K-5 Bhima Sub Basin

Salient Features

1) Geographical area	45.33 Lakh ha.
2) Cultivable area	38.10 Lakh ha.
3) Districts Covered	1. Pune 2. Solapur 3. Ahmednagar 4. Satara 5. Sangli 6. Beed 7. Osmanabad
4) Taluka covered	**Pune District**: Ambegaon, Junnar, Khed (Rajgurunagar), Haveli, Maval, Daund, Baramati, Velhe, Shirur, Mulashi, Indapur, Purandar, Bhor **Solapur District** : Malshiras, Madha, Karamala, Pandharpur, Sangola, Mangalvedha, Mohol, South Solapur, North Solapur, Akkalkot, Barshi **Ahmednagar District** :Shrigonda,Karjat,Parner. Nagar, Jamkhed,Pathardi. **Satara District** : Khandala,Phalatan,Man. **Sangli District** : Jat, Atapadi,Khanapur, Kavathe Mahankal **Beed District :** Ashti, Patoda **Osmanabad District:** Osmanabad,Tulajapur, Paranda, Bhum, Kalamb
5) Population (Lakh)	see table below
6) No. of Watersheds	197
7) Main River	Bhima
8) Main Tributories	Mula-Mutha, Kukadi,Meena,Chandani, Kamini, Moshi, Indrayani, Kumandala, Ghod, Bhama & Pavana, Sina, Nira, Bhogavati and Man
9) Geology	Deccan Trap (99.90%) Area - 45.29 Lakh Ha. Alluvial (0.10%) Area - 0.04 Lakh Ha.
10) Soils	
i) Soil type & Fertility	Class-I - Very good cultivable land - (0.12 %) Class-II- Good cultivable land - (22.74 %) Class-III- Moderately good cultivable land - (21.93 %) Class-IV- Fairly good land suitable for occasional cultivation - (37.39 %) Class-V- Nearly level land not suitable for cultivation because of stoniness wetness etc -(0.80 %) Class-VI- Steep slope highly erosion with shallow soil.-(12.44 %) Class-VII - Steep slope with severe soil erosion resulting in eroded stony and rough soil surfaces with shallow soil depth.-(4.03%) Class-VIII - Very steep slope with very severe soil erosion resulting in very eroded stony and rough soil surfaces shallow.-(0.56%)
ii) Soil suitability for crops	Sugarcane, Sorghum, Wheat, Bajra, Maize, Groundnut, Pulses, Upland paddy. Vegetables, Horticulture, Cotton
iii) Land Development	61.12 % area treated up to march 2013(watershed.)

5) Population (Lakh):

Year	Urban	Rural	Total
2011	79.16	87.92	167.08
2030	125.27	113.35	238.62

11) Land use pattern						
i) Agro climatic zone	Maximum area is under scarcity zone & partly under assured rainfall zone (Western part) & partly transition zone **I** & **II** (Western part).					
ii) Present Land use (Lac ha)	Forest- 3.18, Net sown area-29.79, Cultivable area – 38.10					
12) Hydrology						
i) Annual rainfall	Min. : 415 Max : 4240 Avg. : 688 mm					
ii) Surface water availability (Mm^3)	Dependability : 75% - 9484, 65% - 10686.35 50% - 12046.30 Average – 11439.24 (ref. Chapter – 6)					
iii) Water allocated as per Krishna Water dispute Tribunal Award	11214 Mcum (in TMC-395.94)					
iv) Categorization of sub basin Surface water available per ha of CA	2947 M^3/ha			Category : Deficit		
v) Groundwater availability (Mm^3)	3440 Mm3 & present use 3535 Mm3					
vi) No. of wells in sub basin	Command of irrigation projects - 124007 Non command area - 312895					
vi) Watersheds Nos. & category	Over Exploited:- 14 Critical:- 0, Semi Critical :- 28 Safe:-155 Total - 197					
13) Water Quality	**a) Surface water**			**b) Ground water (Polluted)**		
	Potable after treatment in rainy season / need disinfection must			No. of villages - Not available		
14) Water Balance	**Existing**			**Proposed (2030)**		
Dependability	**Average**	**65%**	**75%**	**Average**	**65%**	**75%**
A) Water Availability (Mm^3)						
i) Water Allocated by KWDT	11439	10686	9484	11439	10686	9484
ii) Recycling	1322	1322	1322	1482	1482	1482
iii) Re-generation	715	715	715	857	857	857
iv) Import from K-1 & Konkan west to east.	727	727	727	828	828	828
Surface water Total (i to iv)	**14203**	**13450**	**12248**	**14606**	**13853**	**12651**
v) Groundwater (70% of net)	3553	3553	3553	3440	3440	3440
Total Water Availability	**17756**	**17003**	**15001**	**18046**	**17293**	**15091**
B) Water Demand (Mm^3)	**Surface**	**GW**	**Total**	**Surface**	**GW**	**Total**
i) Domestic use	1159	153	1312	1245	234	1479
ii) Indsutrial use with power.	279	0	279	307	0	307
iii) Agricultural use	8502	3440	11942	8317	3206	11523
Total	**9940**	**3593**	**13533**	**9869**	**3440**	**13309**
vi) Export to K-6 & WWD Tata	1274	0	1274	1402	0	1402
Total	**11214**	**3593**	**14807**	**11271**	**3440**	**14711**
C) i) Water available for future use 75% Dependable yield (A-B)	-456			- 385		
ii) Water available for future use Average dependable yield	2949	2196	194	3335	2582	380

