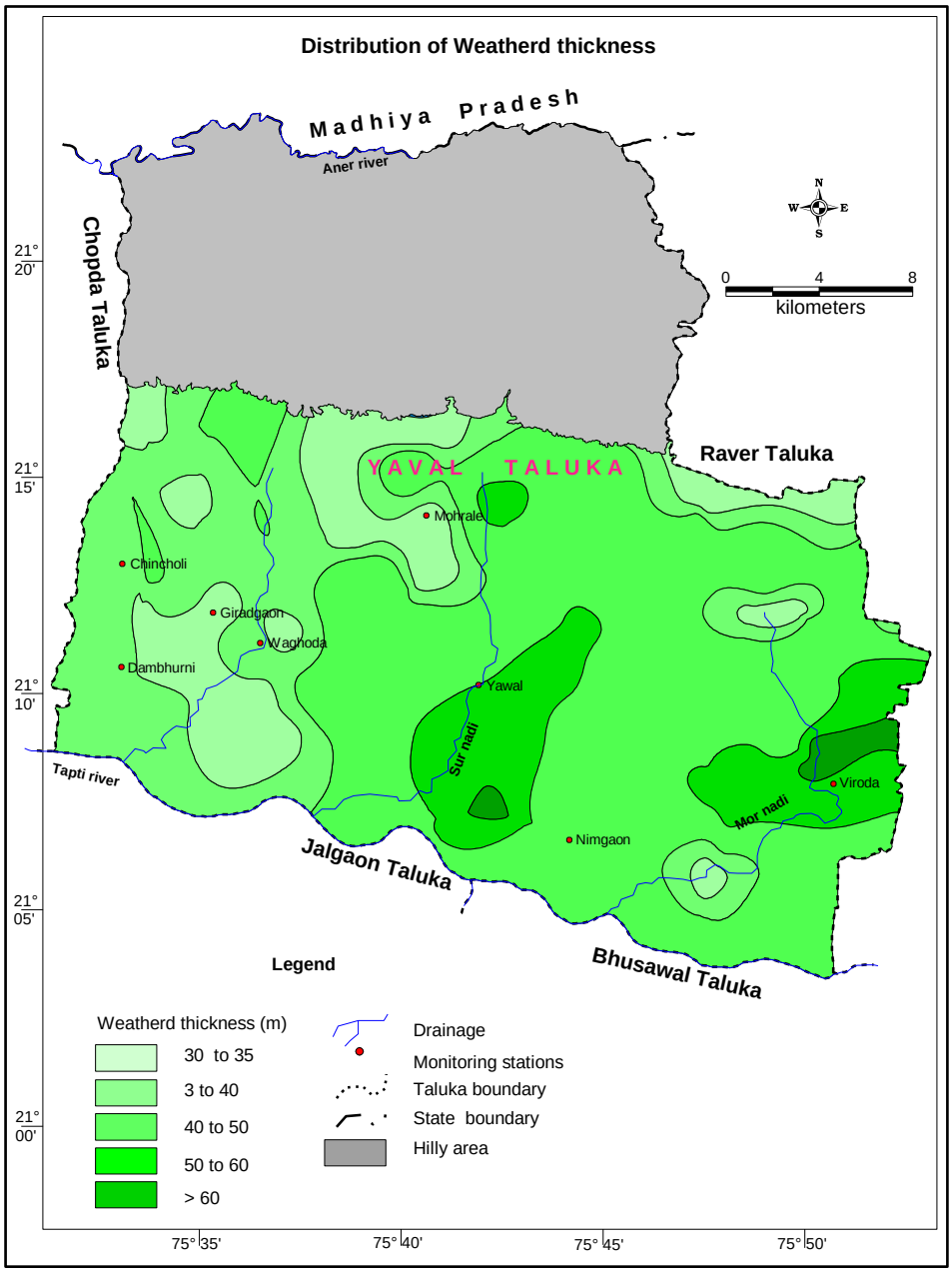


Figure 8: Map showing weathered thickness in Yaval taluka

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 654.00 sq.km is identified for artificial recharge to groundwater.

