

केंद्रीय भूमि जल बोर्ड जल संसाधन, नदी विकास और गंगा संरक्षण विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES RAIGAD DISTRICT, MAHARASHTRA

मध्य क्षेत्र, नागपुर Central Region, Nagpur

Interim Report 2500/NQM/2023 कार्यालयीन उपयोग हेतु For official use only



भारत सरकार

CENTRAL GROUND WATER BOARD

Ministry of Jal Shakti, Division of Water Resources, River Development & Ganga Rejuvenation Government of India

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN

RAIGAD DISTRICT, MAHARASHTRA

AAP 2022-23

मध्यक्षेत्र, नागपुर Central Region, Nagpur 2023

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, RAIGAD DISTRICT, MAHARASHTRA

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1. G	ENERAL INFORMATION		
	Geographical Area	:	7152 sq. km
	Administrative Divisions (2011)	:	Taluka – 15; Alibagh, Panvel, Uran Karjat,
			Khalapur, Pen, Sudhagad Mahad, Roha, Mangaon,
			Poladpur Mhasala, Shriwardhan, Murud and Tala
	Villages (Census 2011)	:	1860 Nos.
	Population (Census 2011)	:	26,34,200
	Rainfall 2021	:	3548.50 mm
	Normal rainfall	:	3213.95 mm
	Long term rainfall Trend	:	Rising trend 33.22 mm/year
	(1998-2020)		
2. G	EOMORPHOLOGY AND DRAI	N/	GE
	Major Physiographic unit	:	Eastern Sahayadri Hilly zone, Central low
			lving fertile zone. Coastal zone.
	Major Drainage	:	Ulhas Patalganga, Kundalika and Savitri
3. L	AND USE (sources: DSA 2020)		Chius, Fuungungu, Hundunnu und Suttin
	Forest Area	•	1481.74 sq. km. (20.71%)
<u> </u>	Cultivable Area	•	1985.35 sg. km. (27 75%)
	Nat Area Sown	·	3054.05 sg km (42.700%)
	Area Sown more then once	•	288.32 Sq. km (4.0.20%)
1			Modium Plack and Deep Plack soil
4. 5 D	DINCIDAL CROPS (2020 21)	•	Medium Black and Deep Black soll.
5. P	RINCIPAL CROPS (2020-21)		04572 ha
	Rice		94575 ha
	Puises	:	99087 na
	Ragi (Nachani)	:	3419 ha
(Gram	:	1549 ha
0.	HORTICULTURAL CROPS	r –	125401
	Mango Citara facit	:	13549 ha
	Citrus fruit	:	5.00 ha
	Banana	:	97 ha
_	Others DDICATION DV	:	/523 ha
7.	IKRIGATION BY		Nos.
	DIFFERENT SOURCES		
	(2014-15)		5426
<u> </u>	Tube wells		105
<u> </u>	Surface weter Imicate 1 Area (1-1)		103
<u> </u>	Surface water Irrigated Area(ha)		4177
<u> </u>	Total Imigated Detertial		2700
	Total Imigated Potential	:	/105
80	DOLIND WATED MONITODIN		WELLS (As on 21st March 2022)
0.0	Dug wells	U	A2
	Dig wons	•	1
0.0		•	
7.0	Deistocene Decent	•	Alluvium (River Alluvium)
<u> </u>	Upper Cretaceous Lata Focore	•	Decean Trans Basalt
10	HVDBOGEOLOGV	•	Dettail Haps Dasalt
10.	Major Water Rearing Formation		Resalt weathered/freetured/isinted
	wajor water bearing formation	ŀ	Dasan-weamereu/fractureu/ jointeu
			semi-confined to confined conditions
			Alluvium- Sand and Gravel under phreatic
			And vium- Sand and Graver, under pineanc

RAIGAD DISTRICT AT A GLANCE

	condition.								
	Depth to water level in Shallow Aquifer								
	Pre-monsoon Depth to Water Level (May-2022)	:	0.35 (Kargaon) to 11.5 mb	gl (Khamgaon).					
	Post-monsoon Depth to Water	:	0.1(Kokavan) and 10.7 mbgl (Khamgaon						
	Depth to water level in Deeper	Am	uifer	uifor					
	Water Level (May 2022)	·							
	Water level Trend (2010-19)								
	Pre- monsoon Water Level \cdot Fall: 0.17 m/year (Lite) to 0.012 m/year								
	Trend (2010-2019)	•	(Dapoli)						
			Rise: 0.012 m/year (Saig 0.29 m/year (Chinchwar	aon Govalwadi) to a).					
	Post-monsoon Water Level	:	Fall: 0.09 m/year (Khala	pur) to 0.006 m/vear					
	Trend (2010-2019)		(Dapoli).	F)					
			Rise: 0.01 m/year (Kumb)	harcha Kosta Bk) to 0.27					
			m/year (Chandore)	harona Robia BR) to 0.27					
11. (GROUND WATER EXPLORAT	IO.	\mathbf{N} (As on March 2022)						
	Wells Drilled (CGWB)		EW-46, OW-17						
	Depth Range		46.50 to 201.30 m bgl						
	SWL		1.0- 100 mbgl						
	Discharge	:	Traces to 29.16 lps						
	Transmissivity	:	40.80 to 50.52 m ² / day						
12. (GROUND WATER QUALITY:	In	major part ground water is	suitable for drinking and					
irrig	ation purposes except localized nit	ate	contaminated villages.	C					
	Constituents	:	Shallow	aquifer					
			Min	Max					
	pH	:	6.05	9.11					
	EC	:	94	2078					
	TDS	•	60	1330					
		•	• •	1550					
	TH	:	30	600					
	TH Ca	:	30 10	600 200					
	TH Ca Mg	• • • • • • • • • • • • • • • • • • • •	30 10 1	600 200 51					
	TH Ca Mg Na	:	30 10 1 3	600 200 51 203					
	TH Ca Mg Na K	:	30 10 1 3 0	600 200 51 203 38					
	TH Ca Mg Na K CO3	: : : :	30 10 1 3 0 0	600 200 51 203 38 24					
	TH Ca Mg Na K CO3 HCO3		30 10 1 3 0 0 12	600 200 51 203 38 24 494					
	TH Ca Mg Na K CO3 HCO3 Cl			600 200 51 203 38 24 494 347					
	TH Ca Mg Na K CO3 HCO3 Cl SO4		$ \begin{array}{r} 30 \\ 10 \\ 1 \\ 3 \\ 0 \\ 0 \\ 12 \\ 4 \\ 0 \end{array} $	1330 600 200 51 203 38 24 494 347 90					
	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3		$ \begin{array}{r} 30 \\ 30 \\ 10 \\ 1 \\ 3 \\ 0 \\ 0 \\ 12 \\ 4 \\ 0 \\ 0 \\ 0 \end{array} $	1330 600 200 51 203 38 24 494 347 90 85					
	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F		$ \begin{array}{r} 30 \\ 30 \\ 10 \\ 1 \\ 3 \\ 0 \\ 0 \\ 12 \\ 4 \\ 0 \\ $	1330 600 200 51 203 38 24 494 347 90 85 0.26					
	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F		30 10 1 3 0 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	1330 600 200 51 203 38 24 494 347 90 85 0.26					
13. I	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER H Annual Extractable Ground		30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	1330 600 200 51 203 38 24 494 347 90 85 0.26					
13. I :P	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER H Annual Extractable Ground Water Recharge		30 30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	1330 600 200 51 203 38 24 494 347 90 85 0.26					
13. I :P	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER I Annual Extractable Ground Water Recharge Total Extraction		30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	600 200 51 203 38 24 494 347 90 85 0.26					
13. I	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER H Annual Extractable Ground Water Recharge Total Extraction Provision for Annual GW		30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	1330 600 200 51 203 38 24 494 347 90 85 0.26					
13. I	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER H Annual Extractable Ground Water Recharge Total Extraction Provision for Annual GW Allocation for Domestic Use as		30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	600 200 51 203 38 24 494 347 90 85 0.26					
13. I	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER H Annual Extractable Ground Water Recharge Total Extraction Provision for Annual GW Allocation for Domestic Use as on 2025	· · · · · · · · · · · · · ·	30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	1330 600 200 51 203 38 24 494 347 90 85 0.26					
13. I	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER H Annual Extractable Ground Water Recharge Total Extraction Provision for Annual GW Allocation for Domestic Use as on 2025 Stage of Ground Water		30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	1330 600 200 51 203 38 24 494 347 90 85 0.26					
13. I	TH Ca Mg Na K CO3 HCO3 Cl SO4 NO3 F DYNAMIC GROUND WATER H Annual Extractable Ground Water Recharge Total Extraction Provision for Annual GW Allocation for Domestic Use as on 2025 Stage of Ground Water Extraction	· · · · · · · · · · · · · ·	30 10 1 3 0 0 12 4 0 0 0 0 0 0 0 0 0 0 0 0 0	600 200 51 203 38 24 494 347 90 85 0.26					

14.	MAJOR GROUND WATER PROBLEMS AND ISSUES							
	• Sustainability in hard rocks							
	Low Ground Water Deve	lop	oment					
15.	Aquifer Management Plan							
	Demand side Management	:	5200 ha area of horticulture (Orchard) crop proposed for Drip irrigation					
	Expected Benefits	:	 Water saving through adopting Micro Irrigation in horticulture area = 20.80 MCM Balance GWR available for Development after SOE 60% – 171.14 MCM Additional 26330 ha area can be brought under assured GW irrigation Even after above, SOE will be 12% (safe category) Increase in GW Availability & Sustainability 					

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, RAIGAD DISTRICT, MAHARASHTRA

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AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, RAIGAD DISTRICT

1.INTRODUCTION

National Aquifer Mapping (NAQUIM) has been taken up in XII five-year plan by CGWB to carry out detailed hydrogeological investigation on 1:50,000 scale. The NAQUIM has been prioritized to study Over-exploited, Critical and Semi-Critical blocks as well as the other stress areas recommended by the State Govt. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers.

The vagaries of rainfall, inherent heterogeneity & poor sustainability of hard rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulatory mechanism, has had a detrimental effect on ground water scenario of the Country in last decade or so. Thus, prompting the paradigm shift from "traditional ground water development concept" to "modern ground water management concept".

Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at the robust and implementable ground water management plans. The proposed management plans will provide the **"Road Map"** for ensuring sustainable management and equitable distribution of ground water resources, thereby primarily improving drinking water security and irrigation coverage. Thus, the crux of NAQUIM is not merely mapping, but reaching the goal of ground water management through community participation. The aquifer maps and management plans will be shared with the administration of Raigad district, Maharashtra for its effective implementation.

The activities under NAQUIM are aimed at:

- **4** Identifying the aquifer geometry
- 4 Aquifer characteristics and their yield potential
- **4** Quality of water occurring at various depths
- 4 Aquifer wise assessment of ground water resources
- Preparation of aquifer maps and
- 4 Formulate ground water management plan

1.1 ABOUT THE AREA

Raigad district is one of the four coastal districts situated along the western coast of the State and is located between north latitude 17°51'00" and 19°08'00" and east longitudes 72°50'00" and 73°40'00". It is bounded by Thane district in the north, Ratnagiri district in the south, Pune district in the east and Arabian sea forms the western boundary having a length of about 250 km.

The district covers an area of 7152 sq. km and has been divided into four revenue division's viz., Alibag, Panvel, Mahad and Mangaon which are further divided into fourteen talukas viz., Alibag, Panvel, Uran, Karjat, Khalapur, Pen, Sudhagad, Mahad, Roha, Mangaon, Poladpur, Mahasala, Shriwardhan and Murud. It has total population of 22, 07,929 with density of 368 persons/sq.km as per 2011 census. The district has15 talukas, 41 towns and 1909 villages out of which 60 villages are un-habitated. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river.

The district is categorized as safe as per Ground Water Resources Estimation 2020. The Index and Administrative map of the Raigad district is presented in **Fig. 1.1**



Figure 1.1 : Index map, Raigad District

Raigad district has been taken up under NAQUIM study in the year 2022-23 (AAP 2022-23) Ground water Exploration in the district has been taken up in different phases since 1996 in areas occupied by Deccan Trap Basalt. A total of 47 exploratory wells (EW), 18 observation wells (OW) have been drilled till March 2022. Apart from these, 2 Pz's have been drilled under Hydrology Project-I through outsourcing.

To assess the ground water regime, 43 existing ground water monitoring stations of CGWB being monitored 4 times in a year are used to acquire micro level hydrogeological data to decipher the water level scenario, sub-surface lithological disposition and hydrogeological setup of shallow aquifer (Aquifer-I). In AAP 2022-23, total 70 no. of key observation wells are established for shallow water level monitoring in pre- and post-monsoon. The details of monitoring wells are given in **Annexure-III**.

1.2 GEOMORPHOLOGY, DRAINAGE AND SOIL TYPES

The Raigad district has three physiographic divisions i.e. (i) Coastal zone in west covers about 20% percent of the district (ii) Central zone covers about 1/3 rd of the district, consisting of fertile land in low lying area (iii) Hilly zone in the eastern part highly uneven in altitude and covered with forest. This hill range is characterized by ruggedness and uneven topography, with crestline of peaks and saddles forming the eastern horizon. Ulhas, Bhogawati, Balganga Amba, Kundlika, Kal, Gandhari, Savitri ghod, Nageshwari, Mandad are main rivers in Raigad district. The geomorphology of the area is shown in **Fig. 1.2**.



Figure 1. 2: Geomorphology, Raigad District

The entire area of the district falls in Coastal part. The Ulas River flowing from north side of the district, and Poshir, Shilar and Pej rives are the tributaries on Ulas river. Kundalika river is the important river and flowing from middle of the district. The Drainage map is shown in **Fig. 1.3**.



Figure 1.3: Drainage, Raigad District

The soils in the district are formed from the Deccan Trap which is predominating rock formation with small out crops of Laterite at a few places in the Poladpur taluka and Matheran hill. The soils are grouped as Forest, Varkas, Rice, Khar or Saline, Coastal Alluvium and Laterite as per the location and topographical situation. The thematic map of soil distribution in the district is shown in **Fig. 1.4**.



Figure 1.4: Soil, Raigad District

1.3 CLIMATE AND RAINFALL

The climate of the district is typical of west coast and characterized with plentiful and regular seasonal rainfall, oppressive weather in summer and high humidity throughout the year. The mean minimum temperature is 16 °C and mean maximum temperature is 38 °C. Climate of the district is characterized by high humidity throughout the year, an oppressive summer followed by well distributed and heavy rainfall during the southwest monsoon season. The cold season starts from December to February followed by summer from March to May. The month with the highest relative humidity is July and the month with the lowest relative humidity is March. The rainfall is not uniform throughout the district. It is considerably more inland than on the coast. The district, however, receives heavy and assured rainfall.

Significant spatial variation in the normal rainfall ranging from less than 2000 mm/year to more than 2600 mm/year is observed. Minimum rainfall in the northwest part of the district and gradually increases reaches maximum towards south and eastern parts of district in parts of Sudaghad and Poladpur blocks. Very strong rainfall gradient is observed from western to eastern parts of the district. Lowest rainfall less than 2000 mm/year is observed in parts of Uran block. Central parts of district particularly Pen and Rona blocks observed with wide range of rainfall variability between 2000 mm/year to 3400 mm/year. The number of rainy days varying between 82 to 131 days.

The normal rainfall of the district is 3217.52 mm. Annual rainfall data of 1998-2022 is analysed and presented in Fig. 1.7. This indicates that Minimum rainfall occurred in 2009 (2245.6 mm) and maximum rainfall in 2019 (4173.3 mm). The rainfall trend analysis shows a rising trend @ 5.39 mm/year. The rainfall analysis show that the departure of annual rainfall from the normal rainfall, expressed in terms of percentage, varied from -40 to 26 percent. The departure percent analysed denotes the rainfall variation pattern occurred during the period 1998-2022. The area experienced 1 times (4 %) excess rainfall, 19 times (76%) normal rainfall and 5 time (20%) moderate drought conditions as given in Table 1.1. The coefficient of variation of the annual rainfall from the mean rainfall has been observed to be 18.1%. The isohyet map of the district is depicted in **Figure 1.5**.