D) Watershed development programme

Total Area Lakh Ha	Worthy area Lakh Ha	Completed area Lakh Ha	Furure Lakh Ha
45.33	42.94	26.25	16.69

E) Irrigation Projects (Storage in Mm^3)

	Completed		On going		Future		Total	
	No.	Storage	No.	Storage	No.	Storage	No.	Storage
Major	5	3194	10	3429	--	--	15	6623
Medium	34	638	3	77	--	--	37	715
Minor (SS)	614	1312	17	125	--	--	631	1437
Minor (LS, ZP)	3692	926	312	83	163	84	4167	1093
Total	**4345**	**6070**	**342**	**3714**	**163**	**84**	**4850**	**9868**

F) Sectorial Allocation of water in Mm^3

Particular	**Present**			**Future year 2030**		
	Surface	**GW**	**Total**	**Surface**	**GW**	**Total**
Domestic	1159	153	1312	1245	234	1479
Industries	279	0	279	307	0	307
Agriculture	8502	3440	11942	8388	3206	11594
Total	**9940**	**3593**	**13533**	**9940**	**3440**	**13380**

G) Irrigation Potential

Sector	**2010**		**2030**	
	Area (Lakh Ha)	**% of CA of Sub basin**	**Area (Lakh Ha)**	**% of CA of Sub basin**
State sector (Project CCA>250 ha)	12.86	34	12.86	34
Local Sector (Project CCA:0 to 250 ha)	1.57	4	2.15	6
Groundwater Area	8.74	23	8.74	23
Total	23.17	61	23.75	63
Area on Micro irrigation System	1.92	4.24	3.84	8.47

Abbreviations used in the chapters

Sr No	Abbreviation	Full Form
1	ARG	Automatic Rain Gauge
2	ARWL	Automatic River Water Level
3	ATMA	Agricultural Technology Management Agency
4	BCM	Billion Cubic Meter
5	BOD	Biological Oxygen Demand
6	CADA	Command Area Development Authority
7	CCA	Cultivable Command Area
8	CCT	Continuous Contour Trenches
9	CDB	Coconut Development Board
10	Cumecs	Cubic Meters per Second
11	Cusecs	Cubic Feet per Second
12	CWC	Central Water Commission
13	D/S	Down stream
14	DIRD	Directorate Of Irrigation Research & Development
15	DSS	Decision Support System
16	FCS	Full Climatic Station
17	ft	feet
18	G.P.	Gram Panchayat
19	GCA	Gross Command Area
20	GDS	Gauging Discharge Station
21	GIS	Geographic Information System
22	GoM	Government of Maharashtra
23	GOS	Gate Operation Schedule
24	GPS	Global Positioning System
25	GR	Government Resolution
26	GSDA	Groundwater Survey and Development Agency
27	Ha	Hectare
28	Ha-m	Hectare Meter
29	HEP	Hydro Electric Project
30	HP	Hydro Power
31	ICA	Irrigable Command Area
32	ICAR	Indian Council for Agriculture Research
33	ID	Irrigation Department
34	IDMWR	Integrated Development And Management Of Water Resources
35	ISWP	Integrated State Water Plan
36	KTW	Kolhapur Type weir
37	KVRBA	Krishna Valley River Basin Agency
38	KWDT	Krishna Water Dispute Tribunal
39	LPCD	Liters per capita per day
40	LS	Local Sector
41	m	Meter
42	Mcft	Million Cubic Feet
43	Mcum	Million Cubic Meters
44	MIDC	Maharashtra Industrial Development Corporation
45	MJP	Maharashtra Jeevan Pradhikaran
46	MKVDC	Maharashtra Krishna Valley Development Corporation
47	MLD	Million Liter per Day
48	MoWR	Ministry of Water Resources
49	MPCB	Maharashtra Pollution Control Board