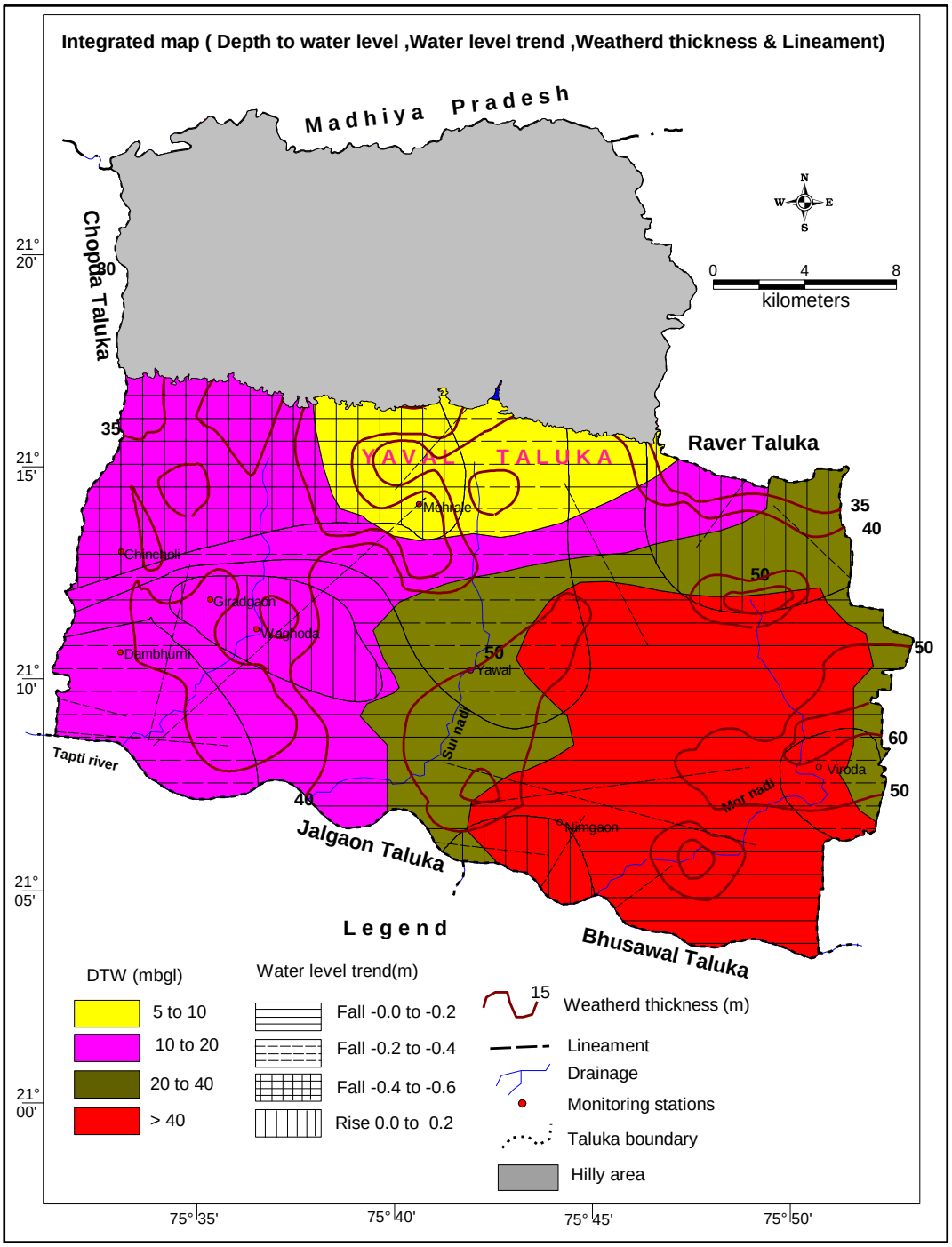


Figure 9: Integrated Map showing feasible area for artificial recharge to groundwater in Yaval taluka

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.

Yaval taluka of Jalgaon district falls in Tapi river basin. The data collected from Irrigation Department, Government of Maharashtra reveals that Tapi river basin covers an area of 51940 sq. km. The basin has surplus surface water runoff availability of 1240 MCM. Based on this data, it is estimated that the proportionate per sq.km. availability of surplus surface water runoff is 0.0239 MCM. Thus the proportionate surplus surface water availability for Yaval taluka comes out to be 15.61 MCM. For estimation of volume of water to be utilised for recharge, 70% of total surplus water availability has been considered. Thus about 10.93 MCM surplus surface water can be considered for preparation and implementation of master plan for artificial recharge in the over-exploited Yaval taluka and for estimation of number of structures required for augmentation of groundwater resource in the area.

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 receiving continuous water from stream, 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 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 (0.26 MCM) for construction of percolation tanks, about 25% surplus water (0.09 MCM) for construction of check dam. The remaining 5% surplus available water (0.02 MCM) is proposed for allocation for construction of various water conservation structures like loose boulder structures, gabbion structures etc. In the soft rock area, the proportionate allocation surplus runoff is 10.56 MCM. On safer side, the average recharge efficiency of artificial recharge structure is considered as 85%.

The tentative locations of proposed artificial recharge structures are shown in Figure 10 and the detail of these locations are given in **Annexure-I**. The locations of recharge shaft are shown as a cluster form and each cluster will contain 10-15 recharge shafts. The design of percolation tank, check dam, recharge shaft 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.