Period	= 1998 to 202	22	No. of Years = 25					
YEA R	AVERAG E	NORMA L	DEPARTU RE	NO. OF RAINY DAYS	CATEGO RY	NORMAL RAINFALL	3217.52	
1998	3335.4	3201.2	4.19	127	NORMAL	STANDAR D DEVIATIO N	567.1385	
1999	3214.6	3201.2	0.42	118	NORMAL	COEFFICIE NT OF VARIATIO N	18.1	
2000	3194	3201.2	-0.22	103	NORMAL	MEAN	3133.4	
2001	2399.7	3201.2	-25.04	108	MODERA TE	MEDIAN	3235.3	
2002	2336.8	3201.2	-27.00	82	MODERA TE	SLOPE	5.39	
2003	3052.1	3201.2	-4.66	116	NORMAL	INTERCEP T	3063.3	
2004	3258.2	3201.2	1.78	108	NORMAL	EQUATIO N OF TREND LINE	5.39x	+ 3063.3

Table 1.1: Long Term Rainfall Analysis (1998 to 2022) of Raigad district

Period	l = 1998 to 202	22	No. of Years	= 25				
YEA R	AVERAG E	NORMA L	DEPARTU RE	NO. OF RAINY DAYS	CATEGO RY	NORMAL RAINFALL	3217.52	
2005	3759.6	3201.2	17.44	102	NORMAL	CATEGOR Y	NUMBE R OF YEARS	%OF TOTAL YEARS
2006	3565.5	3201.2	11.38	116	NORMAL	DEPARTU RES		
2007	3715.9	3201.2	16.08	114	NORMAL	POSITIVE	13	52.00
2008	3113.7	3201.2	-2.73	104	NORMAL	NEGATIVE	12	48.00
2009	2245.6	3201.2	-29.85	94	MODERA TE	DROUGHT S		
2010	3463.2	3201.2	8.18	124	NORMAL	MODERAT E	5	20.00
2011	3861.2	3201.2	20.62	121	NORMAL	SEVERE	0	0.00
2012	2971.4	3201.2	-7.18	109	NORMAL	ACUTE	0	0.00
2013	3273.8	3201.2	2.27	116	NORMAL	NORMAL & EXCESS R/F		
2014	2264.1	3201.2	-29.27	89	MODERA TE	NORMAL	19	76.00
2015	1893.6	3201.2	-40.85	99	MODERA TE	EXCESS	1	4.00
2016	3496.6	3201.2	9.23	109	NORMAL			
2017	3454	3201.2	7.90	116	NORMAL	D • 6 11 1		
2018	2796	3201.2	-12.66	101	NORMAL	Rainfall departure: EXCESS: > +25; NORMAL: +25 TO -25; MODERATE: -25 TO -50; SEVERE: -50 TO -75; ACUTE: < -75		
2019	4173.3	3303.2	26.34	120	EXCESS			
2020	2712.9	3303.2	-17.87	120	NORMAL			
2021	3548.5	3303.2	7.43	131	NORMAL			
2022	3235.3	3303.2	-2.06	107	NORMAL			

Raigad District Analysis (1998-2022)



Figure 1.7: Annual Rainfall Pattern (1998-2022)



Figure 1.5: The isohyet map of the Raigad district

1.4 GEOLOGY

The area is underlain by basaltic lava flows of Deccan traps, of upper Cretaceous to lower Eocene is the major rock formation and intruded by a number of dykes. These flows are covered with soil cover of 0.25 to 0.50 m thick. The western part of the district consisting Basalt flows are altered to Laterite. Recent deposits comprising Beach Sand and Alluvium occur along the coast and in the river mouth. The basaltic lava flows are basically of Aa type. The general geological succession of the area is as follows.

The upper vesicular unit, middle fractured unit and lower massive unit is the characteristic sequence of basalt. The top portion of basalt is often brecciated. The top breccia is often altered to pinkish and purplish color. The main middle section of basalt comprises dark or dark grey dense basal the middle section is fractured shows columnar or rectangular joints. The basalts are amygdaloidal in nature which lack primary porosity. The basal section having chilled basalt or grayish clinker with fragments of highly vesicular or dense purple trap. The generalized geological sequence of the area is given in Table 1.2 and the Geological Map of the district is depicted in Figure 1.6.

Age	Formation	Lithology
Recent	Top Soil	Black cotton Soil, Kankar etc.
		Basaltic lava flows, greyish to drak grey to
Upper	Deccan	greenish black, fine grained, amygdular in nature
Cretaceous to	Trap	filled with Zeolites, quartz and chert, The
lower Eocene		individual flows are separated from each other by
		red bole.

Table 1.2: Generalized Geological sequence Raigad district.



Figure 1.6: Geological Map, Raigad district

2.HYDROGEOLOGY

Hard Rock Areas - Deccan Trap Basalt

Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 10 - 15 mbgl under unconfined condition. The water bearing strata at deeper depth exists under semi confined to confined conditions. The dugwells in these areas show rapid decline in water level during post-monsoon period. In foot hill zones the water table is relatively shallower near water course. The yield of dug wells tapping upper phreatic aquifer ranges between 45 to 60 m³/day, whereas that of borewells varies from 0.50 to > 20 m³/hr, depending upon the local hydrogeological conditions, however in most of the bore wells it is up to 5 m³/hr.

Soft Rock Areas - Beach Sand/Alluvium

The Alluvial deposits are found along the coastal areas in few isolated patches having limited areal extent as Beach Sand and along the course of major rivers. In the alluvial deposits, primary porosity is due to the inter-granular pore spaces making sands and gravels good water bearing formations. The ground water occurs under phreatic/unconfined aquifer at relatively shallow depths of 3-5 m and their yield ranges from about 18 to 43 m³/hr.

Maps depicting aquifer wise depth of occurrence and fractured/granular zone's thickness and yield potential are shown in **Figure 2.1 to 2.2** respectively. A map depicting the hydrogeological features is shown as **Figure 2.3**.

Major Aquifer	Basalt (Deccan Traps)			
Type of Aquifer	Aquifer-I	Aquifer-II		
Formation	Weathered/Fractured	Jointed / Fractured		
	Basalt	Basalt		
Depth of Occurrence (mbgl)	8-35	30-180		
SWL (mbgl)	0.35-6.55	1.00-100		
Weathered / Fractured rocks thickness	5.39-30	1.00 to 5.00		
(m)				
Fractures encountered (mbgl)	Upto 35	Upto 180		
Yield	5 -100	0.14-15 lps		
Sustainability	1 to 3 hrs	0.5 to 3 hrs		
Transmissivity (m ² /day)	-	0.14 to 50.52 m ² /day		
Specific Yield/ Storativity (Sy/S)	0.02	0.0000590 -0.000334		
Suitability for drinking/ irrigation	Suitable for both (except high EC, Nitrate			
	affected villages) drinking & agriculture			



Figure 2.1 Depth of Occurrence Aquifer I



Figure 2.2. Depth of Occurrence Aquifer-II



Figure 2. 3: Hydrogeology, Raigad District

2.1 2-D Aquifer Disposition

Based on the existing data, aquifer disposition in Bar diagram and few hydrogeological sections have been prepared along section lines shown in **Figure 2.4 2.5 and 2.6 (a to c)** to understand the subsurface disposition of aquifer system.



Figure 2.4 Bar Diagram



Figure 2.5. Fence Diagram





(b)



(C)

Figure 2.6 (a), (b), (c): Lithological Sections

2.2 Soil Infiltration Tests

To estimate the actual rate of infiltration of various soil cover and their impact on recharge to ground water 4 infiltration tests have been conducted at Lohansi, Lohare, Nagaon and Lonere villages of Raigad district.

The data has been analyzed and the salient features of the infiltration tests are presented in **Table 2.1** and the plots of soil infiltration tests are presented in **Figure 2.2**. The duration of the test ranged from 100 to 110 minutes; the depth of water infiltrated varied from 1.2 cm to 3.00 cm.

S. No.	Village	Date	Duration (min)	Water Level (cm agl)	Final Infiltrated Water Depth (cm)	Final Infiltration Rate (cm/hr)
1.	Lohansi	26.12.2022	100	16.40	1.60	4.8
2.	Lohare	23.12.2022	110	16.00	3.00	18
3.	Nagaon	23.12.2022	100	15.05	1.05	6.3
4.	Lonere	26.12.2023	100	17.80	1.2	7.2

Table 0.1 Salient Features of Infiltration Tests







Figure 2.2 (a-d). Soil Infiltration tests

3.WATER LEVEL SCENARIO

3.1 DEPTH TO WATER LEVEL (AQUIER-I/SHALLOW AQUIFER)

Central Ground Water Board periodically monitors 43 Ground Water monitoring wells four times a year i.e., in May (Pre-monsoon), August, November (Post-monsoon) and January in the district. Apart from this data, 83 nos key observation wells are established in May-2022 in Raigad district. These monitoring wells has been used for preparation of depth to water level maps of the district Pre-monsoon data are given in Annexure-III.

The depth to water levels during May 2022 were found ranging from 0.35 (Kargaon) to 11.5 mbgl (Khamgaon). Shallow water level within 5 mbgl are observed in all the blocks covering 4898 sq km area of the district. Water levels between 5 and 10 mbgl have been observed in major parts of Sudhagad, Mangaon, Mahad, Poladpur, Karjat and Mhasla and in small parts of Panvel, Alibag, Roha, Murud blocks covering about 1969 sq. km. The depth to water level between 10 to 20 mbgl has been observed in small patches Mhasla and Roha blocks covering 20.23 sq. km. area. The premonsoon depth to water level map is depicted in **Fig. 3.1**.

During Post- Monsoon (Nov. 2022), depth to water level varies between 0.1(Kokavan) and 10.7 mbgl (Khamgaon). Shallow water levels less than 2 mbgl are observed in 2764 sq km area of the district as in central and Northern parts in Uran, Alibag, Roha, Pen, Sudhagad, Murud, Mhasla, Mahad, Panvel, Karjat and Khalapur blocks. Water levels between 2 to 5 mbgl are observed covering major parts i.e., in 3958 sq.km area of the district in parts of Mangaon, Mahad, Poladpur, Shrivardhan, Roha, Panvel, Karjat and Khalapur blocks. Water levels between more than 5 mbgl are observed in the southern part in 165.7 sq km in small parts of Mhasla, Mahad, Mangaon and Poladpur blocks. Spatial variation in post monsoon depth to water levels is shown in **Figure 3.2**.



Figure 3.1: DTWL Shallow Aquifer (May 2022)



Figure 3.3. DTWL, Shallow Aquifer (Nov. 2022)

3.2 DEPTH TO WATER LEVEL (AQUIFER-II / DEEPER AQUIFER)

In Aquifer-II, depth to water levels in Raigad District range between 1.00 (Roha, Roha block) and 100 mbgl (Padvi (Masssur) Mahad block). Depth to water level less than 10 m bgl has been observed in northern and north western part of the district covering parts of Panvel, Karjat, Uran, Alibag, Sudhagad, Shrivardhan, Mahad. The major part of the district shows deeper water levels ranging between 5 and 10 mbgl observed in northern and central part of Raigad district. The deepest water level of more than 30 mbgl are observed in isolated patches



in Mangaon, Murud, Polandar blocks. The depth to water level for Aquifer –II is given in Figure 3.4.

Figure 3.4. DTWL, Deeper Aquifer

3.3 WATER TABLE CONTOUR

Based on the Pre-monsoon water level data, a Pre-monsoon water table contour map has been prepared and presented in **figure 3.5**. The map depicts occurrence and movement of ground water in the district. The ground water flow lines are marked to show the direction of ground water flow. The elevation of water table ranges from 50 to 250 m amsl and generally follows the topography. In general, the ground water movement is towards the southeast. In area of low permeability, the water table contours are closely spaced indicating steep gradient.





3.4 WATER LEVEL TREND (2010-2019)

During pre-monsoon period, falling water level trend has been recorded at 9 stations ranging from 0.17 m/year (Jite, Pen block) to 0.012 m/year (Dapoli). The trend of pre-monsoon shown in **figure 3.6.** In pre-monsoon season, decline upto 0.2 m/year has been observed in 1666 sq. km., i.e., 24% area of the district in the parts of Karjat, Panvel, Pen, Mhasla, and Murud blocks.

In post monsoon season, decline upto 0.2 m/year has been observed in 1374 sq. km., i.e., 20 % area in parts of Karajt, Panvel, khalapur, Mangaon and Shrivardhan blocks ranging from 0.09 m/year (Khalapur) to 0.006 m/year (Dapoli). The decline may be because the area has experienced increased ground water draft and less annual rainfall received than the normal rainfall between the period from 2013-2022.



Figure 3. 6: Pre-monsoon Decadal Trend (2010-2019)



Figure 3.7: Post-monsoon Decadal Trend (2010-19)

3.5 HYDROGRAPH ANALYSIS

The variation in short term and long-term water level trends may be due to variation in natural recharge from rainfall and withdrawal of groundwater for various agricultural, domestic and industrial requirements. The analysis of hydrographs shows that the annual rising limbs in hydrographs indicate the natural recharge of groundwater regime due to monsoon rainfall, as the monsoon rainfall is the sole source of natural recharge to the ground water regime. However, continuous increase in the groundwater draft is indicated by the recessionary limb. The **figure 3.8** shows selected hydrographs (time series) of water levels.



Figure 3.8 a : Hydrograph (2012-22), Bilji (Umta), Alibag Block, Raigad District



Figure 3.8 b: Hydrograph (2012-22), Chinchwan, Panvel Block, Raigad District



Figure 3.8 c: Hydrograph (2012-22), Hudre Bk., Karjat Block, Raigad District



Figure 3.8 d: Hydrograph (2012-22), Phugaon, Roha Block, Raigad District



Figure 3.8 e: Hydrograph (2012-22), Adgaon, Poladpur Block, Raigad District



Figure 3.8 f: Hydrograph (2012-22), Saigaon Govalwadi, Shrivardhan Block, Raigad District


Figure 3.8 g: Hydrograph (2012-22), Sochinde, Mahad Block, Raigad District

4. GROUND WATER QUALITY

Ground water sampling is being done every year from GWM wells during pre-monsoon period (May). In May 2022, 34 samples have been collected from GWM wells of Raigad district. Under NAQUIM study, 45 samples from KOW wells have been collected for ground water quality. The GWM wells and KOW wells both represent the shallow aquifer. The ground water quality data of total 79 water samples from GWM wells and KOW wells have been utilised to decipher the water quality scenario of shallow aquifer of Raigad district which is described below in detail.

The minimum, maximum and average values of chemical parameters analysed in the 79 ground water samples are summarized in **Table 4.1** and water quality data is presented in **Annexure-IV**.

Sr.	Parameters	Minimum	Maximum	Average
No.				
1	pH	6.05	9.11	7.45
	Electrical Conductivity (EC) µS/cm @			
2	25°C	94	1878	516
3	Total Dissolved Solid (TDS) mg/L	60	1202	330
4	Total Hardness (TH) mg/L	30	600	187
5	Calcium (Ca ⁺⁺) mg/L	10	200	50
6	Magnesium (Mg ⁺⁺) mg/L	1	51	15
7	Sodium (Na ⁺) mg/L	2	203	29
8	Potassium (K ⁺) mg/L	0.28	38	5
9	Carbonate (CO ₃) mg/L	0	24	0.30
10	Bi-Carbonate (HCO ₃ ⁻) mg/L	12	494	214
11	Chloride (Cl ⁻) mg/L	4	347	46
12	Nitrate (NO ₃ ⁻) mg/L	BDL	85	6
13	Sulphate (SO ₄) mg/L	BDL	94	14
14	Fluoride (F ⁻) mg/L	0.07	0.26	0.15
15	Uranium (U) µg/L	BDL	5.40	0.26

 Table-4.1: Minimum, Maximum and Average Values of Parameters in Ground Water of

 Shallow Aquifer

(BDL- Below Detection Limit)

4.1 Distribution of pH

The range and average value of pH of the ground water samples of shallow aquifer indicates that the ground water in Raigad district is predominantly alkaline in nature. The pH values also indicate that the CO_2 dissolved in water exists mainly in the form of HCO_3^- . This is also clear from the concentration of HCO_3^- and CO_3^{2-} ions in the ground water. Under the natural condition, the pH of ground water is usually found in the range of 6.5 to 8.5. However, low pH (<6.5) or high pH (>8.5) found in the ground water may be due to the availability or lack of CO_2 in environment in which the water is existing. Sometimes, it may also be due to the percolation of strongly acidic or alkaline wastewater from anthropogenic sources to groundwater. In Raigad district, pH range was found to be between 6.05 and 9.11 with average pH being 7.45. pH less than desirable limit of 6.5 is observed at only 3 locations in KOW wells at Borli, Durtoli Sutarwadi and Vanaste of Raigad district. pH more than 8.5 is observed at only one location at Sopoli in Raigad district.

4.2 Distribution of Electrical Conductivity (EC) and Total Dissolved Solids (TDS)

The measurement of EC of water gives an idea about the ion's concentration in the

water. As the concentration of dissolved ions increases, the water becomes more conductive and also shows rise in TDS values. EC and TDS are interrelated as mostly inorganic substances are dissolved in ground water. The TDS is computed as sum of ions concentration in ground water. It is also an important parameter to assess the quality of water.

The average values of EC and TDS of the samples suggest that the groundwater in all the 79 wells is fresh and potable in nature. It is observed that the EC and TDS of ground water of shallow aquifer in Raigad district are within permissible limit as prescribed by Bureau of Indian Standards (BIS). The EC is in the range of $94 - 1878 \,\mu$ S/cm with the average EC being 516 μ S/cm and TDS is in the range of 60– 1202 mg/L with the average TDS being 330mg/L.

4.3 Distribution of Total Alkalinity

The total alkalinity of water is its acid neutralizing capacity and primarily a function of carbonate, bicarbonate and hydroxide content of water. It is expressed in terms of CaCO₃. The range and average concentration values of carbonate and bicarbonate ions indicate that the alkalinity of ground water is mainly due to the bicarbonate ion. The total alkalinity in Raigad district is found in the range of 12-494 mg/L with the average being 214 mg/L. Total alkalinity is observed to be more than desirable limit of 200 mg/L in 36 locations but within maximum permissible limit of 600 mg/L.