Sr No	Abbreviation	Full Form
50	MWIC	Maharashtra Water and Irrigation Commission (Jal-Sinchan Aayog)
51	MWRRA	Maharashtra Water Resources Regulatory Authority
52	NHM	National Horticulture Mission
53	O & M	Operation and Maintenance
54	RBA	River Basin Agency
55	ROS	Reservoir Operation Schedule
56	RS	Remote Sensing
57	RTDAS	Real Time Data Acquisition System
58	SOP	Standard Operation Procedure
59	SRG	Standard Rain Gauge
60	STP	Sewage Treatment Plant
61	SWOT	Strength, Weakness, Opportunities, Threats
62	SWP	State Water Plan
63	TCM	Thousand Cubic Meter
64	TMC	Thousand Million Cubic Feet
65	U/S	Up stream
66	WSD	Water Shed Development
67	WSS	Water supply scheme
68	WAR	Weighted Average Rainfall
69	WC	Water Conservation
70	WRD	Water Resources Department
71	WUA	Water Users Association
72	WWD	West Ward Diversion
73	ZP	Zilla Parishad

STATE WATER PLAN - INTEGRATED DEVELOPMENT & MANAGEMENT OF WATER RESOURCES OF UPPER BHIMA SUB BASIN (K-5)

INDEX

CHAPTER-1 – INTRODUCTION

1.0 NEED AND PRINCIPLES OF INTEGRATED DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES (IDMWR).

IDMWR is a process, which promotes the coordinated development and management of water, land and the related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystem and environmental aspects

The need and principle of preparing a master plan for IDMWR arises from the fact that the resource i.e. water is limited while its demand is vast for many purposes such as irrigation, drinking, industrial, energy generation, navigation etc. The various uses of water by storing, lifting and economical use need to be studied in view of losses of water either by evaporation, conveyance, leakages etc. Therefore the guiding factors for integration of water with various parameters like rainfall, runoff, ground water, geological and climatic conditions, irrigation for agriculture, water for drinking & industries, environment, type of soils etc. need to be studied so as to get equitable distribution (present and future) with respect to above parameters with maximum benefits at minimum cost.

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1.1. OBJECTIVES OF AN INTEGRATED STATE WATER PLAN FOR A BASIN.

The objectives of an integrated State Water Plan for a basin are:

a. To prepare a long term integrated plan for the development of the basin's surface and ground water resources.

b. To identify and set priorities for promoting water resources development projects

c. To formulate a short term action plan consistent with financial allocations and priorities of the State Government

d. To identify steps to promote water conservation and preservation and enhancement of water quality**.**

1.2. OBJECTIVES OF THE MAHARASHTRA STATE WATER POLICY

Integrated, Multi Sectoral and River Basin Approach to adopt an integrated and multi sectoral approach to water resources planning, development and management on a sustainable basis taking river basin / sub-basin as a unit. The water resources of the State shall be planned, developed managed with a river basin and sub-basin as the unit, adopting multi-sectoral approach and treating surface and sub-surface water with unitary approach. The management of the water resources of the State shall be decentralized to the lowest practicable level on the basis of hydrological or water shed units.