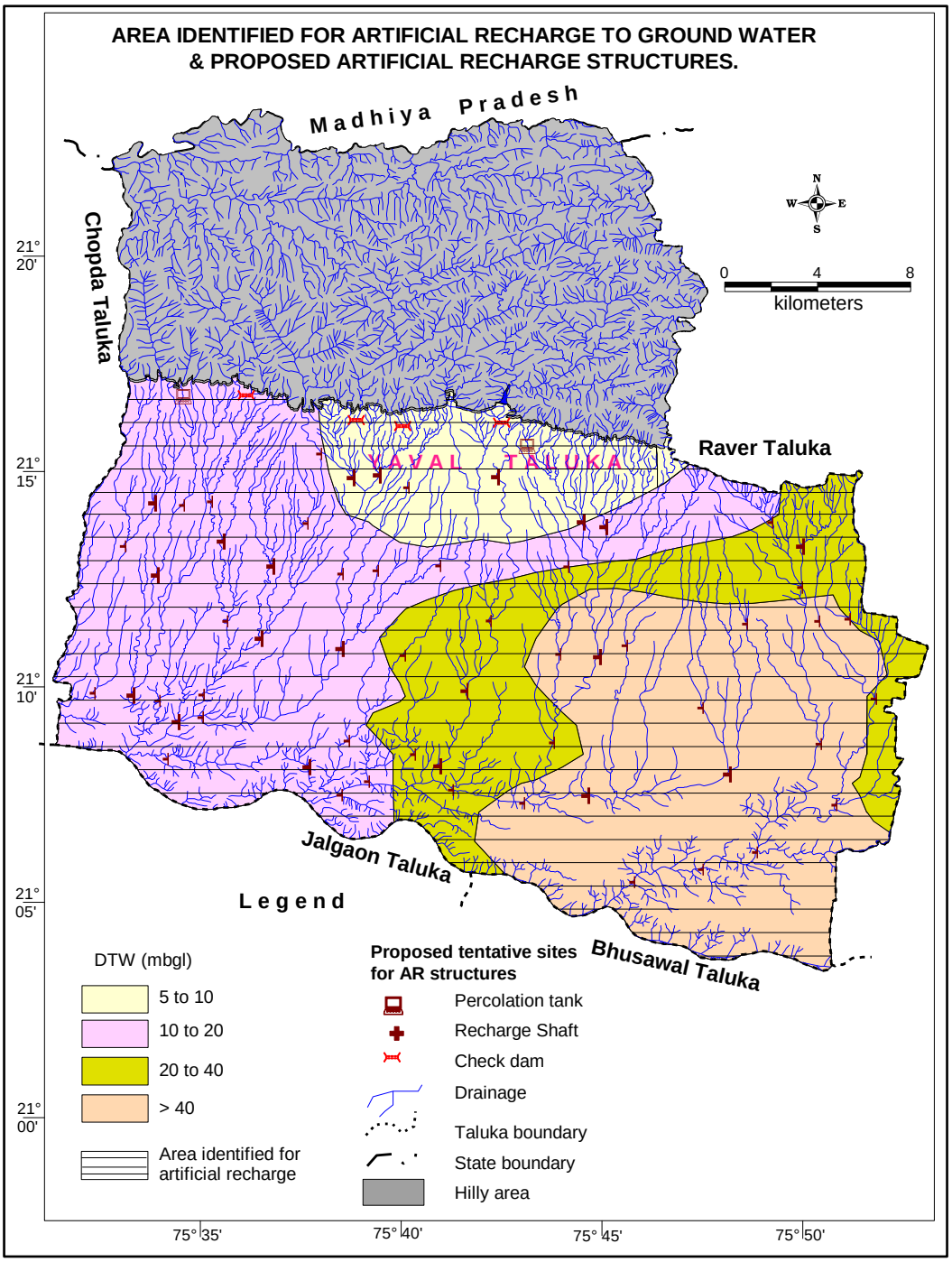


Figure 10: Tentative sites of Percolation Tank, Check Dam and Recharge Shaft and Water Conservation Structures, Yaval Taluka

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. 10.17 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

It is estimated that the total available surplus surface water recharge through percolation tanks is 0.26 MCM. Thus 1 percolation tank will be required to be constructed in Yaval taluka. Considering the recharge efficiency of 85%, it is expected that about 0.22 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 1 percolation tank will be Rs. 0.70 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 0.09 MCM of surplus water can be made available for construction of check dams. Hence it is estimated that about 3 check dams can be constructed to recharge the proportionate allocated surplus water of 0.09 MCM. Considering the recharge efficiency of 85%, it is expected that about 0.08 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 3 check dams will be Rs. 0.21 crores.