4.4 Distribution of Total Hardness (TH)

The total hardness (TH) is the sum of calcium (Ca) and magnesium (Mg) concentration expressed in terms of CaCO₃ in mg/L. The carbonate and bicarbonate salts of Ca and Mg give temporary hardness to ground water while a chloride and sulphate salt gives permanent hardness. The total hardness in Raigad district is found in the range of 30 - 600 mg/L with the average being 187 mg/L. Total hardness more than desirable limit of 200 mg/L is observed in 29 locations in Raigad district but within maximum permissible limit.

4.5 Distribution of Chloride (Cl) and Sulphate (SO4)

As Maharashtra State is covered mainly by Basalt, the possibility of Cl and SO₄ in ground water from aquifer material is low. It is observed that the chloride content in the ground water samples of Raigad district is found in the range of 4 - 347 mg/L with the average being 46 mg/L. Majority of locations have chloride concentration within the desirable limits as prescribed by BIS, i.e. 250 mg/L. Only 2 locations have been found with chloride concentration more than the desirable limit but well within the maximum permissible limits i.e. 1000 mg/L. The sulphate concentration in all 79 samples of Raigad district was within the desirable limit as prescribed by BIS, i.e. 200 mg/L. The range of sulphate concentration was found to be BDL – 94 mg/L with the average being 14 mg/L. The average values of Cl and SO₄ also show that the potability of ground water is less affected due to these ions.

4.6 Distribution of Nitrate (NO3)

Under natural geochemical condition, nitrate rarely becomes a major ion in the ground water. Nitrogen in the form of dissolved nitrate, is a nutrient for vegetation and an essential element to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. The nitrate content in the ground water samples of Raigad district is found in the range of BDL – 85 mg/L with the average being 6 mg/L. Anthropogenic contamination of nitrate (NO₃) is observed above the maximum permissible limits of 45 mg/L in only 2 locations at Kashale and Gorthan.

4.7 Distribution of Fluoride (F)

The concentration of fluoride in Raigad district is found in the range of 0.07 - 0.26 mg/L with the average being 0.15 mg/L. The concentration of fluoride in shallow basaltic aquifer is low. All the 79 wells of Raigad district have concentrations of fluoride less than

desirable limit of 1 mg/L. The source of fluoride in ground water is inherent fluoride bearing minerals present in the geological formation existing in the area.

4.8 Distribution of Uranium (U)

CGWB had decided to conduct ground water quality monitoring for Uranium through its Ground Water Monitoring Stations (GWMS) established throughout the country to generate background ground water quality data for U throughout India after an article titled "Large-Scale Uranium Contamination of Ground Water Resources in India" was published in 'Environmental Science and Technology letter' in May 2018. Based on the report, uranium concentration above the permissible/guideline value of WHO, 2011 (30 ppb) had been observed in ground water in some pockets of 16 States in India. As a part of this activity, the CGWB, Central Region (CR), Nagpur, had also carried out the ground water quality monitoring during AAP 2019-20. Since 2021 all the collected ground water samples have been analyzed for Uranium contamination. In the water quality of Raigad district, the Uranium concentration was found to be in the range of BDL - 5.40 ppb which indicated no Uranium contamination in Raigad district of Maharashtra. The groundwater in Raigad district is safe for drinking as far as U concentration in groundwater is concerned.

4.9 SUITABILITY OF GROUND WATER FOR DRINKING PURPOSE

The suitability of ground water for drinking purpose is determined keeping in view the effects of various chemical constituents in water on the biological system of human being. The standards proposed by the Bureau of Indian Standards (BIS) for drinking water (IS-10500-2012) were used to determine the suitability of ground water for drinking purpose. The ground water samples are classified on the basis of constituents falling below desirable limit (<DL), in the range of desirable and maximum permissible limit (DL-MPL) and above maximum permissible limit (MPL) for drinking water purpose.

The classification of ground water samples of shallow aquifer for drinking water purpose is shown in **Table-4.2** and graphical representation is shown in **Figure-4.1**.

Paramete	Drinking water		Total	Samples		Samples		Samples		
r	Standar	ds	Sample	< DL	< DL		DL	> MPL		
	(IS-1050	0-2012)	S			and MP	[]			
	DL	MPL		Sample	%	Sample	%	Sample	%	
				S		S		S		
pН	6.5-8.5	-	79						1.2	
				3	3.80	75	94.94	1	7	
TDS	500	2000	79							
(mg/L)				65	82.28	14	17.72	0	0	
TH (mg/L)	200	600	79	50	63.29	29	36.71	0	0	
Ca (mg/L)	75	200	79	68	86.08	11	13.92	0	0	
Mg (mg/L)	30	100	79	71	89.87	8	10.13	0	0	
Cl (mg/L)	250	1000	79	77	97.47	2	2.53	0	0	
SO_4	200	400	79							
(mg/L)				79	100	0	0	0	0	
NO ₃	45	No	79						2.5	
(mg/L)		relax		77	97.47	0	0	2	3	
F (mg/L)	1	1.5	79	79	100	0	0	0	0	

 Table-4.2: Classification of Ground Water Samples of Shallow Aquifer as per BIS

 Drinking Water Standards

(DL= Desirable Limit; MPL= Maximum Permissible Limit)



Figure-4.1: Percentage Distribution of Ground Water Samples as per BIS Drinking Water Standards

As seen in **Table-2**, the Ground water quality of Raigad district in shallow aquifer is good and potable in general.

4.10 SUITABILITY OF GROUND WATER FOR IRRIGATION PURPOSE

The quality of water used for irrigation is an important factor in crop productivity, its yield and quality. The irrigation water quality depends primarily on the presence of dissolved salts and their concentrations. The Electrical Conductivity (EC), Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria as per Bureau of Indian Standards (BIS) for quality of irrigation water (IS-11624-1986, Reaffirmed 2009), which influence the water quality and its suitability for irrigation.

1. Electrical Conductivity (EC)

The concentration of dissolved ions in the water is best represented by the parameter electrical conductivity. In relation to hazardous effects of the total salt concentration (EC), the irrigation water can be classified into four major groups-

Low Salinity Water (EC: Below 1500 μ S/cm): Suitable for sensitive crops. Medium Salinity Water (EC: 1500 – 3000 μ S/cm): Suitable for semi-tolerant crops. High Salinity Water (EC: 3000 – 6000 μ S/cm): Suitable for tolerant crops. Very High Salinity Water (EC: >6000 μ S/cm): Not suitable for irrigation.

It is clear from **Table-4.3** that majority samples fall under low salinity and only 1 location has medium salinity water. This shows that the ground water from shallow aquifer of Raigad district is safe to use for irrigation.

Table-4.3: Classification of Ground water of Shallo	w Aquifer for Irrigation based on EC
values	

Sr.	Class	Range of EC in µS/cm	No. of samples	% of samples
1	Low Salinity Water	< 1500	78	98.73
2	Medium Salinity Water	1500 - 3000	1	1.27
3	High Salinity Water	3000 - 6000	0	0

Sr.	Class	Range of EC in µS/cm	No. of samples	% of samples	
4	Very High Salinity Water	> 6000	0	0	
Total			79	100	

2. Sodium Adsorption Ratio (SAR)

Since Calcium and Magnesium replace Sodium more readily than vice versa, the ratio reflects the Sodium hazard. The SAR indicates the relative activity of the Sodium ions in exchange reactions with the soil. Irrigation water with a high SAR will cause the soil to tighten up. The Sodium Adsorption Ratio (SAR) can be calculated from following formula-

Sodium Absorption ratio= $\frac{\text{Na}^+}{\left[\frac{(\text{Ca}^{++} + \text{Mg}^{++})}{2}\right]^{1/2}}$

(Here, the concentrations of cations are expressed in meq/L).

In relation to hazardous effects of SAR, the irrigation water quality is given in **Table-4.4**.

 Table-4.4: Classification of Ground water of Shallow Aquifer for Irrigation based on

 SAR values

Sr.	Class	ClassSARNo. ofValuesamples				
1	Low	0-10	79	100		
2	Medium	10-18	0	0		
3	High	18-26	0	0		
4	Very high	>26	0	0		
Tota	ıl	79	100			

All the water samples of shallow aquifer have SAR values less than 10 and are considered good for irrigation.

3. Residual Sodium Carbonate (RSC):

The RSC index of irrigation water and soil water is used to indicate the alkalinity hazards for soil. RSC is considered to be superior to SAR as a measure of sodicity particularly at low salinity levels. Calcium reacts with bi-carbonate and precipitates as CaCO₃. Magnesium salt is more soluble and so there is less tendency for it to precipitate. When Calcium and Magnesium are lost from the water, the proportion of Sodium is increased resulting in the increase in sodium hazard. This hazard is evaluated in terms of RSC.

Residual Sodium Carbonate=(CO₃⁻⁻+ HCO₃⁻⁻)- (Ca⁺⁺+ Mg⁺⁺)

(All the ionic concentrations in the above equation are expressed in meq/L).

In relation to hazardous effects of RSC, the irrigation water quality is given in **Table-4.5**.

Table-4.5:	Classification	of Ground	water	of Shallow	Aquifer	for Ir	rigation	based on
RSC value	S							

Sr.	Class	RSC Value	No. of samples	% of samples
1	Low	< 1.5	76	96.20
2	Medium	1.5 - 3.0	2	2.53

Sr.	Class	RSC Value	No. of samples	% of samples		
3	High	3.0 - 6.0	1	1.27		
4	Very high	>6.0	0	0		
Total			79	100		

From the table it is observed that 96.2 % of the samples of shallow aquifer show RSC values less than 1.5 meq/L while 2 samples show medium RSC of 1.5 - 3.0 and 1 sample shows RSC value more than 3.0 meq/L. Overall, the ground water quality of Raigad district is suitable for irrigation purpose based on above study.

4.11 DISCUSSION ON TRACE ELEMENTS CONTENT

From the area under investigation, all the collected 23 water samples were analyzed for selected trace elements viz. Mn, Cr, Fe, Zn, Pb, Cu, Cd As, Se and Ni content. All the ground water samples contain Copper, Lead, Cadmium, Arsenic, Selenium and Nickel below the desirable limit of BIS for the drinking water. The concentration of Manganese found in the ground water of study area is in the range of BDL to 0.698 mg/L. Total 8.7 % samples are found containing Mn above the BIS permissible limit of 0.3 mg/L. Iron in ground water generally exists as Fe (II) but may oxidised to Fe (III) when ground water is under aerobic condition. In the study area, the iron content in ground water varies from BDL to 1.494 mg/L. Total 39.13% samples are found containing Fe above the BIS permissible limit (0.3 mg/l). Thus, it can be concluded that the ground water quality in major part of the study area is affected by excess of iron. After proper treatment of iron contamination, the ground water of area is suitable for drinking purpose from other trace elemental contamination point of view.

5. GROUND WATER RESOURCES

DYNAMIC GROUND WATER RESOURCES - AQUIFER-I

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Raigad district based on GEC-2015 methodology. Block wise ground water resources are given in Table 5.1, and graphical representations of the resources on the map are shown in **Figure-5.1**.

Ground Water Resource estimation was carried out for 7155.00 sq. km. area. As per the estimation, the Annual extractable ground water resources is 356.67 MCM. The total Extraction is estimated at 63.67 MCM with irrigation sector having a draft of 43.53 MCM and Domestic use having draft of 20.15 MCM. The net ground water availability for future use is estimated at 292.99 MCM. Stage of ground water development varies from 8.85 % (Uran) to 46.83% (Alibag). The overall stage of ground water development for the district is 17.85 %. Block wise assessments indicate that all the blocks in the district fall under "Safe" category.



Figure-5.1. Dynamic Ground Water Resources, of Raigad District, 2022

Assessme	Gro	und Wa	ter Rech	arge	Total	Total	otal Annu Current Annual Ground Water						Net	Stage of	Categoriz
nt Unit		(M	CM)		Annu	Natur	al		Extracti	on(MCM	()	GW	Ground	Ground	ation
Name/	Monso	on	Non-		al	al	Extra	Irrig	Indus	Domes	Total	Allocati	Water	Water	(OE/Criti
Block	Season monsoon		on	Grou	Disch	ctable	ation	trial	tic Use	Extra	on for	Availab	Extract	cal/Semic	
			season		nd	arges	Groun	Use	Use		ction	for	ility for	ion	ritical/Saf
	Rech	Rech	Rech	Rech	wate		a Watar					Jomest	Iuture		e)
	arge	arge	arge	arge	r Rech		Water Recho					ic Use	use		
	Irom Doinf	Irom Otho	Irom Doinf	Irom Otho	arge		rge					2025			
	Naiiii oll	r	Nann oll	r	arge		150					2025			
	an	Sour	an	Sour											
		ces		ces											
	(MCM	(MCM	(MCM	(MCM	(MCM	(MCM/	(MCM/	(MCM	(MCM	(MCM/	(MCM/	(MCM/Y	(MCM/Y	%	
	/Yr)	/Yr)	/Yr)	/Yr)	/Yr)	Yr)	Yr)	/Yr)	/Yr)	Yr)	Yr)	r)	r)		
ALIBAG	22.22	0.16	0.00	5.20	27.58	1.39	26.19	9.93	0.00	2.34	12.27	2.34	13.92	46.83	safe
KARJAT	29.30	0.80	0.00	7.54	37.65	2.14	35.51	1.76	0.00	1.66	3.42	1.66	32.09	9.64	safe
KHALAP	36.72	0.56	0.00	1.96	39.24	1.98	37.26	1.79	0.00	1.69	3.48	1.69	33.78	9.34	safe
UR															
MAHAD	21.77	0.26	0.00	1.63	23.66	1.18	22.48	1.98	0.00	1.68	3.66	1.68	18.82	16.28	safe
MANGA	38.67	0.34	0.00	5.98	44.99	2.25	42.74	1.96	0.00	1.87	3.83	1.87	38.91	8.95	safe
ON															
MHASAL	10.92	0.18	0.00	2.32	13.42	0.67	12.75	4.60	0.00	0.72	5.32	0.72	7.43	41.70	safe
A															
PANVEL	28.33	0.29	0.00	2.29	30.90	1.59	29.31	5.07	0.00	3.75	8.82	3.75	20.50	30.08	safe
POLADP	8.74	0.10	0.00	0.34	9.18	0.46	8.72	0.41	0.00	0.93	1.34	0.93	7.38	15.37	safe
UR															
ROHA	30.45	0.29	0.00	16.18	46.92	2.36	44.57	3.22	0.00	1.39	4.60	1.39	39.96	10.33	safe
SUDHAG	23.07	0.32	0.00	3.13	26.51	1.36	25.15	1.71	0.00	1.08	2.78	1.08	22.37	11.07	safe
AD															
TALA	6.23	0.10	0.00	0.79	7.13	0.36	6.78	2.18	0.00	0.37	2.55	0.37	4.23	37.58	safe
URAN	17.99	0.08	0.00	0.47	18.53	0.93	17.61	1.04	0.00	0.52	1.56	0.52	16.05	8.85	safe

Table 5.1 Dynamic Ground Water Resources of Raigad District, 20	22
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Assessme nt Unit Name/ Block	Ground Water Recharge (MCM) Monsoon Season Season Season			on	Total Annu al Grou nd	Total Natur al Disch arges	Annu al Extra ctable Groun	Curren Irrig ation Use	nt Annua Extracti Indus trial Use	al Ground on(MCM Domes tic Use	d Water	Annual GW Allocati on for for	Net Ground Water Availab ility for	Stage of Ground Water Extract ion	Categoriz ation (OE/Criti cal/Semic ritical/Saf
	Rech arge from Rainf all	Rech arge from Othe r Sour ces	Rech arge from Rainf all	Rech arge from Othe r Sour ces	Wate r Rech arge		d Water Recha rge					Domest ic Use as on 2025	future use		е)
SHRIWA RDHAN	9.05	0.16	0.00	2.41	11.61	0.58	11.03	4.01	0.00	0.61	4.62	0.61	6.41	41.90	safe
PEN	23.66	0.34	0.00	1.15	25.15	1.28	23.87	1.40	0.00	1.06	2.46	1.06	21.41	10.30	safe
MURUD	9.56	0.11	0.00	3.71	13.38	0.67	12.71	2.48	0.00	0.49	2.97	0.49	9.74	23.39	safe
Total	316.6 6	4.08	0.00	55.10	375.8 4	19.17	356.67	43.53	0.00	20.15	63.67	20.15	292.99		Safe

6. GROUND WATER RELATED ISSUES

a. Sustainability in hard rock areas

The major part of the district is occupied by hard rock formations. The yields of the wells are the functions of the permeability and transmissivity of aquifer encountered. This varies with location, diameter and depth of wells. There are mainly two types of ground water structures in the district i.e., dugwells and borewells. Yield of dugwells in Basalt varies according to the nature of formations tapped. The yield of dugwells in phreatic aquifer ranges from 45 to 60 m³/day and pumping rarely exceeds 2 to 3 hours.