The State shall be divided into five river drainage basins and appropriate river basin agencies shall be established within each river basin. Water Resources
Development Corporations shall be established within each river basin. The river basin agencies shall have the responsibility and authority for the integrated planning, development and management of the water resources and water sheds of their respective river basins for flood management, drought management and operation and maintenance of water storage and delivery infrastructure. These river basin agencies shall prepare integrated river basin plans with effective inclusion and participation of representatives of all basin water user entities, categories of water users and other stake-holders. Such basin plan shall include a development plan, long term operation plan, a monitoring plan, comprehensive water shed management plan, an efficient improvement and water conservation plan and a waste minimization and water quality management plan.

1.3 STATE WATER PLAN

Based on the water resources management and development plans developed by the respective river basin agencies, the State shall prepare a State Water Resources Plan to promote a balanced development and by proper coordination among diverse water uses, which shall include structural measures, operational measures, watershed management measures, demand management measures such as conservation, scarcity scheduling and efficient technologies, water pollution control measures and monitoring measures that will assure comprehensive sustainable management of the water resources and equity in water distribution for the benefit of the State and its people."

1.4 KRISHNA BASIN

The river Krishna rises in the western ghats at an altitude of 1337 meters just north of Mahabaleshwar about 64 Km. from the Arabian Sea and flows from west to east through the States of Maharashtra, Karnataka and Andhra Pradesh before it joins to the bay of Bengal. The major tributaries of Krishna are Koyna, Warna, Panchganga, Dudhganga, Ghatprabha, Malprabha, Bhima, Tungabhadra, Musi, Palleru and Maneru.

The Government of India had appointed Krishna Godavari Commission in 1961 to review the position of availability of supplies in Krishna and Godavari rivers. Krishna Godavari Commission divided the Krishna basin into 12 sub-basins designated from K-1 to K-5, which has since been followed by Krishna Water Disputes Tribunals.

1.5 KRISHNA BASIN IN MAHARASHTRA STATE

Out of total catchment area 251369 Sq km of Krishna basin 69425 Sq km area lies in Maharashtra. Krishna basin in Maharashtra consists of part catchment area of 5 sub basins namely K-1, K-2, K-3, K-5 and K-6. The sub basin wise catchment areas of Krishna basin in Maharashtra as per page 47 of Hon. Bachawat Tribunal report are as under :

Table-1.1

Sr. No.	Sub basin	Drainage/ Catchment area in Maharashtra (sq.km)	Percentage Drainage/ Catchment area (sq.km)
1	**K-1-Upper Krishna**	**17128**	**24.67**
2	**K-2-Middle Krishna (Agrani)**	**1388**	**2.00**
3	**K-3-Ghatprabha**	**2010**	**2.90**
4	K-5-Upper Bhima	45335	65.30
5	**K-6-Lower Bhima (Bori Benitura)**	**3564**	**5.13**
	Total	69425	100

The Krishna River is the second biggest river in peninsular India. It then runs for a distance of 303 km in Maharashtra, 480 km through the breadth of North Karnataka and the rest of its 1300 km journey in Andhra Pradesh before it empties into the Bay of Bengal.

The Bhima River is a major tributary of Krishna river. It originates from a Jyotirling, named Bhimashankar in Ambegaon Taluka of Pune district. It flows southeast for 861 kilometres through Maharashtra, Karnataka, and Telangana states, before confluence with the Krishna River at Kadlur (Raichur) in Karnataka. . After the first sixty-five kilometers in a narrow valley through rugged terrain upto Khed (Rajgurunagar) taluka of Pune district, the banks open up and form a fertile agricultural area which is densely populated.

1.6 LOCATION OF UPPER BHIMA SUB-BASIN (K-5)

Sr. No.	Name of Sub basin	Latitude		Longitude		Catchment Area in SqKm
		From	To	From	To	
1	**Upper Bhima**	**17.18 N**	**19.24 N**	**73.20 E**	**76.15 E**	**45335**

Source:- MWIC report vol.-II, pg. no. 285 & 309

The index map is attached as Map no 1.1.