Water Conservation Structures

After the allocation of surplus runoff water for the major structures like percolation tanks and check dams for the hard rock area of Yaval taluka, the remaining quantum of surplus water can be taped by means of feasible water conservation structures for soil and water conservation. Thus about 0.02 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 1 water conservation structure will be required to conserve the 0.02 MCM of surplus runoff water. Considering efficiency of 85%, about 0.017 MCM of water can be harvested / recharged. The structure can be constructed on lower order streams i.e. streams of 1st and 2nd 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 1 water conservation structure will be Rs. 0.0025 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 Yaval Taluka. As per census 2011, there are about 60781 households in Yaval taluka. It is assumed that about 10 % of the households i.e. 6078 households may have the average roof area of about 50 sq.m. Therefore, considering the average annual rainfall of 738 mm, average roof area of 50 sq.m and runoff coefficient of 0.85, the total rainwater harvesting potential generated in the urban households of Yaval taluka is about 0.191MCM.

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 0.16 MCM shall be recharged through adoption of rainwater harvesting in the urban households.

Recharge Shaft

The total area underlain by the soft rock i.e. alluvium in Yaval taluka is 612.90 sq.km. Based on the earlier studies carried out by CGWB in the State of Maharashtra, Recharge shaft are the only suitable artificial recharge structures feasible in are underlain by the alluvium. The surface water availability for artificial recharge in alluvium area is 10.56 MCM. Thus about 176 nos. recharge shafts will be required which will recharge about 10.56 MCM of

water. Considering the recharge efficiency of 85%, about 8.98 MCM water can be recharged into subsurface.

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 176 recharge shaft will be Rs. 4.40 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
25 To 36 months	Impact Assessment

Annexure - I

Tentative Locations of Proposed Artificial Recharge Structures in Yaval Taluka of Jalgaon District