Figure 6. 1 b: Yield Potential (Shallow Aquifer)





b. Low Ground Water Development: Stage of ground water Extraction varies from 8.85 % (Uran) to 46.68% (Alibag). The overall stage of ground water development for the district is 17.85 % only as per Ground water resource estimation 2022. The stage of ground water development increased from 12 % to 17.85% from year 2008 to 2022.



Figure 6. 3: Low Ground Water Development

7. GROUND WATER MANAGEMENT PLAN

A comprehensive ground water resources management plan has been proposed to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management. The supply side management is proposed based on surplus surface water availability and the unsaturated thickness of aquifer whereas the demand side management is proposed by use of micro irrigation techniques and change in cropping pattern.

SUPPLY SIDE MANAGEMENT

The supply side management of ground water resources can be done through the artificial recharge by utilization of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to understand the unsaturated aquifer volume available for recharge. But in case of Raigad district, the entire area having shallow water level and stage of ground water Extraction varies from 8.85 % (Uran) to 46.68% (Alibag). The overall stage of ground water development for the district is 17.85 % only as per Ground water resource estimation 2022. Whereas, the intensity of rainfall in Raigad district is more. Hence Supply-side management plan is not recommended in Raigad district. Soil conservation structures like contour bunding, contour trenching is recommended in hilly area.

DEMAND SIDE MANAGEMENT

The Demand Side Management is proposed in areas where the stage of ground water development is relatively high and adopting micro-irrigation techniques for water intensive crops or change in cropping pattern or both are required to save water.

The stage of ground water development in Raigad district varies from 8.85 % (Uran) to 46.83% (Alibag). The overall stage of ground water development for the district is 17.85 % only as per Ground water resource estimation 2022.

The micro-irrigation techniques are proposed to be adopted in 5200 ha horticulture (Orchard) area in the district. This intervention would lead to saving of about 20.80 MCM as given **Table 7.1**. **Figure 7.1** depicts the proposed demand side interventions in the area.

No change in cropping patterns is proposed in any of the blocks of Raigad.

Block	Proposed	Horticulture	Total Volume of
	Cropping Pattern	(Orchard) area (25%)	water expected to be
	cnange	DCA) proposed to be	saved (MICM)
		covered under Drip	
		(ha)	
ALIBAG	None	600	2.40
KARJAT	None	300	1.20
KHALAPUR	None	300	1.20
MAHAD	None	600	2.40
MANGAON	None	600	2.40
MHASALA	None	150	0.60
PANVEL	None	500	2.00
POLADPUR	None	150	0.60
ROHA	None	350	1.40
SUDHAGAD	None	500	2.00
TALA	None	150	0.60
URAN	None	150	0.60
SHRIWARDHAN	None	150	0.60
PEN	None	350	1.40
MURUD	None	350	1.40
Total		5200	20.80

Table 7.1 Proposed Demand Side Interventions, Raigad District



Figure 7.1. Demand Side Intervention in Raigad District, Maharashtra

Expected Benefits

The impact of groundwater management plans on the groundwater system in the district after its implementation is evaluated and the outcome shows significant improvement in groundwater scenario in all blocks as given in the **Table 7.2**.

Block	Annu al Availa ble Resou rce (MC M)	Curren t Ground Water Extract ions (MCM)	Stage Of GW Develop ment (%)	Volume of Water expecte d to be saved after Demand Side Interven tion (MCM)	Total GW Extracti on after Demand side interven tion (MCM)	Stage of GWD after Supply side and demand side intervent ions (%)	Balance GWR available for GW Develop ment so that STAGE OF GWD is ENHAN CED to 60% (MCM)	Additi onal area that can be brough t under assure d GW irrigati on with av. CWR of 0.65 m (Ha)
Alibag	26.19	12.27	46.83	2.40	9.87	37.67	5.85	900
Karjat	35.51	3.42	9.64	1.20	2.22	6.26	19.08	2935
Khalapu r	37.26	3.48	9.34	1.20	2.28	6.12	20.08	3089
Mahad	22.48	3.66	16.28	2.40	1.26	5.61	12.23	1882
Mangao n	42.74	3.83	8.95	2.40	1.43	3.34	24.22	3726
Mhasala	12.75	5.32	41.70	0.60	4.72	36.99	2.93	451
Panvel	29.31	8.82	30.08	2.00	6.82	23.26	10.77	1657
Poladpu r	8.72	1.34	15.37	0.60	0.74	8.49	4.49	691
Roha	44.57	4.60	10.33	1.40	3.20	7.19	23.54	3622
Sudhaga d	25.15	2.78	11.07	2.00	0.78	3.12	14.31	2202
Tala	6.78	2.55	37.58	0.60	1.95	28.72	2.12	326
Uran	17.61	1.56	8.85	0.60	0.96	5.44	9.61	1478
Shriwar dhan	11.03	4.62	41.90	0.60	4.02	36.46	2.6	400
Pen	23.87	2.46	10.30	1.40	1.06	4.43	13.26	2040
Murud	12.71	2.97	23.39	1.40	1.57	12.38	6.05	931
Total	356.67	63.67	17.85	20.80	42.87	12.02	171.14	26330

Table 7.2 Expected Benefits after implementation of Demand side interventions, Raigad district

DEVELOPMENT PLAN

The ground water development plan has been proposed with the view of developing the additional ground water resources available after bring the stage of ground water development up to 60 %. The 171.14 MCM volume of ground water generated can bring additional 26330 ha area. Kharif Crop area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 10269 Dug wells and 1712 Bore wells. Block wise details are given in Table 7.3. The area feasible for ground development is shown in **Fig. 7.2**.

Block	GW Resources Available for Development and Bring Stage of GWD upto 60% from present SOD (MCM)	Proposed no. of DW (@ 1.5 ham for 90% of GWR Available)	Proposed no. of BW* (@ 1.0 ham for 10% of GWR Available)	Additional area that can be brought under assured GW irrigation with av. CWR of 0.65 m (Ha)
Alibag	5.85	351	59	900
Karjat	19.08	1145	191	2935
Khalapur	20.08	1205	201	3089
Mahad	12.23	734	122	1882
Mangaon	24.22	1453	242	3726
Mhasala	2.93	176	29	451
Panvel	10.77	646	108	1657
Poladpur	4.49	269	45	691
Roha	23.54	1412	235	3622
Sudhagad	14.31	859	143	2202
Tala	2.12	127	21	326
Uran	9.61	577	96	1478
Shriwardhan	2.6	156	26	400
Pen	13.26	796	133	2040
Murud	6.05	363	61	931
Total	171.14	10269	1712	26330

Table 7.3: Block wise additional area under assured GW Irrigation



Figure 7. 2: Additional area Proposed to be bought under assured GW irrigation

8. SUM UP

The study was carried out based on the data available in-house as well as acquired from State Govt. departments and in pursuit to fill up the data gaps, generated data in-house; prepared GIS maps for various themes. All the available data was brought on GIS platform and an integrated approach was adopted for preparation of block wise aquifer maps and aquifer management plans of the district.

Raigad district covering an area of about 7152 sq. km. is occupied by Basalt The stage of ground water development of the district is 17.85%. The area has witnessed declining water level, low rainfall and drought; low yield potential of aquifers and low development of GW resources are the major issues in the district.

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management.

In case of Raigad district, the entire area having shallow water level and stage of ground water Extraction varies from 8.85 % (Uran) to 46.68% (Alibag). The overall stage of ground water development for the district is 17.85 % only as per Ground water resource estimation 2022. Hence Supply-side management plan is not recommended in Raigad district. Whereas, in Demand Side Interventions the micro-irrigation techniques are proposed to be adopted in 5200 ha horticulture area in the district. This intervention would lead to saving of about 20.80 MCM

The ground water development plan has been proposed in view of the developing additional ground water resources available after supply side interventions to bring the stage of ground water development up to 60 %. The 171.14 MCM/year volume of ground water generated can bring 26330 ha additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 10269 Dug wells and 1712 Bore wells in a phased manner.

Other than the above interventions following recommendations are proposed to be adopted:

- 1. Desilting of existing water conservation and artificial recharge structures.
- 2. Soil Conservation techniques in hilly areas
- 3. Form ponds, contour trenches, contour bund, graded bund, and other soil water conservation techniques to be carried out in all cultivable area so that maximum rain water is harvested and percolated to augment ground water and this will also help in sustainable springs for longer period during non-monsoon season for augmentation of runoff water in hilly areas.
- 4. Intercropping cultivation excess available water can be used effectively to produce greater yield per unit area of the land.

IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory ground water management. These types of programmes have helped the general public to understand the problems, that they will face in future if the ground water is continued to be exploited in unplanned way and also sewage wastes is not properly managed resulting in ground water pollution.

These interventions also need to be supported by regulations for deeper aquifer and hence it is recommended to regulate/ban deeper tube wells/bore wells of more than 60 m depth in these blocks, so that the deeper ground water resources are protected for future generation and also serve as ground water sanctuary in times of distress/drought.

ANNEXURES

Annexure I

Details of GW monitoring wells in Raigad district

Sr. No.	State Name	Distri ct	Block	Village	Lat decimal	long decimal	Depth of Well	Measuring Point	Diamet er	TOPOSHE ET	RL	Type of Aquifer
1	Maharash tra	Raiga d	Mangaon	Temple	18.135	73.325	6.7	0.7	2.9	47F/08	7.88	Unconfined
2	Maharash tra	Raiga d	Pen	Veshwi	18.75	73.03333	9.82	0.95	5.25	47B/14	13.0 9	Unconfined
3	Maharash tra	Raiga d	Mahad	Varandha	18.13333	73.56667	7	0.85	3.9	47F/12	46.9 2	Unconfined
4	Maharash tra	Raiga d	Roha	Kharapati	18.45	73.1	7.72	0.8	4	47F/03	18.1 6	Unconfined
5	Maharash tra	Raiga d	Poladpur	Poladpur	17.98333	73.46667	9.07	1	2.1	47G/05	19.1 8	Unconfined
6	Maharash tra	Raiga d	Karjat	Hudhre Budruk (Karjat	18.9125	73.31944	6.7	0.85	3.25	47F/05	47.3 4	Unconfined
7	Maharash tra	Raiga d	Mangaon	Chandore	18.16667	73.18333	9	0	2	47 F/4	209. 5	Unconfined
8	Maharash tra	Raiga d	Alibag	Bilji (Umta)	18.53472	72.98333	6.1	1	3.8	47B/01	6.31	Unconfined
9	Maharash tra	Raiga d	Panvel	Chinchwad	18.925	73.11667	10.3	0.8	4.8	47F/01	46.2 3	Unconfined
10	Maharash tra	Raiga d	Mahad	Sochinde	18.07083	73.4	6.09	0.8	3	47F/08	15.4 7	Unconfined
11	Maharash tra	Raiga d	Murud	Khutal	18.35833	73.03056	6.85	1	2.5	47F/03	17.8 9	Unconfined
12	Maharash tra	Raiga d	Pen	Jite	18.81389	73.0875	7.8	0.9	3.15	47F/01	1.66	Unconfined
13	Maharash tra	Raiga d	Khalapur	Kargaon	18.72639	73.29861	6.54	1.4	4	47F/16	80.4 3	Unconfined
14	Maharash tra	Raiga d	Roha	Dapoli	18.47778	73.00833	8	1.15	4	47F/03	11.9 3	Unconfined
15	Maharash tra	Raiga d	Roha	Phugaon	18.43333	73.20556	6.82	0.8	3.07	47F/03	79.0 3	Unconfined
16	Maharash tra	Raiga d	Mhasla	Kelte	18.08889	73.10556	4.8	0.9	3.05	47F/04	213. 53	Unconfined

Sr.	State	Distri	Block	Village	Lat	long	Depth of	Measuring	Diamet	TOPOSHE	RL	Type of
No.	Name	ct			decimal	decimal	Well	Point	er	ET		Aquifer
17	Maharash tra	Raiga d	Shrivardh an	Saigaon Govalwadi	18.03194	73.08056	5	0.75	3	47F/04	7.28	Unconfined
18	Maharash tra	Raiga d	Mangaon	Kumbharcha Kosta Bk	18.30278	73.30556	6.5	0.73	4.1	47F/07	57.1 8	Unconfined
19	Maharash tra	Raiga d	Alibag	Poynad	18.69167	72.99167	7.71	1	3.65	47B/14	14.9 4	Unconfined
20	Maharash tra	Raiga d	Alibag	Nagaon	18.61167	72.9	7.3	1	2.15	47B/14	17.9 9	Unconfined
21	Maharash tra	Raiga d	Sudhagad	Pali	18.5425	73.21889	6.7	0.8	1.85	47F/02	17.8 5	Unconfined
22	Maharash tra	Raiga d	Khalapur	Khalapur	18.82778	73.28417	7.2	0.6	3	47F/05	71.6 9	Unconfined
23	Maharash tra	Raiga d	Pen	Vadkhal	18.73333	73.05	4.6	1		47 F/2	5.16	Unconfined
24	Maharash tra	Raiga d	Mahad	Lohare_Pz	18.00417	73.4	125			47F/12	38.4 5	Semiconfine d
25	Maharash tra	Raiga d	Panvel	Ajivali-1	18.95694	73.155	5.2	0.5	3.8	47 F/1	16	Unconfined
26	Maharash tra	Raiga d	Panvel	Targhar	18.98556	73.03806	8	0.9	6	47 F/1	1.3	Unconfined
27	Maharash tra	Raiga d	Panvel	Navade-1	19.05056	73.10083	6.5	0.5	5.5	47 E/4	5	Unconfined
28	Maharash tra	Raiga d	Alibag	Valvade Shababaj	18.60694	72.97944	7	0.73	4.05	47 B/14	48.2	Unconfined
29	Maharash tra	Raiga d	Mhasla	Madegaon	18.12222	73.21556	6	0.9	4.25	47 F/4	235. 7	Unconfined
30	Maharash tra	Raiga d	Alibag	Vadva Bk	18.62167	72.95056	9.5	1	4	47 B/14	16.3	Unconfined
31	Maharash tra	Raiga d	Murud	Kude	18.49472	72.98222	8.5	1	3.2	47 B/15	2.3	Unconfined
32	Maharash tra	Raiga d	Roha	Shenvai-1	18.46806	73.07528	8.72	1	6.8	47 F/3	1.6	Unconfined
33	Maharash tra	Raiga d	Roha	Sukeli	18.4875	73.18417	8.52	1	6.5	47 F/3	32	Unconfined
34	Maharash tra	Raiga d	Mangaon	Indapur-1	18.29861	73.23889	5.5	0.8	2.85	47F/03	20.8	Unconfined

Sr. No.	State Name	Distri ct	Block	Village	Lat decimal	long decimal	Depth of Well	Measuring Point	Diamet er	TOPOSHE ET	RL	Type of Aquifer
35	Maharash tra	Raiga d	Mahad	Kembulde	18.07278	73.40361	10.7	1.2	6.5	47 F/8	7.2	Unconfined
36	Maharash tra	Raiga d	Roha	Nagothan-1	18.53167	73.11139	5	0.9	3.8	47 F/2	11	Unconfined
37	Maharash tra	Raiga d	Murud	Murud	18.33278	72.95861	7.1	1	5	47 B/15	7	Unconfined
38	Maharash tra	Raiga d	ROHA	Khari	18.44278	73.10083	6	0.9	3.5	47 F/3	9.3	Unconfined
39	Maharash tra	Raiga d	MURUD	Usroli	18.38806	72.93944	6.5	0.85	3.2	47 B/15	6.6	Unconfined
40	Maharash tra	Raiga d	ALIBAG	Alibag	18.64639	72.875	4	0.4	1.8	47 B/14	9	Unconfined
41	Maharash tra	Raiga d	URAN	Uran	18.87944	72.94194	6.5	0.7	5	47 B/13	6.4	Unconfined
42	Maharash tra	Raiga d	PANVEL	Chinchpara	18.98556	73.09	4.5	0.6	3.5	47 F/1	9	Unconfined
43	Maharash tra	Raiga d	KARJAT	Chinchawali	18.97583	73.32944	7.5	0.8	4	47 F/5	52.3	Unconfined

Annexure II

S. no	Location	Taluka	Dist rict	Latit ude	Longi tude	Form ation	We ll. De pth	Height of MP (magl)	Diamet er (m)	Nature of lining	DTW (mbgl) May-22	Spot EC	DTW (mbgl) Nov-22	Spot EC
							(m)							
1	Agarkot	Alibag	Rai gad	18.55 467	72.94 319	Basalt	7	0.6	4.3	Cement	3.5	1275	1.9	721
2	Borli	Alibag	Rai gad	18.51 164	72.91 558	Basalt	6	1	2.7	Basalt	2.6	170	1.4	232
3	Kashid	Murud	Rai gad	18.44 953	72.90 322	Basalt	7	0.6	6.65	Cement	3.7	547	2.05	554
4	Usadi	Murud	Rai gad	18.27 606	73.02 733	Basalt	5	0.9	3.3	Basalt	2.1	396	1.5	250
5	Khambavali	Tala	Rai gad	18.27 994	73.11 825	Basalt	6	0.9	3	Basalt	2.5	354	1.55	259
6	Borichamar	Tala	Rai gad	18.21 958	73.13 992	Basalt	7	2.8	4	Basalt	7	254	1.9	150
7	Durtoli Sutrwadi	Roha	Rai gad	18.41 081	73.28 169	Basalt	5	0.95	3.3	Basalt	2.35	107	1.8	100
8	Patharshet	Roha	Rai gad	18.38 033	73.28 764	Basalt	6	1	3.9	Basalt	2.5	145	1.5	110
9	Warasgaon	Roha	Rai gad	18.39 125	73.21 489	Basalt	9	0.85	4	Basalt	2.95	412	1.7	250
10	Nigudshet Phata	Tala	Rai gad	18.31 375	73.18 992	Basalt	7	0.6	4	Basalt	3.5	217	2.25	155
11	Vanaste	Tala	Rai gad	18.26 997	73.13 325	Basalt	9.3	1.9	8	Basalt	3.3	125	2.2	150
12	Murgaon	Roha	Rai gad	18.35 461	73.12 361	Basalt	18	0.9	4.4	Basalt	10.4	512	2.6	545
13	Virjoli	Roha	Rai gad	18.34 292	73.09 417	Basalt	8	0.75	3	Basalt	5.75	693	3.15	412