1.7 RAIN FALL VARIATION IN UPPER BHIMA SUB BASIN (K5)

Rainfall variation in Upper Bhima Sub basin (K5) ranges from maximum 4240 mm to 415 mm, with an average of 688 mm.
(Source:- MWIC report vol.-II, pg. no. 369 & 444)

1.8 CATCHMENT AREA

1.8.1. Total Catchment Area of Upper Bhima Sub Basin (K5) & Area in State

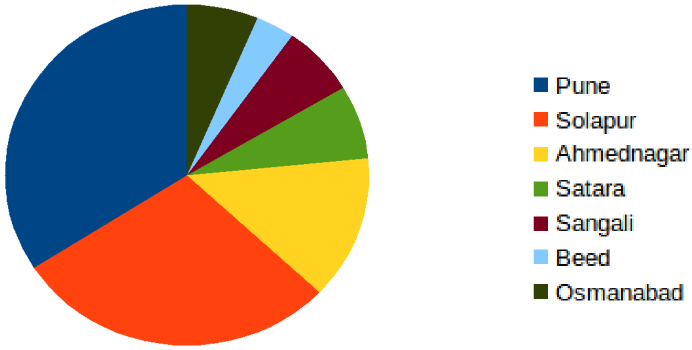
Catchment area of K5 basin (Sq.Km)	Catchment area of k5 in State (Sq.Km)	Percentage Catchment area in state
45335	**45335**	**100 %**

Source: - KWDT report 1976, vol.-I, chapter-III, pg. no. 14

1.8.2. Districts falling in Upper Bhima Sub Basin K5) & their areas.

Sr. No.	Name of District	Population in Lakhs (2011)	Area (Sqkm)
1)	**Pune**	**94.30**	**15483**
2)	**Solapur**	**43.29**	**13055**
3)	**Ahmednagar**	**13.25**	**6180**
4)	**Satara**	**8.49**	**3168**
5)	**Sangali**	**3.96**	**3013**
6)	**Beed**	**1.59**	**1567**
7)	**Osmanabad**	**2.20**	**2869**
	Total	167.08	45335

Figure No. 1 – District wise Percentage of sub basin area



1.8.3 - TALUKAS IN SUB BASIN :

Talukas covered	**Pune District:** Ambegaon, Junnar, Khed (Rajgurunagar), Haveli, Maval, Daund, Baramati, Velhe, Shirur, Mulashi, Indapur, Purandar, Bhor **Solapur District :** Malshiras, Madha, Karamala, Pandharpur, Sangola, Mangalvedha, Mohol, South Solapur, North Solapur, Akkalkot, Barshi **Ahmednagar District** :Akola Shrigonda,Karjat,Parner. Nagar,Jamkhed,Pathardi. **Satara District :** Khandala,Phalatan,Man. **Sangli District** : Jat, Atapadi,Khanapur, Kavathe Mahankal **Beed District :** Ashti, Patoda **Osmanabad District**: Osmanabad,Tulajapur, Paranda, Bhum, Washi,Kalamb

The tahsil map is attached as map no 1.2.

1.9 DISTRICT WISE DEMOGRAPHIC PROFILE OF THE SUB BASIN

1.9.1 – District wise Demographic Profile

Name of District	RURAL Year 2011 - population	RURAL Year 2030- population	URBAN Year 2011 - population	URBAN Year 2030 - population
Pune	34.60	45.20	59.70	92.65
Satara	7.72	10.50	0.77	8.75
Sangli	3.53	4.45	0.43	0.55
Solapur	29.05	36.60	14.24	17.93
Osmanabad	1.98	2.59	0.22	0.37
Beed	1.59	1.95	0.00	0.00
Ahmednagar	9.45	12.10	3.80	5.02
TOTAL K-5	**87.92**	**113.39**	**79.16**	**125.27**

(Source- MJP chapter 12 table 12.2)

1.9.2 TOPOGRAPHICAL DESCRIPTION

Upper Bhima Subbasin (K5) covers part of Deccan platue on eastern side of Sahyadri ranges. .Area divided in two parts 1.Ghat area and 2.Non Ghat area.

Area of basin	Elevation in 'M'(MSL)	
	From	To
Ghat area (Sahyadri ranges)	1170	900
Non Ghat area (Other than Sahyadri ranges)	748	439

Source: - MWIC report Volume -II, pg. no. 365,399,421,

The origin of Bhima river at Bhimashankar lies in the mountain ranges of Sahyadri mountain which is on the western part of Indian peninsula.. The river flows eastward / southwards from the origin. At the southern end, there are the mountains of Balaghat in the district of Osmanabad.