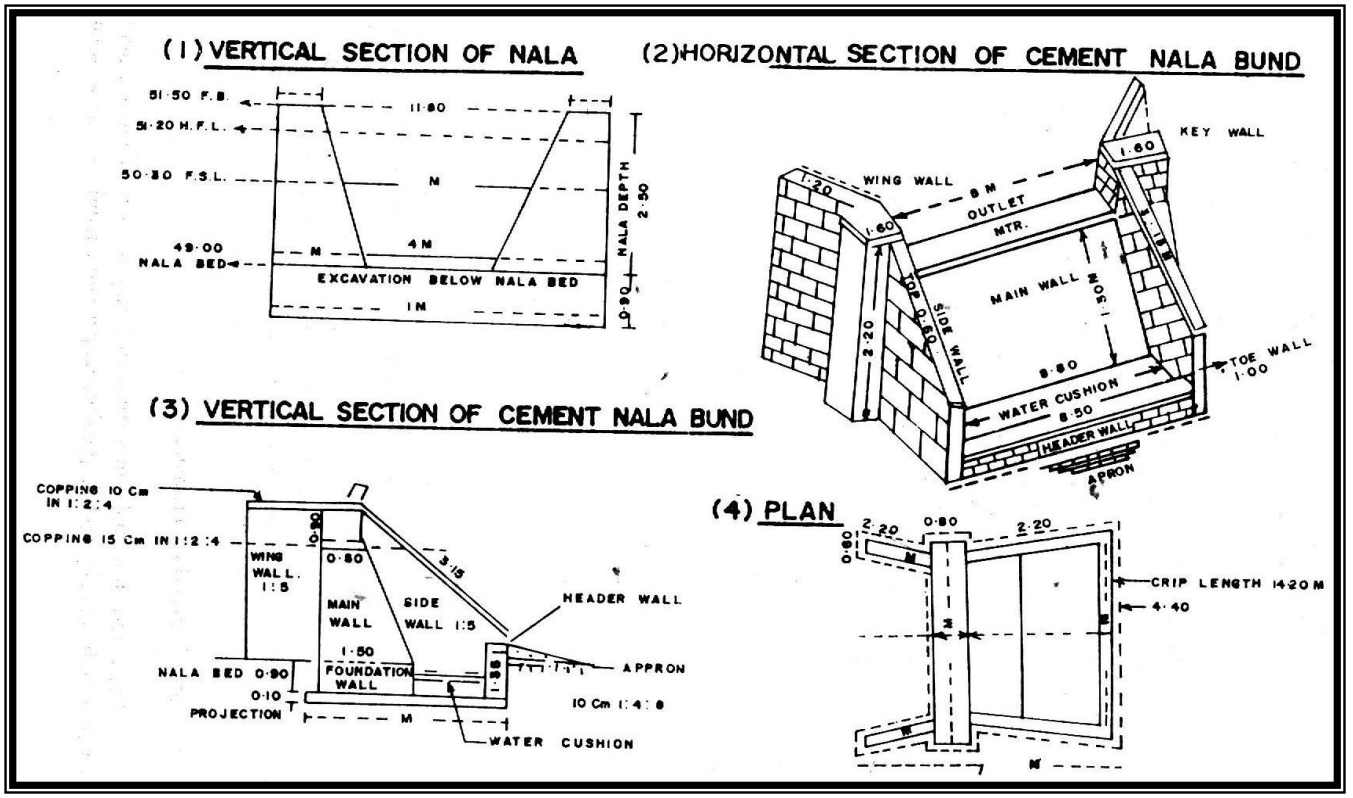
Sl. No.	District	Taluka	Structure	Village name	Long	Lat	Remarks
1	Jalgaon	Yaval	PT	Dangarkuthora	75.7187	21.2615	
2	Jalgaon	Yaval	CD	Malod	75.6027	21.2792	
3	Jalgaon	Yaval	CD	Mohrale	75.6675	21.2673	
4	Jalgaon	Yaval	CD	Vaghazira	75.6483	21.2696	
5	Jalgaon	Yaval	RS	Padalse	75.8025	21.1337	
6	Jalgaon	Yaval	RS	Kosgaon	75.8141	21.1034	
7	Jalgaon	Yaval	RS	Bhortek	75.7915	21.0967	
8	Jalgaon	Yaval	RS	Anjale	75.7631	21.0918	
9	Jalgaon	Yaval	RS	Karanji	75.847	21.1218	
10	Jalgaon	Yaval	RS	Virode	75.8405	21.1452	
11	Jalgaon	Yaval	RS	Pimprud	75.8632	21.1629	
12	Jalgaon	Yaval	RS	Nhavi P Yaval	75.8327	21.2058	
13	Jalgaon	Yaval	RS	Nhavi P Yaval	75.8399	21.1928	
14	Jalgaon	Yaval	RS	FAIZPUR	75.8525	21.1937	
15	Jalgaon	Yaval	RS	Hambardi	75.8099	21.1917	
16	Jalgaon	Yaval	RS	Bhalod	75.7914	21.1593	
17	Jalgaon	Yaval	RS	Sangvi Bk	75.7599	21.1834	
18	Jalgaon	Yaval	RS	Atrawal	75.7484	21.1791	
19	Jalgaon	Yaval	RS	YAWAL	75.7324	21.1801	
20	Jalgaon	Yaval	RS	YAWAL	75.7034	21.193	
21	Jalgaon	Yaval	RS	Sakali	75.6416	21.1823	
22	Jalgaon	Yaval	RS	Sakali	75.6081	21.1861	
23	Jalgaon	Yaval	RS	Dambhurni	75.5548	21.1642	
24	Jalgaon	Yaval	RS	Dagadi	75.5838	21.1556	
25	Jalgaon	Yaval	RS	Dagadi	75.5843	21.1642	
26	Jalgaon	Yaval	RS	Shiragad	75.5736	21.154	
27	Jalgaon	Yaval	RS	Dambhurni	75.5659	21.1622	
28	Jalgaon	Yaval	RS	Nhavi P Adawad	75.539	21.1652	
29	Jalgaon	Yaval	RS	Pathrale	75.5695	21.1396	
30	Jalgaon	Yaval	RS	Pilode Kh	75.6278	21.1365	
31	Jalgaon	Yaval	RS	Shirsad	75.6677	21.1796	
32	Jalgaon	Yaval	RS	Shirsad	75.6446	21.1466	
33	Jalgaon	Yaval	RS	Pimpri	75.6528	21.1308	
34	Jalgaon	Yaval	RS	Shirsad	75.672	21.1414	
35	Jalgaon	Yaval	RS	YAWAL	75.6936	21.166	
36	Jalgaon	Yaval	RS	Bhalshiv	75.682	21.1369	
37	Jalgaon	Yaval	RS	Bhalshiv	75.6877	21.1274	