Details of KOW's in Raigad district

S.	Location	Taluka	Dist	Latit	Longi	Form	We	Height of	Diamet	Nature of lining	DTW (mbgl)	Spot EC	DTW (mbgl)	Spot EC
			rici	uue	tuue	ation	n. De	MIF (magi)	er (m)	or mining	May-22	EC	(indgi) Nov-22	EC
							pth							
							(m)							
14	Aare Khurd	Roha	Rai gad	18.46 244	73.08 294	Basalt	6	0.9	2.7	Basalt	1.1	512	1	298
15	Kokwan	Roha	Rai gad	18.43 536	72.98 989	Basalt	8	0.9	3	Basalt	0.5	524	0.1	381
16	Amali			18.50 906	75.96 158	Basalt	7	0.8	2.7	Basalt	3.25	353	1.6	298
17	Hemnagar	Alibag	Rai gad	18.65 131	73.02 675	Basalt	6.4	0.9	3.3	Basalt	1.85	394	0.8	257
18	Chirnar	Alibag	Rai gad	18.61 886	73.06 722	Basalt	8	1	6	Basalt	2.1	420	0.6	290
19	Kuhire	Pen	Rai gad	18.56 322	73.10 022	Basalt	5	0.65	3	Basalt	0.65	375	0.45	293
20	Nigade	Roha	Rai gad	18.63 853	73.10 094	Basalt	4.5	0.7	5.5	Basalt	3.05	525	1.5	250
21	Sopoli		Rai gad	18.72 275	73.14 892	Basalt	9	0.7	9	Cement	2.25	311	2.1	163
22	Paned		Rai gad	18.73 294	73.18 408	Basalt	7.5	0.8	5	Basalt	3	315	2.45	176
23	Karbeli	Pen	Rai gad	18.76 653	73.18 933	Basalt	8	0.75	4	Basalt	6.3	724	5.4	375
24	Pen	Pen	Rai gad	18.73 969	73.11 075	Basalt	7	0.8	4	Basalt	4.3	283	3.1	174
25	Veshwi	Alibag	Rai gad	18.65 567	72.89 439	Basalt	7	0.9	4.8	Basalt	3.05	996	1.5	550
26	Karle	Alibag	Rai gad	18.67 878	72.90 392	Basalt	8	0.9	4	Basalt	3.9	1041	0.65	345
27	Wagode	Alibag	Rai gad	18.67 464	72.97 367	Basalt	6	1	3.8	Basalt	2.6	667	0.9	345

S.	Location	Taluka	Dist rict	Latit ude	Longi tude	Form ation	We 11	Height of MP (magl)	Diamet	Nature of lining	DTW (mbgl)	Spot FC	DTW (mbgl)	Spot FC
•			The	uuc	tuuc	ation	De	ivii (iiiagi)		or ming	May-22	EC	Nov-22	LC
							pth							
							(m)							
28	vashi Naka	Pen	Rai gad	18.72 647	73.07 353	Basalt	5	0	4	Basalt	2	442	1.5	250
29	Kihim	Alibag	Rai gad	18.72 892	72.86 939	Basalt	7	1	4.5	Basalt	2.7	638	1.1	419
30	Navedar Kolgaon	Alibag	Rai gad	18.79 408	72.86 547	Basalt	7.5	0.7	4.5	Basalt	4.4	1129	2.5	550
31	Mandawa	Alibag	Rai gad	18.79 492	72.89 422	Basalt	8	0.8	5.5	Basalt	5.6	1147	2.1	560
32	Navkhar	Alibag	Rai gad	18.79 531	72.92 181	Basalt	5	0.6	3.3	Bricks	1.6	1752	1.4	1858
33	Manoli	Alibag	Rai gad	18.71 5	72.88 983	Basalt	6	0.7	4	Basalt	2.7	143	1.5	101
34	Parhur	Alibag	Rai gad	18.70 419	72.91 911	Basalt	8	0.8	3.3	Basalt	5.8	239	2.5	251
35	Veshwi Sainagar	Alibag	Rai gad	18.66 422	72.90 025	Basalt	8	0.9	3	Basalt	2.35	927	1.1	76
36	Kamarli Vakrul		Rai gad	18.73 35	73.17 556	Basalt	6	1	4	Basalt	2.8	430	1.5	250
37	Gagode Kh	Pen	Rai gad	18.76 389	73.16 861	Basalt	7	0.75	4.7	Basalt	3.2	250	2.35	196
38	Gagode Kh	Pen	Rai gad	18.76 25	73.17 194	Basalt	6.5	0.8	4.7	Basalt	2	245	0.8	200
39	Shirgaon	Murud	Rai gad	18.49 25	72.96 667	Basalt	8	1.1	3.5	Basalt	3.5	305	2.2	226
40	Chanere	Roha	Rai gad	18.41 778	73.02 889	Basalt	8	1.1	4	Basalt	3.8	350	3	292
37	Kandalgaon BK	Manga on	Rai gad	18.34 379	73.31 514	Basalt	8.6	0.85	6	basalt blocks	5.2	75	2.15	55

S.	Location	Taluka	Dist	Latit	Longi	Form	We	Height of	Diamet	Nature	DTW	Spot	DTW	Spot
no			rict	ude	tude	ation	II. Do	MP (magl)	er (m)	of lining	(mbgl) May-22	EC	(mbgl) Nov-22	EC
•							pth				1 1111 - 22		1107-22	
							-							
							(m)							
38	Khardi Budruk	Manga	Rai	18.26	73.28	Basalt	4.4	0.8	5	basalt	3.8	248	2.4	192
		On Manage	gad	/08	764		3			blocks				
39	Chavanwadi	Manga	Rai	18.25	13.29	Basalt	8.1	0.7	4.2	blocks	3.2	168	1.27	128
		Manga	gau Rai	18 16	73 31					basalt				
40	Navhare	on	gad	424	974	Basalt	8.5	0.8	4.8	blocks	6.5	456	2.95	481
4.1	D'' 1		Rai	18.01	73.41	D 1/	5.0	0.75	4.7	basalt	5 A 5	170	2.5	1.4.1
41	Bijghar	Mahad	gad	562	437	Basalt	5.6	0.75	4./	blocks	5.45	1/8	2.5	141
42	Nagaon	Mahad	Rai	17.97	73.40	Basalt	7	0.1	5 5	basalt	55	121	3	134
72	ragaon	wianad	gad	919	898	Dasan	'	0.1	5.5	blocks	5.5	121	5	134
43	karanjadi	Mahad	Rai	18.00	73.40	Basalt	4.8	0.8	3.5	basalt	4.8	256	3.05	100
	5	D 11	gad	412	253					blocks				
44	Katetali	Poldap	Rai	17.98	/3.45	Basalt	4.9	0.95	3	basalt	4.8	216	4.1	177
		Poldan	gau Rai	402	73.46					basalt				
45	Lohare	ur	gad	679	191	Basalt	3.7	1	3.8	blocks	2.65	278	1.8	265
1.6	XX 1'	Poldap	Rai	18.00	73.48	D L		0.0		basalt	2.0	1.00	2	1.7.7
46	Wazarwadi	ur	gad	273	083	Basalt	5.9	0.9	3.3	blocks	3.9	160	2	155
47	Turbhua BK	Poldap	Rai	18.01	73.48	Recelt	28	0.7	3.25	basalt	3.6	241	2.45	222
47	Turbilue DK	ur	gad	399	309	Dasan	5.0	0.7	5.25	blocks	5.0	241	2.43	233
48	Parle	Poldap	Rai	18.03	73.46	Basalt	9.5	1		basalt	8.5	380	5.7	262
		ur	gad	916	424	20000	2.0	-		blocks		200		
49	Sav	Mahad	Rai	18.07	73.38	Basalt	8.5	0.9	4	basalt	5.15	390	3.9	339
			gad	088	704					blocks				
50	Gothe Bk	Mahad	rai	305	73.30 66	Basalt	6.5	0.75		blocks	4.5	365	3.75	303
			Rai	18.07	73 45					basalt				
51	Rajewadi	Mahad	gad	68	357	Basalt	6.9	0.75	4	blocks	5.2	311	2.28	273

S.	Location	Taluka	Dist	Latit	Longi	Form	We	Height of MP (magl)	Diamet	Nature of lining	DTW (mbgl)	Spot FC	DTW (mbgl)	Spot FC
			Tici	uue	tuue	ation	De	MII (IIIagi)	er (m)	or mining	May-22	EC	Nov-22	EC
							pth				L L			
							(m)							
52	Raddhval	Mahad	Rai gad	18.06 871	73.36 664	Basalt	6.6 5	0.75		basalt blocks	5.1	333	2.5	337
53	Kharvali	Mahad	Rai gad	18.09 569	73.51 151	Basalt	8	1.6	3	basalt blocks	2	232	8.35	118
54	Barasgaon	Mahad	Rai gad	18.11 886	73.55 22	Basalt	7.9	0.8		basalt blocks	3.65	230	2.4	229
55	Nandvi	Manga on	Rai gad	18.11 647	73.28 622	Basalt	6.4	0.8	4	basalt blocks	3	345	2.05	443
56	Tol kh	Manga on	Rai gad	18.10 305	73.31 169	Basalt	11. 85	0.9	6.4	Conceret e lining	8.5	195	6.18	220
57	Khadi	Mhasla	Rai gad	18.00 938	73.11 434	Basalt	6	0.8	6	basalt blocks	4.3	71	3	67
58	Khamgaon	Mhasla	Rai gad	18.11 257	73.24 071	Basalt	12. 55	1	4	basalt blocks	11.5	210	10.7	189
59	Nigdi	Shivard han	Rai gad	18.03 577	73.07 151	Basalt	8	0.9		basalt blocks	7.15	105	4.95	76
60	Ranwali	Shivard han	Rai gad	18.06 81	73.05 488	Basalt	5.2 5	0.75	2.5	laterite bricks	3.9	201	3.05	211
61	Ghonse	Mhasla	Rai gad	18.15 56	73.15 834	Basalt	12. 25	0.8	8	basalt blocks	2.6	187	1.95	180
62	Morba	Manga on	Rai gad	18.21 493	73.24 924	Basalt	5.4 5	0.8	3	basalt blocks	1.45	407	3.05	408
63	Dasgaon	Mahad	Rai gad	18.09 441	73.35 698	Basalt	9.6	0.7	4	basalt blocks	4.3	397	2.4	372
64	Lonere-1	Manga on	Rai gad	18.16 186	73.32 635	Basalt	7.1	0.7	6	basalt blocks	6.9	384	4.7	345
65	Lonere-2	Manga on	Rai gad	18.16 377	73.33 967	Basalt	10. 4	1.5	8	Conceret e lining	2.4	162	3.75	137

S.	Location	Taluka	Dist rict	Latit ude	Longi tude	Form ation	We II.	Height of MP (magl)	Diamet er (m)	Nature of lining	DTW (mbgl)	Spot EC	DTW (mbgl)	Spot EC
•			1100	uut	tuue	unon	De pth	(mugi)		or ming	May-22		Nov-22	
							(m)							
66	Panhalghar BK	Manga on	Rai gad	18.16 464	73.35 226	Basalt	6.9	0.8	8	basalt blocks	6	164	4.55	117
67	Talegaon	Manga on	Rai gad	18.19 33	73.31 343	Basalt	8.7	0.8	4	basalt blocks	6.7	360	5.3	350
68	Chapadi	Manga on	Rai gad	18.19 122	73.29 652	Basalt	5.2	0.85	4	basalt blocks	5.2	389	4.7	253
69	Lonshi	Manga on	Rai gad	18.21 272	73.29 269	Basalt	7.7	0.9	4	basalt blocks	3.3	305	4.3	374
70	Sale	Manga on	Rai gad	18.25 537	73.26 048	Basalt	10	0.7	6	basalt blocks	7.75	146	3.22	243
71	Kelte	Mhasla	Rai gad	18.08 883	73.10 323	Basalt	8.9	1	3.68	basalt blocks	3.05	65	2.48	51
72	Mahad	Mahad	Rai gad	18.08 079	73.42 734	Basalt	12. 3	0.4	4	Conceret e lining	5.59	908	4.12	803
73	MAHAGOON	SADH AGAD	Rai gad	18. 6546	73. 2058	Basalt	6	0.85	4	Conceret e lining	2.95	288	0.8	265
74	NADSUR	SUDH AGOD	Rai gad	18. 5580 6	73. 2931	Basalt	7.5	0.9	4.5	Conceret e lining	4.15	234	2.1	220
75	PIMPLOLI	SUDH AGOD	Rai gad	18.48 813	73. 3254	Basalt	13	0.9	6.5	Conceret e lining	7.6	308	3.4	289
76	DHEKU	KHAL APUR	Rai gad	18.78 44	73.30 67	Basalt	9	0.2	7	Conceret e lining	6	625	2.3	395
77	TONDALI	KHAL APUR	Rai gad	18.74 491	73.26 855	Basalt	7	1	4	basalt blocks	1.35	248	0.8	185
78	SHENGAON	KHAL APUR	Rai gad	18.81 94	73.33 34	Basalt	7	1	3.65	Conceret e lining	4.5	642	2.9	496
79	HATNOLI	KHAL APUR	Rai gad	18.90 16	73.26 31	Basalt	8	1	4	basalt blocks	3.8	588	2.1	423

S.	Location	Taluka	Dist rict	Latit ude	Longi tude	Form ation	We IL	Height of MP (magl)	Diamet er (m)	Nature of lining	DTW (mbgl)	Spot EC	DTW (mbgl)	Spot EC
•			1100	uue	tuue	ution	De	in (in gr)		org	May-22	20	Nov-22	20
							pth							
							(m)							
80	KOPRI	KHAL PUR	Rai gad	18.86 8	73.22 88	Basalt	8	1	4	basalt blocks	5.03	358	2.7	254
81	VADVIHIR	KHAL PUR	Rai gad	18.93 23	73.27 83	Basalt	8	0.95	4	basalt blocks	3.85	274	1.9	207
82	PIRKON	URAN	Rai gad	18.84 76	73.01 15	Basalt	9	0.9	3.5	Conceret e lining	2.7	808	1.9	599
83	VINAYAK(Ke gaon)	URAN	Rai gad	18.88 2	72.92 37	Basalt	7.5	0.9	4	basalt blocks	1.8	960	0.75	760
84	BARAPADA	PANV EL	Rai gad	18.85 63	73.09 12	Basalt	7	0.9	3.5	basalt blocks	2.55	810	1.6	658
85	POSARI	KARJA T	Rai gad	18.89 58	73.14 79	Basalt	6.5	1	3	basalt blocks	1.4	618	0.5	478
86	SAVANE	PANV EL	Rai gad	18.50 358	73.10 17	Basalt	12	0.9	6	basalt blocks	2.3	155	1.3	106
87	TALEGAON	KHAL APUR	Rai gad	18.92 42	73.18 46	Basalt	8	0.9	4.5	basalt blocks	4.25	266	3.9	169
88	SHIVKAR	PANV EL	Rai gad	18.98 05	73.15 15	Basalt	8	0.95	4	basalt blocks	5.15	1260	3.5	879
89	DHODANI	PANV EL	Rai gad	19.01 79	73.15 22	Basalt	8.5	1	9	Conceret e lining	6.4	231	4.8	119
90	TAKAVE	KARJA T	Rai gad	18.96 64	73.39	Basalt	9	0.9	3	basalt blocks	1	395	0.5	239
91	WARRI	KARJA T	Rai gad	19.07 43	73.34 41	Basalt	7	1	2	Conceret e lining	2.5	349	1.4	342
92	SALOKH	KARJA T	Rai gad	19.10 35	73.37 44	Basalt	7.5	1	5	Conceret e lining	Dry	-	3.6	238
93	CHAFEWADI	KARJA T	Rai gad	19.13 8	73.41 57	Basalt	1	0.8	8	Conceret e lining	5.6	135	3.2	104