38	Jalgaon	Yaval	RS	Pimpri	75.6416	21.1255	
39	Jalgaon	Yaval	RS	Tembhi Kh	75.7299	21.1457	
40	Jalgaon	Yaval	RS	Rojore	75.7436	21.1254	
41	Jalgaon	Yaval	RS	Borawal Bk	75.7173	21.1223	
42	Jalgaon	Yaval	RS	Borkhede Bk	75.8328	21.2219	
43	Jalgaon	Yaval	RS	Borkhede Bk	75.8205	21.2311	
44	Jalgaon	Yaval	RS	Dangarkuthora	75.7512	21.2294	
45	Jalgaon	Yaval	RS	Dangarkuthora	75.7416	21.2314	
46	Jalgaon	Yaval	RS	Mohrale	75.7064	21.249	
47	Jalgaon	Yaval	RS	Savkhedesim	75.657	21.2496	
48	Jalgaon	Yaval	RS	Chunchale	75.646	21.2484	
49	Jalgaon	Yaval	RS	Mohrale	75.6693	21.2445	
50	Jalgaon	Yaval	RS	Kingaon Bk	75.6129	21.2142	
51	Jalgaon	Yaval	RS	Chunchale	75.6275	21.2308	
52	Jalgaon	Yaval	RS	Kingaon Bk	75.5923	21.2238	
53	Jalgaon	Yaval	RS	Ichkheda	75.5877	21.239	
54	Jalgaon	Yaval	RS	Kasarkhede	75.5761	21.2377	
55	Jalgaon	Yaval	RS	Adgaon	75.5638	21.2387	
56	Jalgaon	Yaval	RS	Chunchale	75.6331	21.2577	
57	Jalgaon	Yaval	RS	Dahigaon	75.6565	21.2124	
58	Jalgaon	Yaval	RS	Borale	75.6419	21.2111	
59	Jalgaon	Yaval	RS	Mahelkhedi	75.6825	21.2142	
60	Jalgaon	Yaval	RS	Dangarkuthora	75.7359	21.214	
61	Jalgaon	Yaval	RS	Sakali	75.5943	21.1928	
62	Jalgaon	Yaval	RS	Chincholi	75.5517	21.2219	
63	Jalgaon	Yaval	RS	Dongaon	75.5651	21.2106	
64	Jalgaon	Yaval	RS	Hingone	75.7921	21.1921	
65	Jalgaon	Yaval	RS	FAIZPUR	75.8656	21.1835	
66	Jalgaon	Yaval	RS	Amode	75.8333	21.1745	
67	Jalgaon	Yaval	RS	Bhalod	75.7674	21.1648	
68	Jalgaon	Yaval	RS	Kosgaon	75.82	21.1145	
69	Jalgaon	Yaval	RS	Bhalshiv	75.6957	21.1295	
70	Jalgaon	Yaval	RS	Dambhurni	75.5779	21.1839	
71	Jalgaon	Yaval	RS	Deogaon	75.5389	21.1957	
72	Jalgaon	Yaval	RS	Naigaon	75.6104	21.2333	
73	Jalgaon	Yaval	RS	Naigaon	75.6045	21.242	
74	Jalgaon	Yaval	RS	Naigaon	75.5988	21.2443	
75	Jalgaon	Yaval	RS	Vadhode Pr Yawal	75.661	21.2087	
76	Jalgaon	Yaval	RS	Viravali Bk	75.681	21.1945	
77	Jalgaon	Yaval	RS	YAWAL	75.7311	21.1953	
78	Jalgaon	Yaval	RS	Padalse	75.8025	21.1337	Clusture points
79	Jalgaon	Yaval	RS	Kosgaon	75.8141	21.1034	Clusture points

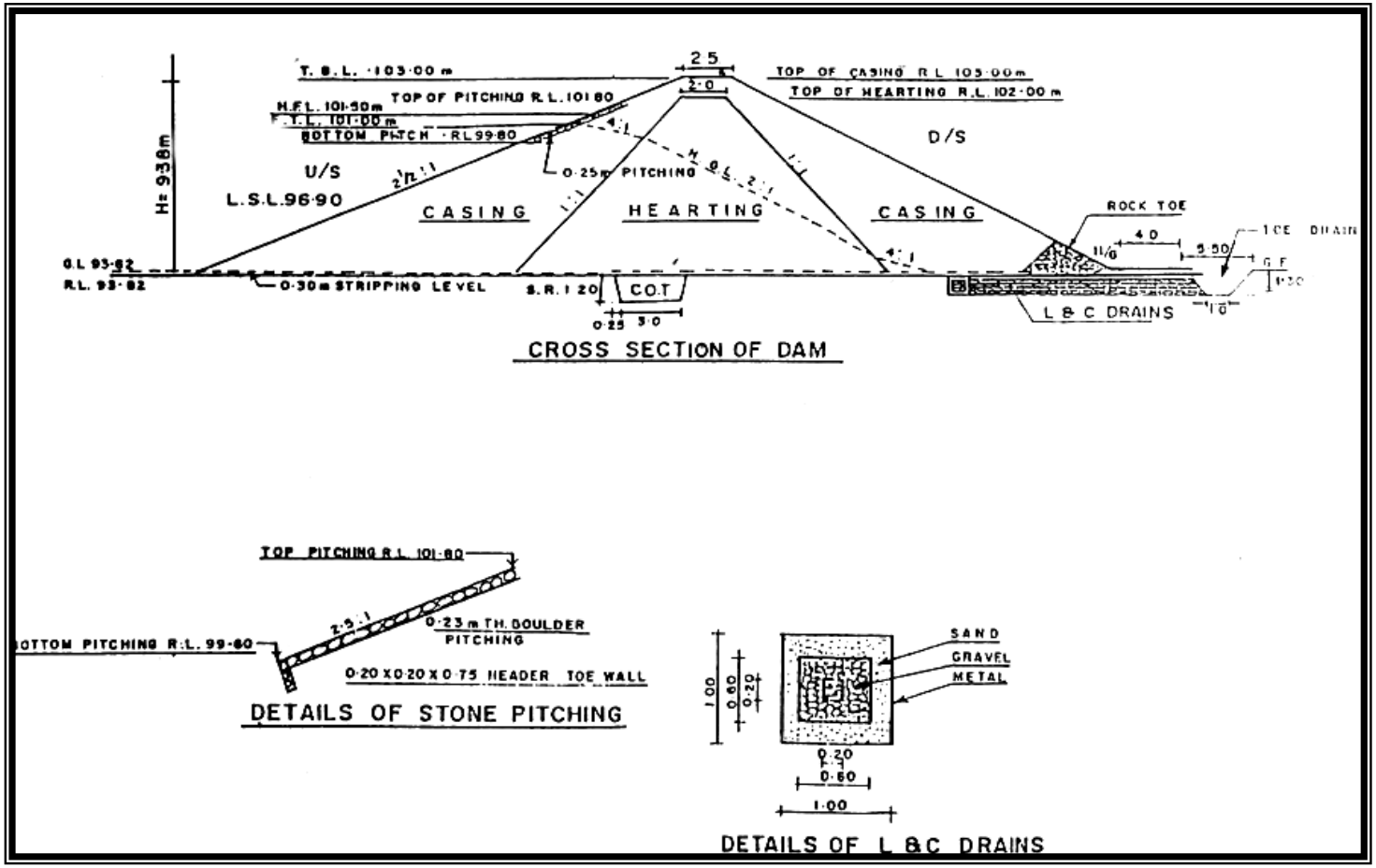
80	Jalgaon	Yaval	RS	Atrawal	75.7484	21.1791	Clusture points
81	Jalgaon	Yaval	RS	Sakali	75.6416	21.1823	Clusture points
82	Jalgaon	Yaval	RS	Sakali	75.6081	21.1861	Clusture points
83	Jalgaon	Yaval	RS	Dambhurni	75.5548	21.1642	Clusture points
84	Jalgaon	Yaval	RS	Shiragad	75.5736	21.154	Clusture points
85	Jalgaon	Yaval	RS	Pilode Kh	75.6278	21.1365	Clusture points
86	Jalgaon	Yaval	RS	YAWAL	75.6936	21.166	Clusture points
87	Jalgaon	Yaval	RS	Bhalshiv	75.682	21.1369	Clusture points
88	Jalgaon	Yaval	RS	Rojore	75.7436	21.1254	Clusture points
89	Jalgaon	Yaval	RS	Borkhede Bk	75.8328	21.2219	Clusture points
90	Jalgaon	Yaval	RS	Dangarkuthora	75.7512	21.2294	Clusture points
91	Jalgaon	Yaval	RS	Dangarkuthora	75.7416	21.2314	Clusture points
92	Jalgaon	Yaval	RS	Mohrale	75.7064	21.249	Clusture points
93	Jalgaon	Yaval	RS	Savkhedesim	75.657	21.2496	Clusture points
94	Jalgaon	Yaval	RS	Chunchale	75.646	21.2484	Clusture points
95	Jalgaon	Yaval	RS	Kingaon Bk	75.6129	21.2142	Clusture points
96	Jalgaon	Yaval	RS	Kingaon Bk	75.5923	21.2238	Clusture points
97	Jalgaon	Yaval	RS	Adgaon	75.5638	21.2387	Clusture points
98	Jalgaon	Yaval	RS	Dongaon	75.5651	21.2106	Clusture points