S. no ·	Location	Taluka	Dist rict	Latit ude	Longi tude	Form ation	We ll. De nth	Height of MP (magl)	Diamet er (m)	Nature of lining	DTW (mbgl) May-22	Spot EC	DTW (mbgl) Nov-22	Spot EC
							(m)							
94	KASHALE	KARJA T	Rai gad	19.01 4	73.42 04	Basalt	8	0.8	6	Conceret e lining	5.5	590	2.9	421
95	GAURKAMAT	KARJA T	Rai gad	18.92 58	73.38 25	Basalt	8.5	0.9	4	Conceret e lining	3.3	278	2.2	207
96	GORTHON	KHAL APUR	Rai gad	18.77 97	73.22 12	Basalt	8	0.9	3	Conceret e lining	5.8	861	3.8	401
97	DENVAT THOKURWA DI	KHAL APUR	Rai gad	18.79 08	73.25 2	Basalt	9	0.9	4	Conceret e lining	2.6	297	1.7	230
98	GHODEVALI	KHAL APUR	Rai gad	18.83 32	73.30 97	Basalt	8.5	0.95	4	Conceret e lining	5.55	330	2.5	193

Annexure III

Soil Infiltration Test

Date	26-12-22						
Village	Lonhsi						
Taluka	Mangaon						
District	Raigad						
Coordinates	18.212811,73.292768						
Initial water level	18						
Geology	Deccan trap						
Soil Type	clay loam						
Final Infiltration Rate	10.51						
S.no	Duration (min)	Cum Time	Water level Depth	Infiltrated	Infiltration	Time (Min)	Infiltration
		(min)	(cm)	water depth	rate (cm/hrs)		rate
				(cm)			(cm/hrs)
1	0.50	0.50	17.70	0.30	36	0.5	36
2	0.50	1	17.80	0.20	24	1	24
3	1.00	2	17.70	0.30	18	2	18
4	1.00	3	17.80	0.20	12	3	12
5	1.00	4	17.80	0.20	12	4	12
6	2.00	6	17.80	0.20	6	6	6
7	2.00	8	17.70	0.30	9	8	9
8	2.00	10	17.70	0.30	9	10	9
9	5.00	15	17.50	0.50	6	15	6
10	5.00	20	17.50	0.50	6	20	6
11	5.00	25	17.50	0.50	6	25	6
12	5.00	30	17.50	0.50	6	30	6
13	10.00	40	17.00	1.00	6	40	6
14	10.00	50	17.00	1.00	6	50	6
15	10.00	60	17.00	1.00	6	60	6
16	20.00	80	16.00	2.00	6	80	6
17	20.00	100	16.40	1.60	4.8	100	4.8

Date 23-12-22

Village	Lohare						
Taluka	Poldapur						
District	Raigad						
Coordinates	18.013495,73.463991						
Initial water level	19						
Geology	Deccan trap						
Soil Type	Clayey Soil						
Final Infiltration Rate	33.93						
S.no	Duration (min)	Cum Time	Water level	Infiltrated water	Infiltration	Time	Infiltration
		(min)	Depth (cm)	depth (cm)	rate (cm/hrs)	(Min)	rate (cm/hrs)
1	0.50	0.50	18.20	0.80	96	0.50	96
2	0.50	1	18.40	0.60	72	1	72
3	1.00	2	17.90	1.10	66	2	66
4	1.00	3	18.10	0.90	54	3	54
5	1.00	4	18.20	0.80	48	4	48
6	2.00	6	17.60	1.40	42	6	42
7	2.00	8	17.90	1.10	33	8	33
8	2.00	10	18.00	1.00	30	10	30
9	5.00	15	16.50	2.50	30	15	30
10	5.00	20	16.90	2.10	25.2	20	25.2
11	5.00	25	17.50	1.50	18	25	18
12	5.00	30	17.50	1.50	18	30	18
13	10.00	40	15.60	3.40	20.4	40	20.4
14	10.00	50	16.00	3.00	18	50	18
15	10.00	60	16.00	3.00	18	60	18
16	10.00	70	16.00	3.00	18	70	18
17	10.00	80	16.00	3.00	18	80	18
18	10.00	90	16.00	3.00	18	90	18
19	10.00	100	16.00	3.00	18	100	18
20	10.00	110	16.00	3.00	18	110	18

Date	26-12-22
Village	Lonere

Taluka	Mangaon						
District	Raigad	1					
Coordinates	18.163685,73.33944						
Initial water level	19						
Geology	Deccan trap						
Soil Type	Clay loam						
Final Infiltration Rate	18.92						
S.no	Duration (min)	Cum Time	Water level Depth	Infiltrated	Infiltration	Time (Min)	Infiltration
		(min)	(cm)	water depth	rate (cm/hrs)		rate
				(cm)			(cm/hrs)
1	1.00	1	17.90	1.10	66	1	66
2	1.00	2	18.00	1.00	60	2	60
3	1.00	3	18.40	0.60	36	3	36
4	2.00	5	18.20	0.80	24	5	24
5	2.00	7	18.10	0.90	27	7	27
6	3.00	10	18.50	0.50	10	10	10
7	5.00	15	18.10	0.90	10.8	15	10.8
8	5.00	20	18.00	1.00	12	20	12
9	10.00	30	17.90	1.10	6.6	30	6.6
10	10.00	40	17.80	1.20	7.2	40	7.2
11	10.00	50	17.80	1.20	7.2	50	7.2
12	10.00	60	17.80	1.20	7.2	60	7.2
13	10.00	70	17.80	1.20	7.2	70	7.2
14	10.00	80	17.80	1.20	7.2	80	7.2
15	10.00	90	17.80	1.20	7.2	90	7.2
16	10.00	100	17.80	1.20	7.2	100	7.2

Date	23-12-22	
Village	Nagaon	
Taluka	Mahad	

District	Raigad						
Coordinates	17.979425,73.40863						
Initial water level	15.5						
Geology	Deccan trap						
Soil Type	Silty loam						
Final Infiltration Rate	15.38						
S.no	Duration (min)	Cum Time (min)	Water level Depth (cm)	Infiltrated water depth (cm)	Infiltration rate (cm/hrs)	Time (Min)	Infiltration rate (cm/hrs)
1	1.00	1	15.10	1.10	66	1	66
2	1.00	2	14.50	0.50	30	2	30
3	1.00	3	14.40	0.40	24	3	24
4	2.00	5	14.70	0.70	21	5	21
5	2.00	7	14.60	0.60	18	7	18
6	3.00	10	14.50	0.50	10	10	10
7	5.00	15	14.60	0.60	7.2	15	7.2
8	5.00	20	14.70	0.70	8.4	20	8.4
9	10.00	30	15.40	1.40	8.4	30	8.4
10	10.00	40	15.60	1.60	9.6	40	9.6
11	10.00	50	15.30	1.30	7.8	50	7.8
12	10.00	60	15.40	1.40	8.4	60	8.4
13	10.00	70	15.20	1.20	7.2	70	7.2
14	10.00	80	15.20	1.20	7.2	80	7.2
15	10.00	90	15.10	1.10	6.6	90	6.6
16	10.00	100	15.05	1.05	6.3	100	6.3
Annexure IV

Sl.	Block	SITE	Latitude	Longitude	pН	EC	TD	Т	Ca	Μ	Na	K	С	HC	Cl	SO	NO	F	U	SA	RS
Ν		NAME	(N)	(E)			S	Н		g			O 3	03		4	3			R	С
0						μS/c	<				mg	/L		•••••••		.>			pp		
						m					U								b		
1	Pen	Veshwi	18.75	73.0333333	7.68	702	449	29	80	23	25	1	0	348	43	22	1	0.2	0.0	0.6	-
-		X 7 11	10 100000		5.05	200	105	5		2	0	_	0	104	20	10	10	6	8	3	0.20
2	Mahad	Varandha	18.133333	/3.566666/	7.25	289	185	12	44	2	9	/	0	104	28	12	10	0.1 6	L BD	0.3 6	- 0.70
3	Roha	Kharapati	18.45	73.1	7.52	584	374	23	80	7	19	3	0	244	35	16	9	0.1	0.2	0.5	-
		-						0										4	8	5	0.60
4	Poladpur	Poladpur	17.983333	73.4666667	7.16	425	272	17	60	6	17	3	0	159	39	15	13	0.1	BD	0.5	-
5	Variat	Hudhro	18 0125	72 2104444	7.61	762	100	20	11	5	25	0	0	266	52	14	2	1	L 0.1	0	0.90
5	Kaijai	Budruk	18.9123	/3.3194444	7.01	703	400	0	2	5	33	0	0	300	55	14	2	2	1	0.8 9	0.00
6	Mangaon	Chandore	18.166667	73.1833333	7.27	126	81	60	18	4	6	5	0	61	14	5	2	0.1	BD	0.3	-
	-																	1	L	4	0.20
7	Alibag	Bilji (Umta)	18.534722	72.9833333	7.50	456	292	19	70	4	16	1	0	214	35	12	2	0.1	BD	0.5	-
0		G 1 1	10.070022	70.4	7.40	4.40	207	0	64	~	10	-	0	1.65	50	1.1	7	2	L	1	0.30
8	Mahad	Sochinde	18.070833	73.4	7.43	449	287	18	64	5	18	5	0	165	53	11	7	$\frac{0.1}{2}$	L BD	0.5 8	- 0.90
9	Murud	Khutal	18.358333	73.0305556	7.71	520	333	19	66	6	35	1	0	244	35	8	1	0.2	BD	1.1	0.20
								0										1	L	2	
10	Pen	Jite	18.813889	73.0875	7.55	437	280	19	70	5	14	1	0	232	18	11	4	0.1	BD	0.4	-
								5										8	L	3	0.10
11	Khalapur	Kargaon	18.726389	73.2986111	7.65	354	226	17	60	5	11	1	0	195	18	7	1	0.1 7	BD I	0.3 5	- 0.20
12	Roha	Dapoli	18,477778	73.0083333	7.30	1878	120	60	20	24	16	1	0	397	34	94	4	0.1	1.0	2.8	-
		Dupon	10111110	10100000000	1.00	10/0	2	0	0		0	1	Ŭ	077	7	<i>.</i>		3	9	5	5.50
13	Roha	Phugaon	18.433333	73.2055556	7.52	723	462	25	90	6	29	2	0	226	71	19	41	0.1	BD	0.8	-
								0				9						3	L	1	1.30
14	Mhasla	Kelte	18.088889	73.1055556	7.48	94	60	50	10	6	4	2	0	49	11	6	2	0.1	BD	0.2	-
15	Shrivardha	Saigaon	18.031044	73 0805556	7 10	134	86	50	16	2	6	0	0	61	11	1	1	01	L BD	03	0.20
15	n	Govalwadi	10.031744	13.0003330	1.17	1.54	00	50	10	2	0			01	11	1	1	0.1	L	8	0.00
16	Mangaon	Kumbharcha	18.302778	73.3055556	7.52	473	302	19	54	13	21	2	0	195	50	14	4	0.1	BD	0.6	-
	Ŭ	Kosta Bk						0										4	L	6	0.60

Chemical analysis of ground water samples, Aquifer- I / Shallow aquifers

SI.	Block	SITE	Latitude	Longitude	pH	EC	TD	Т	Ca	Μ	Na	Κ	С	HC	Cl	SO	NO	F	U	SA	RS
Ν		NAME	(N)	(E)	-		S	Η		g			O 3	O 3		4	3			R	С
0						<i>C1</i>				-											
						μS/c	<>											pp			
15	4.111	D	10.001.007	53 001 4445		m	170	•	=0	20	20		0	220	50			0.0	D	1.0	
17	Alibag	Poynad	18.691667	72.9916667	7.76	737	472	29	70	28	38	2	0	330	53	21	1	0.2	0.2	1.0	-
18	Alibag	Nagaon	18 611667	72.0	7 87	830	537	31	10	16	36	1	0	415	30	17	6	02	1	2	0.40
10	Milling	Tuguon	10.011007	12.9	7.07	037	557	5	0	10	50	3	0	415	57	17	0	3	1	4	0.50
19	Sudhagad	Pali	18.5425	73.2188889	7.64	691	442	22	68	12	35	3	0	293	50	16	3	0.1	BD	1.0	0.40
	5							0				1						2	L	7	
20	Khalapur	Khalapur	18.827778	73.2841667	7.54	282	180	80	24	5	16	1	0	122	18	12	2	0.1	BD	0.7	0.40
												6						3	L	8	
21	Pen	Vadkhal	18.733333	73.05	7.65	1238	792	42	11	36	87	3	0	336	23	23	4	0.1	0.9	1.6	-
22	D 1	NT 1 1	10.050556	72 1009222	0.10	1011	775	5	0	6	20	1	0	407	0	54	2	5	0	2	3.00
22	Panvel	Navade-1	19.050556	/3.1008333	8.19	1211	115	12	40	0	20	1	0	427	14	54	Z	0.2	I BD	1.9	4.50
23	Alibag	Valvade	18.606944	72,9794444	7.63	740	474	24	70	16	55	3	0	232	10	30	7	0.1	0.1	1.5	-
	1 moug	Shababaj	10.000711		1100			0		10		2	Ű		6	20		2	4	3	1.00
24	Mhasla	Madegaon	18.122222	73.2155556	7.60	283	181	14	40	10	13	0	0	165	21	3	2	0.1	0.4	0.4	-
								0										3	4	7	0.10
25	Alibag	Vadvhav Bk	18.621667	72.9505556	7.88	1126	721	43	14	21	50	5	0	476	10	35	5	0.1	BD	0.9	-
26		77 1	10.404700	72.0022222	7.60	600	204	5	0	01	24	1	0	1.50	3	20	2	5	L	9	0.90
26	Murud	Kude	18.494722	12.9822222	7.60	600	384	23	60	21	24	1	0	153	89	28	3	0.1	0.5	0.6	- 2 20
27	Roha	Shenyai-1	18 468056	73 0752778	7 55	559	384	20	54	16	33	1	0	153	89	24	2	01	BD	10	-
	110110	Show a	1011000000	1010102110	1.00	007	20.	0	0.	10	00	-	Ű	100	0,		-	5	L	3	1.50
28	Roha	Sukeli	18.4875	73.1841667	7.48	1084	694	46	12	36	27	1	0	183	26	20	2	0.1	BD	0.5	-
								5	6						6			0	L	4	6.30
29	Mangaon	Indapur-1	18.298611	73.2388889	7.93	659	422	26	70	21	28	4	0	275	71	6	1	0.0	0.3	0.7	-
20	N 1		10 222770	72.059(111	7.07	755	402	0	76	22	20	2	0	207	20	10	2	9	5	6	0.70
30	Murud	Murud	18.332778	/2.9586111	/.8/	/55	483	28	/6	23	38	3	0	397	28	18	3	0.1	I BD	0.9	0.80
31	ROHA	Khari	18 442778	73 1008333	7.72	396	253	16	46	12	13	1	0	183	25	13	4	01	0.8	04	_
51	Rollin	Tenari	10.442770	75.10005555	1.12	570	255	5	-10	12	15	1	0	105	23	15	-	3	0.0	5	0.30
32	ALIBAG	Alibag	18.646389	72.875	7.89	766	490	22	84	4	53	2	0	189	10	30	18	0.2	BD	1.5	-
		_						5				2			6			2	L	4	1.40
33	PANVEL	Chinchpara	18.985556	73.09	7.77	679	435	24	68	17	37	1	0	305	46	21	2	0.1	0.8	1.0	0.20
	WADLAT		10.055020			200	2.10	0	60		10			014	_	_		5	3	5	0.00
34	KARJAT	Chinchawali	18.975833	73.3294444	7.67	389	249	17	60	6	10	1	0	214	7	7	3	0.1	BD	0.3	0.00
1					1			5			1	1						5	L	4	I