Annexure-II

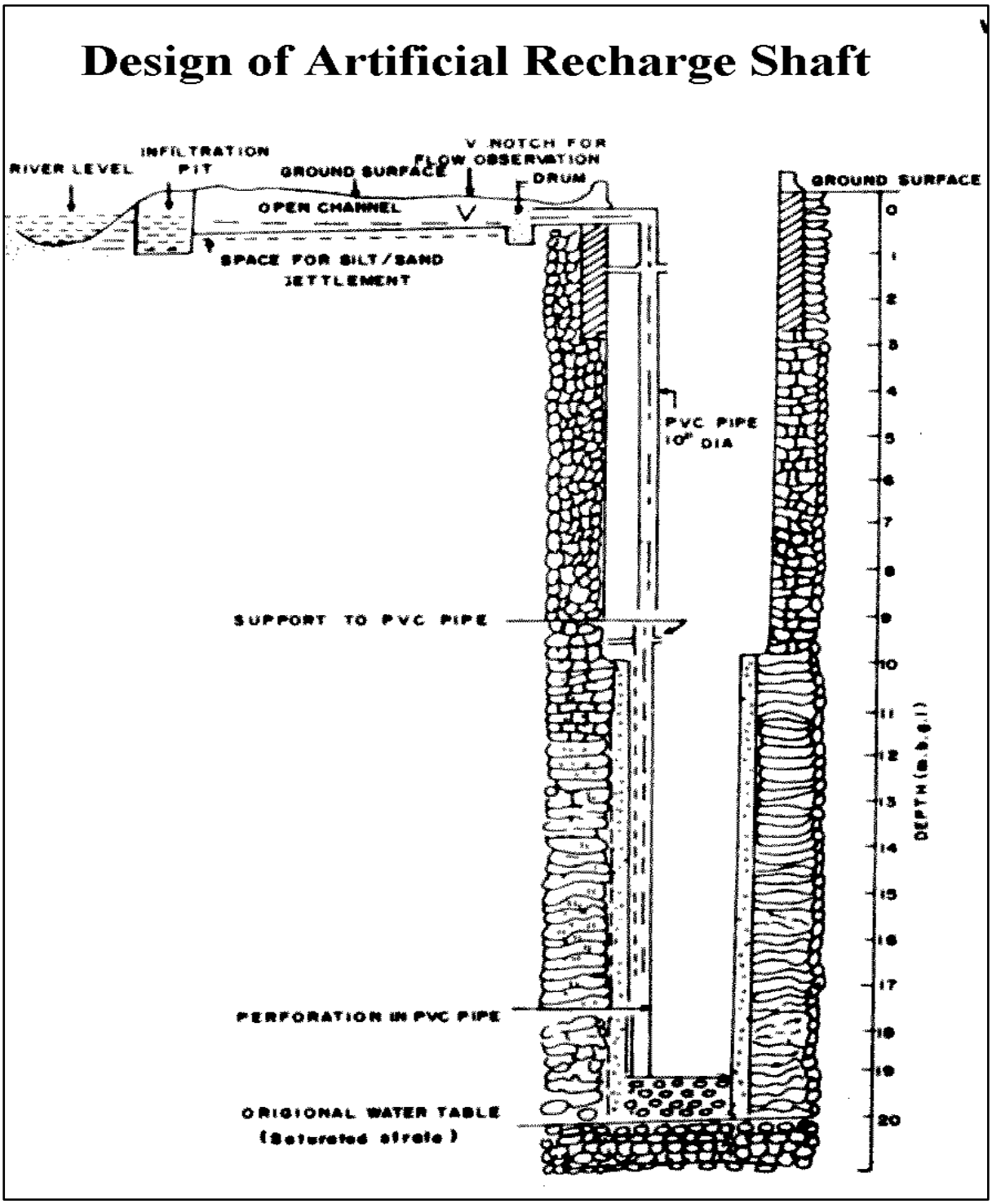
Design of Check Dam



Design of Percolation Tank

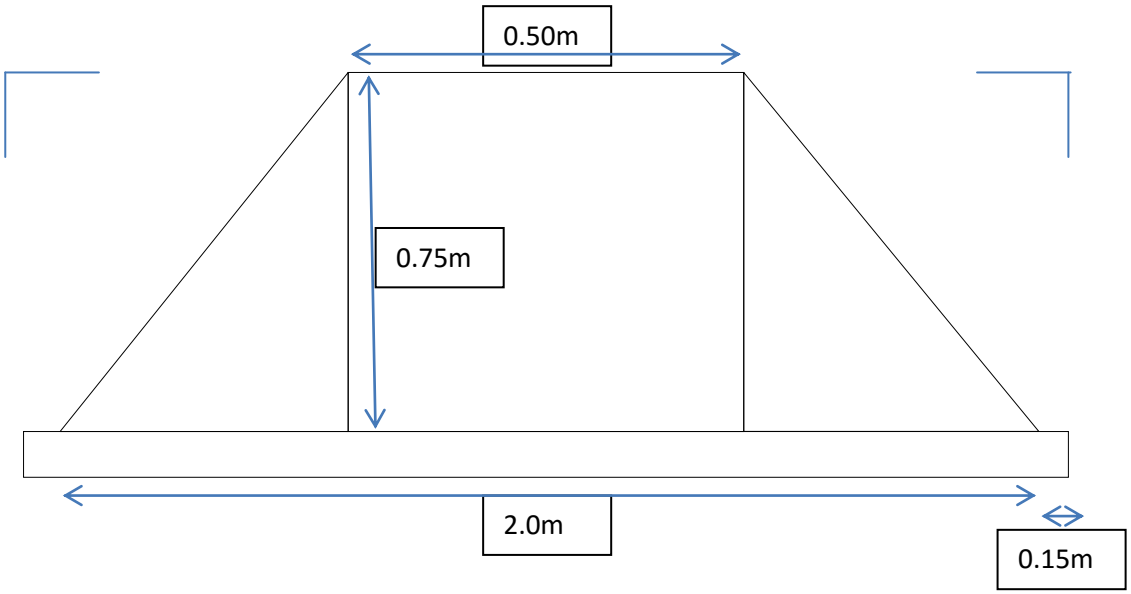


Design of Recharge Shaft



DESIGN OF WATER CONSERVATION STRUCTURES

Cross Section of Loose Boulder Structure



Cross Section of Gabbion Structure