SI.	Block	SITE	Latitude	Longitude	pН	EC	TD	Т	Ca	Μ	Na	K	С	HC	Cl	SO	NO	F	U	SA	RS
Ν		NAME	(N)	(E)	_		S	Η		g			O 3	O 3		4	3			R	С
0						C / -	-			_		/ T									
						μS/c	<	••••••	•••••	•••••	mg	ζ/L	•••••	•••••	•••••	.>			pp b		
25		Dorli	19 511620	72.0155922	6.26	206	122	75	22	5	12	1	0	110	11	0	1	0.0		0.6	0.20
55		DOIII	18.511059	72.9155855	0.20	200	152	15	22	5	15	1	0	110	11	0	1	8	L	3	0.50
36		Kashid	18.449528	72.903222	6.80	602	385	18	48	15	56	1	0	275	50	6	8	0.0	0.1	1.8	0.90
								0										9	4	1	
37		Khambavali	18.279944	73.11825	6.61	389	249	15 0	48	7	17	4	0	214	14	0	3	0.0 9	2.0 2	0.6 1	0.50
38		Durtoli Sutarwadi	18.410806	73.2816944	6.05	113	72	45	10	5	6	2	0	55	11	1	3	0.0 7	3.7 7	0.4 1	0.00
39		Vanaste	18.269747	73.13325	6.38	138	88	55	16	4	5	1	0	67	7	0	3	0.0	5.4	0.3	0.00
																		7	0	1	
40		Kokwan	18.435361	72.9898889	6.93	504	323	16 0	46	11	42	1 4	0	275	28	2	1	0.1 1	0.0 4	1.4 5	1.30
41		Nigade	18.638528	73.1009444	6.80	413	264	17	46	13	16	1	0	177	46	2	2	0.0	BD	0.5	-
10		G 1	10 50055	50 1 4001 (5	0.11	1.5.4		0	10		20		24	10			-	8	L	4	0.50
42		Sopoli	18.72275	73.1489167	9.11	154	99	30	10	1	20	3	24	12	11	11	2	0.1	I BD	1.5	0.40
43		Karbeli	18.766528	73,1893333	6.74	708	453	27	48	36	33	4	0	244	82	20	27	- 0.0	0.0	0.8	-
		Arraw						0					Ĩ					7	7	6	1.40
44		Venshi	18.655667	72.8943889	7.14	982	628	29	58	35	89	5	0	451	89	13	0	0.1	0.4	2.2	1.60
			10			10.7		0			•						-	2	7	7	0.10
45		Vashi Naka	18.726472	73.0735278	6.73	485	310	17	46	15	29	3	0	220	32	16	5	0.0	0.1	0.9	0.10
46		Kihim	18 717806	72 8693889	7.23	687	440	19	34	27	61	7	0	348	30	0	3	9	4	/	1.80
-10		Kiilii	10.717000	72.0075007	1.25	007	0	5	54	21	01	,	0	540	57	0	5	3	2	0	1.00
47		Navedar	18.794083	72.8654722	7.29	1175	752	34	54	51	89	3	0	476	64	90	3	0.1	1.7	2.0	0.90
		Kolgaon						5				3						7	7	9	
48	Mangaon	Kandalgaon BK	18.343794	73.315135	7.73	109	70	45	12	4	5	0	0	55	7	0	2	0.1 0	BD L	0.3 1	0.00
49	Mangaon	Khardi Budruk	18.267079	73.287635	7.62	309	198	10 0	28	7	22	2	0	140	21	7	2	0.0 9	BD L	0.9 5	0.30
50	Mangaon	Chavanwadi	18.257257	73.291228	7.61	202	129	10	22	12	2	1	0	110	11	1	2	0.1	BD	0.1	-
L								5										0	L	0	0.30
51	Mangaon	Navhare	18.16424	73.31974	7.71	561	359	22	36	33	19	1	0	232	43	19	11	0.1	BD	0.5	-
50	Mahad	Diiahan	18.015622	72 41 4265	7.46	240	154	5	20	7	22	0	0	140	11	0	2	3		5	0.70
32	wanau	Біјднаг	16.013022	/3.414303	/.40	240	134	80	20	/	22	0	0	140	11	0	5	2	L	1.0 6	0.70

NAME NAME NAME NAME PAME <!--</th--><th>Sl.</th><th>Block</th><th>SITE</th><th>Latitude</th><th>Longitude</th><th>pН</th><th>EC</th><th>TD</th><th>Т</th><th>Ca</th><th>Μ</th><th>Na</th><th>K</th><th>С</th><th>HC</th><th>Cl</th><th>SO</th><th>NO</th><th>F</th><th>U</th><th>SA</th><th>RS</th>	Sl.	Block	SITE	Latitude	Longitude	pН	EC	TD	Т	Ca	Μ	Na	K	С	HC	Cl	SO	NO	F	U	SA	RS
0 1	Ν		NAME	(N)	(E)			S	Η		g			O 3	O 3		4	3			R	С
Image Image <th< th=""><th>0</th><th></th><th></th><th></th><th></th><th></th><th></th><th>-</th><th></th><th></th><th></th><th></th><th>-/T</th><th></th><th></th><th></th><th>Ļ</th><th></th><th></th><th></th><th></th><th></th></th<>	0							-					-/T				Ļ					
Mahad Nagoon 17.97919 73.408976 7.6 171 100 65 12 9 1 0 1 <							μ 5 /c	<	•••••	•••••	••••••	mg	;/L	•••••	•••••	•••••	.>			pp b		
3.3 mmm Ragenti 1.3577 7.36070 7.17 10 60 12 9 12 9 12 9 12 9 12 9 12 9 12 9 12 9 12	53	Mahad	Nagaon	17 07010	73 /08976	7.76	171	109	65	12	0	0	1	0	02	4	4	3	0.1	D RD	0.4	0.20
54 Poldapur Katetali 17.98402 73.451748 7.16 262 16 26 13 8 1 0 11 0	55	Ivianau	Ivagaon	17.57515	75.400770	7.70	1/1	107	05	12			1	0	12	4	4	5	2	L	0.4 7	0.20
- -	54	Poldapur	Katetali	17.98402	73.451748	7.16	262	168	12	26	13	8	1	0	134	11	0	11	0.1	BD	0.3	-
55 Poldapur Lohare 18.016787 73.461913 7.25 386 247 16 66 17 13 1 0 177 21 6 2 2 0 1 3.03 0.03 0.01 177 21 6 2 0 1 0.1 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>9</td> <td>L</td> <td>2</td> <td>0.20</td>									0										9	L	2	0.20
o o	55	Poldapur	Lohare	18.016787	73.461913	7.25	386	247	16	36	17	13	1	0	177	21	6	2	0.2	BD	0.4	-
36 Poldapur Wazarwali 18.002/34 /3.48082 7.02 10 122 85 20 9 6 1 0 10 7 0 1 0.1 BD 0.2 0 57 Poldapur Turbhue BK 18.013988 73.483085 7.32 311 199 13 30 13 12 2 0 17.1 14 0 4 0.1 BD 0.4 8 0 0.1 8 0 0.1 8 0 0.1 8 0.1 8 0 0.1 8 0 0.1 8 0 0.1 8 0 0.1 8 0 0.1 8 0 0.1 8 0 0.1 8 0.1 8 0.1 8 0.1 8 0.1 8 0.1 8 0.1 8 0.1 8 0.1 8 0.1 8 0.1 8 0.1 7 0.1 10 10 10 10 10 10 10 10 10 10		D 11		10.000704	50.400005	7 .02	100	100	0	20	0	-		0	104	_	0		0	L	3	0.30
77 Poldapur Turbhue BK 18.013988 73.483085 7.32 311 199 13 02 12 2 0 171 14 0 4 18 0 0 0 0 18 0 0 18 0 18 0 18 0 18 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 0 18 18 18 0 18	56	Poldapur	Wazarwadi	18.002734	73.480825	7.02	190	122	85	20	9	6	1	0	104	1	0	1	0.1	I BD	0.2	0.00
1 Notepar Name of a	57	Poldanur	Turbhue BK	18.013988	73 483085	7 32	311	199	13	30	13	12	2	0	171	14	0	4	01	BD	04	0.20
58 Mahad Sav 18.076879 73.387042 7.39 494 316 20 54 10 35 14 1 0.1 L 9 0.80 59 Mahad Gothe Bk 18.083051 73.366001 7.32 403 258 15 40 13 19 5 0 158 46 9 5 0.2 BD 0.4 1 0.5 0.50 60 Mahad Rajewadi 18.0768 7.453565 7.45 349 23 15 38 13 12 1 0 18.3 7 8 2 0.2 BD 0.4 0.10 1.5 0.5 61 Mhasla Nadvi 18.01647 73.453565 7.45 109 70 55 12 6 3 0 0 283 7 8 2 0.2 BD 0.1 1.5 0.2 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	57	ronaupur	Turonue Dir	10.015700	15.105005	1.52	511	177	0	50	10	12	-	Ū	1/1	1.	0		8	L	8	0.20
1 < 0 < 0 < 0 < 0 < 0 < 0 < 0 < 0 < 0 <	58	Mahad	Sav	18.076879	73.387042	7.39	494	316	20	42	24	16	3	0	201	35	14	1	0.1	BD	0.4	-
59 Mahad Gothe Bk 18.083051 73.366601 7.32 403 25 15 40 13 19 5 0 150 46 9 5 0.2 BD 0.6 - 0.50 0.50 60 Mahad Rajewadi 18.0768 7.3453555 7.45 349 23 15 38 13 12 1 0 183 7 8 2 0.2 BD 0.4 0.50 61 Mnsla Nandvi 18.11647 73.286216 7.65 705 45 25 64 23 41 5 0 299 60 28 2 0.2 BD 0.4 2 0.20 <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7</td><td>L</td><td>9</td><td>0.80</td></th<>									5										7	L	9	0.80
60 Mahad Rajewadi 18.0768 73.453565 7.45 349 223 15 38 13 12 1 0 183 7 8 2 0 3 1 2 1 0 183 7 8 2 0 3 1 0 183 7 8 2 0 3 1 0 61 Mhasla Nandvi 18.11647 73.28216 7.65 705 451 25 64 23 41 5 0 29 60 28 2 0 4 2 0.20 62 Mhasla Khadi 18.009377 73.114342 7.55 109 70 55 12 6 3 0 0 15 11 0 0 1 1 2 0.0 15 11 10 10 10 11 7 10 10 10 11 10 11 10 </td <td>59</td> <td>Mahad</td> <td>Gothe Bk</td> <td>18.083051</td> <td>73.366601</td> <td>7.32</td> <td>403</td> <td>258</td> <td>15</td> <td>40</td> <td>13</td> <td>19</td> <td>5</td> <td>0</td> <td>159</td> <td>46</td> <td>9</td> <td>5</td> <td>0.2</td> <td>BD</td> <td>0.6</td> <td>-</td>	59	Mahad	Gothe Bk	18.083051	73.366601	7.32	403	258	15	40	13	19	5	0	159	46	9	5	0.2	BD	0.6	-
800 Mailad Repeating 18.0786 1.4333353 1.43 349 223 13 58 12 1 0 183<7 6 2 0.2 B0 0.4 0.00 61 Mhasla Nandvi 18.11647 73.286216 7.65 705 451 25 64 23 41 5 0 299 60 28 2 0.2 BD 0.1 - 62 Mhasla Khadi 18.009377 73.114342 7.55 109 70 55 12 6 3 0 0 55 11 0 0 0.1 BD 0.1 - 0.20 0.3 0.1 0.20 0.3 0.20 0.3 0.20 0.3 0.20 0.3 0.20 0.3 0.20 0.3 0.20 0.3 0.20 0.3 0.3 0.20 0.3 0.3 0.20 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 <t< td=""><td>60</td><td>Mahad</td><td>Daiawadi</td><td>19.0769</td><td>72 152565</td><td>7 45</td><td>240</td><td>222</td><td>5</td><td>20</td><td>12</td><td>10</td><td>1</td><td>0</td><td>102</td><td>7</td><td>0</td><td>2</td><td>3</td><td>L</td><td>5</td><td>0.50</td></t<>	60	Mahad	Daiawadi	19.0769	72 152565	7 45	240	222	5	20	12	10	1	0	102	7	0	2	3	L	5	0.50
61 Mhasla Nandvi 18.11647 73.286216 7.65 705 451 25 64 23 41 5 0 299 60 28 2 4 L 2 0.20 62 Mhasla Khadi 18.009377 73.114342 7.55 109 70 55 12 6 3 0 0 55 11 0 0 61 BD 0.1 5 0.20 63 Mhasla Khamgaon 18.112574 73.240713 7.31 369 236 15 42 12 11 2 0 159 21 7 13 0.1 BD 0.3 - 0.50 0.4 15 0 159 21 7 13 0.1 BD 0.3 - 0.55 14 4 6 0 0 61 7 1 0 0.1 BD 0.3 - 0.5 - 1.1 0.1 BD 0.5 - 0.5 - 0.4 L 9 9 0	00	Ivianau	Kajewaui	18.0708	75.455505	7.45	349	223	0	30	15	12	1	0	165	/	0	2	3	L	0.4	0.00
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	61	Mhasla	Nandvi	18.11647	73.286216	7.65	705	451	25	64	23	41	5	0	299	60	28	2	0.2	BD	1.1	-
62 Masla Khadi 18.009377 73.114342 7.55 109 70 55 12 6 3 0 55 11 0 0 0.1 BD 0.1 0.10									5										4	L	2	0.20
i i i i i i i i i i i i i i i i i i i	62	Mhasla	Khadi	18.009377	73.114342	7.55	109	70	55	12	6	3	0	0	55	11	0	0	0.1	BD	0.1	-
65 Mnasta Khamgaon 18.1125/4 73.240/13 7.31 369 236 15 42 12 11 2 0 159 21 7 13 0.1 BD 0.3 - 64 Shivardhan Nigdi 18.035773 73.071512 7.16 136 87 50 14 4 6 0 0 61 7 1 0.1 BD 0.3 - 65 Mhasla Ghonse 18.035773 73.071512 7.16 136 87 50 14 4 6 0 0 61 7 1 0 18 D0 0.3 - 65 Mhasla Ghonse 18.155597 73.15834 7.35 235 150 80 16 10 11 7 0 92 21 2 5 0.1 BD 0.5 - 66 Mahada Dasgaon 18.094412 73.32058 7.47 474 303 18 40 19 24 9 0 230 <td></td> <td></td> <td>171</td> <td>10 11055 1</td> <td>50.040510</td> <td>5.01</td> <td>2.60</td> <td>226</td> <td>1.7</td> <td>10</td> <td>10</td> <td></td> <td></td> <td>0</td> <td>1.50</td> <td>0.1</td> <td>-</td> <td>10</td> <td>6</td> <td>L</td> <td>5</td> <td>0.20</td>			171	10 11055 1	50.040510	5.01	2.60	226	1.7	10	10			0	1.50	0.1	-	10	6	L	5	0.20
64 Shivardhan Nigdi 18.035773 73.071512 7.16 136 87 50 14 4 66 0 0 61 7 1 0 1 80 1 4 1 0 1 0 1 0 0.1 80 0.00 1 1 0 1 0 0.1 80 0.00 1 1 0 1 0 0 1 0 1 0 0.00 1 0 0 0 0 0 0 0 1 0 <td>63</td> <td>Mhasla</td> <td>Khamgaon</td> <td>18.112574</td> <td>73.240713</td> <td>7.31</td> <td>369</td> <td>236</td> <td>15</td> <td>42</td> <td>12</td> <td>11</td> <td>2</td> <td>0</td> <td>159</td> <td>21</td> <td>1</td> <td>13</td> <td>0.1</td> <td>BD</td> <td>0.3</td> <td>-</td>	63	Mhasla	Khamgaon	18.112574	73.240713	7.31	369	236	15	42	12	11	2	0	159	21	1	13	0.1	BD	0.3	-
one Indication Inditert Indication	64	Shiyardhan	Nigdi	18.035773	73 071512	7 16	136	87	50	14	4	6	0	0	61	7	1	0	01	BD	03	0.00
65 Mhasla Ghonse 18.155597 73.15834 7.35 235 150 80 16 10 11 7 0 92 21 2 5 0.1 BD 0.5 - 66 Mahad Dasgaon 18.094412 73.356978 7.47 474 303 18 40 19 24 9 0 220 32 5 5 0.1 BD 0.7 0.10 67 Mahagaon 18.6546 73.2058 7.50 336 215 15 0 11 1 0 183 11 4 1 0.1 0.2 0.3 0.00 10 10 10 11 1 0 183 11 4 1 0.1 0.2 0.3 0.00 10 10 10 10 11 1 0 183 11 4 1 0.1 0.2 0.3 0.00 10 10 10 18.3 11 4 1 0.1 0.2 0.3 0.00 10 10	0.	Shivuranun	rugui	10.055775	/5.0/1512	/.10	150	07	50	1.	· ·	0	Ŭ	Ū	01	,		Ŭ	4	L	9	0.00
Image: constraint of the state of the s	65	Mhasla	Ghonse	18.155597	73.15834	7.35	235	150	80	16	10	11	7	0	92	21	2	5	0.1	BD	0.5	-
66 Mahad Dasgaon 18.094412 73.356978 7.47 474 303 18 40 19 24 9 0 220 32 5 5 0.1 BD 0.7 0.00 67 Mahagaon 18.6546 73.2058 7.50 336 215 15 36 15 11 1 0 183 11 4 1 0.1 0.2 0.3 0.00 00 00 0 10 11 1 0 183 11 4 1 0.1 0.2 0.3 0.00 00 00 0 183 11 4 1 0.1 0.2 0.3 0.00 00 0 18 11 1 0 183 11 4 1 0.1 0.2 0.3 0.00 00 0 18 11 1 0 18 11 1 0 18 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1																			4	L	1	0.10
67 Mahagaon 18.6546 73.2058 7.50 336 215 15 36 1 1 0 183 11 4 1 0.1 0.2 0.3 0.00 9 1 0 183 11 4 1 0.1 0.2 0.3 0.00 9 1 0 183 11 4 1 0.1 0.2 0.3 0.00 9 1 0 183 11 4 1 0.1 0.2 0.3 0.00 9 1 0 183 11 4 1 0.1 0.2 0.3 0.00 9 1 0 183 11 1 0 183 11 1 0 183 11 0 18 1 0.1 0.1 0.2 0.3 0.00 10 10 10 10 10 11 0 10 10 10 11 0.1 10 10 11 0.1 10 11 0.1 10 10 11 10 11 10 11	66	Mahad	Dasgaon	18.094412	73.356978	7.47	474	303	18	40	19	24	9	0	220	32	5	5	0.1	BD	0.7	0.00
67 Managaon 18.0540 73.2038 7.50 330 213 15 50 15 11 1 0 1853 11 4 1 0.1 0.2 0.3 0.00 68 Nadsur 18.5581 73.2931 7.47 274 175 12 24 16 6 1 0 146 7 0 9 0.10 0 9 0.10 0 9 0.10 0 9 0.10 0 9 0 0 0 16 0	67		Mahagaan	18 6546	72 2059	7.50	226	215	15	26	15	11	1	0	192	11	4	1	9		9	0.00
68 Nadsur 18.5581 73.2931 7.47 274 175 12 24 16 6 1 0 146 7 0 2 1.1 BD 0.2 - 69 Pimploli 18.4881 73.3214 7.14 373 239 15 44 11 9 1 0 189 14 1 11 0.1 BD 0.3 0.00 69 Pimploli 18.4881 73.3214 7.14 373 239 15 44 11 9 1 0 189 14 1 11 0.1 BD 0.3 0.00 70 Dheku 18.7844 73.3067 7.61 635 406 23 46 28 34 9 0 299 32 18 6 0.1 BD 0.9 7 0.30 0 0 0 0 189 14 1 11 0.1 BD 0.9 0 0 0 18 18 18 0 0 0 0<	07		Managaon	18.0340	75.2058	7.50	330	215	0	50	15	11	1	0	165	11	4	1	7	0.2	9	0.00
Image: style styl	68		Nadsur	18.5581	73.2931	7.47	274	175	12	24	16	6	1	0	146	7	0	2	0.1	BD	0.2	-
69 Pimploli 18.4881 73.3214 7.14 373 239 15 44 11 9 1 0 189 14 1 11 0.1 BD 0.3 0.00 70 Dheku 18.7844 73.3067 7.61 635 406 23 46 28 34 9 0 299 32 18 6 0.1 BD 0.9 0.30									5										6	L	3	0.10
Image: Note of the system Image:	69		Pimploli	18.4881	73.3214	7.14	373	239	15	44	11	9	1	0	189	14	1	11	0.1	BD	0.3	0.00
$\begin{bmatrix} 70 \\ 70 \end{bmatrix} = \begin{bmatrix} 18.7844 \\ 73.5067 \\ 7.61 \\ 6.55 \\ 7.61 \\ 6.55 \\ 7.61 \\ 6.55 \\ 7.61 \\ 6.55 \\ 7.61 \\ 6.55 \\ 7.61 \\$	70			10.7044	72 20/7	7.61	(25	101	5	1.5	20	24	1	0	200	22	10		7	L	3	0.20
	/0		Dneku	18./844	/3.306/	/.61	635	406	23	46	28	54	9	0	299	32	18	6	0.1	I RD	0.9	0.30

Sl.	Block	SITE	Latitude	Longitude	pН	EC	TD	Т	Ca	Μ	Na	K	C	HC	Cl	SO	NO	F	U	SA	RS
N		NAME	(N)	(E)			S	Н		g			O 3	O 3		4	3			R	С
0						μS/c m	<		•••••	•••••	mg	/L		•••••	•••••	.>			pp b		
71		Kopri	18.868	73.2288	7.57	382	244	16 5	38	17	11	1	0	183	18	12	2	0.1 6	BD L	0.3 7	- 0.30
72		Kegaon	18.882	72.9237	7.92	1057	676	35 5	74	41	68	1 1	0	494	67	30	3	0.2 0	BD L	1.5 8	1.00
73		Barapada	18.8563	73.0912	7.74	845	541	25 0	64	22	58	3 8	0	360	64	31	3	0.1 7	BD L	1.5 9	0.90
74		Talegaon	18.9242	73.1846	7.57	301	193	12 5	26	15	11	1	0	165	11	4	0	0.1 8	BD L	0.4 2	0.20
75		Warui	19.0743	73.3441	7.70	501	321	21 0	36	29	12	8	0	287	11	7	0	0.1 7	BD L	0.3 5	0.50
76		Chafewadi	19.138	73.4157	7.41	196	125	85	18	10	5	1	0	98	14	0	2	0.1 9	BD L	0.2 4	- 0.10
77		Kashale	19.0124	73.4204	7.59	605	387	22 0	40	29	31	9	0	171	57	21	85	0.1 8	BD L	0.9 2	- 1.60
78		Gorthan Bk	18.7797	73.2215	7.74	859	550	29 0	48	41	59	9	0	317	85	25	51	0.1 6	BD L	1.5 0	- 0.60
79		Donvat (Thakurwadi)	18.7908	73.252	7.62	349	223	14 0	30	16	14	1	0	177	18	6	1	0.1 7	BD L	0.5 2	0.10

Annexure V

Pre-Monsoon Trend

S.N	ID_SITE_ID	ID_SITE_NAME	Lat	Long	201	201	201	201	201	201	201	201	201	201		Pre-trend
о.					0	1	2	3	4	5	6	7	8	9		Final
1	W18052007306	Kelte	18.088	73.105	2.7	2.4	1.2	3.0	2.5	0.6	1.2	1.7	3.3	1.4	-	0.06381818
	2001		89	56			6	8			1			2	0.0638	2
															2	
2	W18041507324	Sochinde	18.070	73.4	4.1	2.2	1.3	1.5	3	1	1.1	1.3	3.7	0.6	-	0.14254545
	0001		83					3					2	7	0.1425	5
															5	
3	W18015507304	Saigaon	18.031	73.080	3.3	2.2	2.4	2.1	2.5	2	2.2	5	1.7	2.1	-	0.01212121
	5001	Govalwadi	94	56	5	1	2	8						4	0.0121	2
															2	
4	W18080607319	Temple	18.135	73.325	5.7	2.5	1.3	1.7	3.3	1.8	2.1	1.7	2.7	2.6	-	0.15054545
	3001					5	8	3		5	1			8	0.1505	5
															5	
5	W18080007334	Varandha	18.133	73.566	4.0	2.6	2.7	2.6	3.7	2.0	3	2.1	6.1	2.6	0.0485	-
	0001		33	67	5	7		4		5			5	3	45	0.04854545
																5
6	W18260007312	Phugaon	18.433	73.205	2.1	2.3	1.3	1.3	1.1	0.5	0.8	0.9	5.7	1.0	0.0601	-
	2001		33	56		5		6	2	7	5			5	21	0.06012121
																2
7	W18181007318	Kumbharcha	18.302	73.305	4.8	3.1	0.8	1.0	2	0.5	0.9	0.7	3.9	1.3	-	0.17363636
	2001	Kosta Bk	78	56		7	6	2		7	5			2	0.1736	4
															4	
8	W18413007259	Poynad	18.691	72.991	4.4	3.3	4.0	2.8	3.9	1.8	2.1	2.1	3.1	1.8	-	0.23169697
	3001		67	67			9				3			7	0.2317	
9	W18330007308	Nagothan	18.55	73.133	0.2	1.4	0.4	0.4	1.3	0	0.1	0.8	1.3	0.0	-	0.01381818
	0001			33			5	1			7	8		1	0.0138	2
															2	

S.N	ID_SITE_ID	ID_SITE_NAME	Lat	Long	201	201	201	201	201	201	201	201	201	201		Pre-trend
о.					0	1	2	3	4	5	6	7	8	9		Final
10	W18323307313	Pali	18.542	73.218	1.9	2.5	1.6	1.0	2.6	1.0	1.4	0.0	5.7	1.5	0.0583	-
	0801		5	89		4	7	8		5		1			64	0.05836363
																6
11	W18320507259	Bilji (Umta)	18.534	72.983	4.3	2.7	2.4	2.0	4.4	0.9	2.1	1.7	2.7	1.3	-	0.19975757
	0001		72	33				5		5	7			7	0.1997	6
															6	
12	W18284007300	Dapoli	18.477	73.008	2.6	1.7	0.7	0.3	3.4	0.9	1.8	1.5	3.4	0.9	0.012	-0.012
	3001		78	33		5	4	6		5	2					
13	W18270007306	Kharapati	18.45	73.1	2.5	1.3	3.7	1.6	1.9	0.6	2.7	1	2.7	0.8	-	0.10672727
	0001				5	1		3							0.1067	3
															3	
14	W18181007314	Indapur	18.302	73.238	2.7	4.1	0.6	5.6	2.7	0.2	1	0.0	5.1	1.3	-	0.15181818
	2001		78	89			5			5		1			0.1518	2
															2	
15	W18100007311	Chandore	18.166	73.183	4.6	5.8	2.6	2.6	4.8	2.2	1.5	1.2	3.4	8.9	0.0533	-
	0001		67	33			5				2				94	0.05339393
																9
16	W19014507319	Neral	19.029	73.325	2.6	2.7	1.8	1.4	3.3	2.1	2.6	3.2	2.3	2.5	0.0329	-
	3001		17				6	6			5		1		7	0.03296969
																7
17	W18571007309	Ajivali	18.952	73.15	3.3	2.2	1.8	1.6	2	1.4	0.9	2.2	4.4	2.6	0.0512	-
	0001		78			5	6	1			7	2	6		12	0.05121212
																1
18	W18553007307	Chinchwan	18.925	73.116	8.5	2.5	0.8	2.1	4.7	0.9	0.5	1.1	7.3	0.3	-	0.29090909
	0001			67	5	1		6							0.2909	1
															1	
19	W18544507319	Hudhre Budruk	18.912	73.319	3.3	1.1	0.2	0.6	1.3	0.7	0.3	0.0	3.7	0.0	-0.082	0.082
	1001	(Karjat	5	44				1				1		5		
20	W18494007317	Khalapur	18.827	73.284	2.9	2.8	1.9	1.6	3.7	2.6	2.7	3.3	2.6	2.9	0.0507	-
	0301		78	17			4	6	5		7		5	5	88	0.05078787
																9

S.N	ID_SITE_ID	ID_SITE_NAME	Lat	Long	201	201	201	201	201	201	201	201	201	201		Pre-trend
о.					0	1	2	3	4	5	6	7	8	9		Final
21	W18485007305	Jite	18.813	73.087	0.8	1.9	0.5	0.3	1.7	0	0.8	0.0	6.5	0.7	0.1709	-
	1501		89	5		3		8				1			09	0.17090909
																1
22	W18450007302	Veshwi	18.75	73.033	6.8	4.0	4.3	2.5	4.4	2.1	2.3	3.2	7.1	1.9	-	0.18727272
	0001			33		5	2	5		5				5	0.1872	7
															7	
23	W18433507317	Kargaon	18.726	73.298	2.9	0.7	0.9	1.2	1.3	0.0	1.3	0.8	3.5	0.5	-	0.01987878
	5501		39	61					4	5	1			2	0.0198	8
															8	
24	W17590007328	Poladpur	17.983	73.466	6.6	4	6.8	7.1	2.1	6.2	6.3	5.5	4.7	1.5	-	0.27618181
	0001		33	67				4	5		5	5			0.2761	8
															8	

Annexure VI

Post-Monsoon Trend

S.N	ID_SITE_ID	ID_SITE_NAME	Lat	Long	201	201	201	201	201	201	201	201	201	201		Post_trend
о.					0	1	2	3	4	5	6	7	8	9		Final
1	W17590007328	Poladpur	17.983	73.466	6.6	4.2	2.6	4.7	4.2	5.2	5.9	3.1	2.8	4.2	-	0.148060606
	0001		33	67			5	5						3	0.1480	
															6	
2	W18052007306	Kelte	18.088	73.105	1.7	2.4	1.2	3.0	2.5	0.6	1.2	1.7	1.3	1.4	-	0.094121212
	2001		89	56			6	8			1			2	0.0941	
															2	
3	W18041507324	Sochinde	18.070	73.4	4.1	2.2	1.3	1.5	3	1	1.1	1.3	1.8	0.6	-0.224	0.224
	0001		83					3						7		
4	W18015507304	Saigaon	18.031	73.080	1.7	2.2	2.4	2.1	2.5	2	2.2	5	1.9	2.1	0.0836	-
	5001	Govalwadi	94	56	5	1	2	8						4	36	0.083636364
5	W18260007312	Phugaon	18.433	73.205	0.8	2.3	1.3	1.3	1.1	0.5	0.8	0.9	1.2	1.0	-	0.059878788
	2001		33	56		5		6	2	7	5			5	0.0598	
															8	

S.N	ID_SITE_ID	ID_SITE_NAME	Lat	Long	201	201	201	201	201	201	201	201	201	201		Post_trend
о.					0	1	2	3	4	5	6	7	8	9		Final
6	W18213007301	Khutal	18.358	73.030	1.3	3.2	1.4	1.4	2.4	1.5	0.6	0.0	1.4	0.7	-	0.169151515
	5001		33	56			5	6		5		1		8	0.1691	
															5	
7	W18181007318	Kumbharcha	18.302	73.305	1.4	1	0.8	1.0	2	0.5	0.9	0.7	1.3	1.3	-	0.010242424
	2001	Kosta Bk	78	56	7		6	2		7	5			2	0.0102	
															4	
8	W18320507259	Bilji (Umta)	18.534	72.983	0.3	2.7	2.4	2.0	4.4	0.9	2.1	1.7	1.5	1.3	-	0.032484848
	0001		72	33				5		5	7			7	0.0324	
															8	
9	W18284007300	Dapoli	18.477	73.008	0.8	1.7	0.7	0.3	3.4	0.9	1.8	1.5	1	0.9	0.0056	-
	3001		78	33	5	5	4	6		5	2				36	0.005636364
10	W18270007306	Kharapati	18.45	73.1	0.8	1.3	3.7	1.6	1.9	0.6	2.7	1	0.6	0.8	-	0.100363636
	0001					1		3							0.1003	
	N/40400007044	Characteria	10.466	72 4 02	2.4	5.0	2.6	2.6	4.0	2.2	4 5	1.2	2.0	4.2	6	0.000040404
11	W18100007311	Chandore	18.166	/3.183	2.4	5.8	2.6	2.6	4.8	2.2	1.5	1.2	2.8	1.2	-	0.268242424
	0001		67	33			5				2			/	0.2682	
12	W18080607210	Tomplo	10 125	72 225	1 5	2 5	1 2	17	2.2	10	2.1	17	2.2	26	4	
12	2001	remple	10.155	/5.525	1.5	2.5	0	1./ 2	5.5	1.0 5	2.1	1./	2.7	2.0	0.0765	
12	3001 W/19090007224	Varandha	10 122	72 566	10	26	0 27	26	27	20	2	2.1	20	0 26	45	0.078343433
15	0001	Varanuna	22	67	4.0 5	2.0	2.7	2.0	5.7	5	5	2.1	2.0	2.0	-	0.095575758
	0001		33	07	5	/		4		5				5	0.0933 8	
14	W18330007308	Nagothan	18 55	73 133	05	1 4	0.4	0.4	1 3	0	0.1	0.0	1	03	-	0 050727273
14	0001	Nagothan	10.55	33	0.5	1.4	5	1	1.5	Ŭ	7	1	1	5	0.0507	0.030727273
	0001			33				-			, ·	-			3	
15	W18323307313	Pali	18.542	73.218	1.5	2.5	1.6	1.0	2.6	1.0	1.4	0.0	1	1.5	-	0.119212121
	0801		5	89		4	7	8		5		1	-		0.1192	
								-		-					1	
16	W19014507319	Neral	19.029	73.325	2.1	2.7	1.8	1.4	3.3	2.1	2.6	3.2	2.5	2.1	0.0464	-
	3001		17				6	6			5				85	0.046484848

S.N	ID_SITE_ID	ID_SITE_NAME	Lat	Long	201	201	201	201	201	201	201	201	201	201		Post_trend
о.					0	1	2	3	4	5	6	7	8	9		Final
17	W18571007309 0001	Ajivali	18.952 78	73.15	1.5	2.2 5	1.8 6	1.6 1	2	1.4	0.9 7	2.2 2	1.3	1.6 2	- 0.0381 2	0.038121212
18	W18553007307 0001	Chinchwan	18.925	73.116 67	1.2	2.5 1	0.8	2.1 6	4.7	0.9	0.5	1.1	1.4	0.3	- 0.1403	0.14030303
19	W18544507319 1001	Hudhre Budruk (Karjat	18.912 5	73.319 44	0.4 5	1.1	0.2	0.6 1	1.3	0.7	0.3	0.0 1	0.3	0.0 5	- 0.0707 9	0.070787879
20	W18494007317 0301	Khalapur	18.827 78	73.284 17	2.4	2.8	1.9 4	1.6 6	3.7 5	2.6	2.7 7	3.3	3	2.9 5	0.0929 09	- 0.092909091
21	W18485007305 1501	Jite	18.813 89	73.087 5	0.8	1.9 3	0.5	0.3 8	1.7	0	0.8	0.0 1	0.8	0.7	- 0.0709 1	0.070909091
22	W18450007302 0001	Veshwi	18.75	73.033 33	2.9 5	4.0 5	4.3 2	2.5 5	4.4	2.1 5	2.3	3.2	4.9	1.9 5	- 0.0706 1	0.070606061
23	W18413007259 3001	Poynad	18. 6 91 67	72.991 67	4.4	3.3	4.0 9	2.8	3.9	1.8	2.1 3	2.1	2.3	1.8 7	- 0.2656 4	0.265636364