Satellite image of Upper Bhima sub basin is attached as Map no 1.3 & the transport network map is attached as map no 1.4.

CHAPTER-2 – RIVER SYSTEM

2.1 Introduction -The Krishna river and it's tributaries are an interstate river system flowing through the states of Maharashtra, Karnataka and Andhra pradesh. Krishna Water Dispute Tribunal (KWDT) has classified Krishna Basin in 12 sub-basins. Out of 12 Sub-basins of Krishna river. Drainage area of five sub basins namely K1, K2, K3, K5 & K6 are covered in Maharashtra state. .

2.2 Status of Rivers & Tributaries in Upper Bhima Sub basin (K-5)

The Bhima river is main river in upper Bhima sub basin,(K-5) . It originates at Bhimashankar Dist Pune., The details of length and catchment area of rivers in sub basin are as below.

Table-2.2.1 Details of rivers and tributaries -

Sr. No.	Name of river	Length (Km)	Catchment Area (Sqkm)	Origin	Elevation (m)	Confluence	Elevation (m)	Average Gradient
1	Bhima	861	13943	Bhima shankar	700	Krishna (A.P)	343	1:770
2	Bhama	53						
3	Indrayani	83		Apti	900	Pargaon (Mula River)		
4	Vel	60						
5	Pawana	55	113	Mula	900	Dapodi (Mutha)	439	1:119
6	Mula	50	2872	Mazgaon		Pargaon	522	
7	Mutha	63.5		Dawzer	900	Khadki (Mula)	564	1:189
8	Ghod	170	4574	Gawadewadi	1000	Daund Bhima)	498	1:339
9	Mina	53		Amboli		Ghod		
10	Kukadi	85		Ghatghar		Shirur ghod)	562	
11	Pushpawati	35		Khireshwer		Kukadi		
12	Nira	209	7073	Shirgaon	1170	Narsingpur	463	1:295
13	Man	154	4750	Kulakjai	900	Sarkoli (Bhima)	439	1:334
14	Sina	300	12010	Juar-Ahmednagar	748	Kudal-Solapur	413	1:896

The spread of the sub basin under study lies in the following districts and talukas.

Table-2.2.1 (a) – Spread of the Sub basin

Particulars	Districts	Taluka
2	3	4
Sub Basin Upper Bhima K-5	Pune	1.Ambegaon 2.Junner 3. Khed 4.Haveli 5. Mawal 6. Daund 7. Baramati 8.Velhe 9.Shirur 10. Mulshi 11. Indapur 12.Bhor 13.Purandar
	Ahmednagar	1.Shrigonda 2. Karjat 3.Parner 4.Jamkhed 5.Pathardi 6.Ahmednagar
	Satara	1.Khandala 2.Phaltan 3.Man
	Sangali	1.Jat 2.Atpadi 3. Kavtemahankal
	Solapur	1.Sangola 2.Mangalvedha 3.North Solapur 4.South Solapur 5.Mohol 6.Pandharpur 7.Malshiras 8.Madha 9.Karmala 10.Barshi 11. Akkalkot
	Beed	1.Ashti 2.Patoda
	Osmanabad	1.Osmanabad 2.Tuljapur 3.Paranda 4.Bhum 5.Kalamb 6.Washi

Topographical Description

The topographical description showing the four sides of the basin is as under

Table-2.2.1 (b) – Boundaries of Sub basin

Sr. No.	Direction	Particulars
1	North	Upper Godawari Basin
2	East	Sub Basin Lower Bhima K-6 (Bori-Benitura)
3	West	Sahyadri Mountains and konkan
4	South	Sub Basin Upper Krishna K-1 , Sub Basin Middle Krishna K-2 and Karnataka state

The other prominent features regarding this sub basin such as topographical area watersheds, cultivable area, population etc as are under

Table-2.3 – Other prominent features -

Sr.No.	Features	Unit	Quantity
1	Topographical Area	Sq.km	45335
2	Watersheds	No.	197
3	Main Tributaries	No.	13
4	Villages	No.	3100
5	Main Urban Centers (Nagar Parishad)	No.	28
6	Mahanagarpalika	No.	4
7	Population (2011)	Lakhs	167.08
8	Cultivable Area	Thousand Ha.	3810
9	Groundwater Net Availability	Mm^3	3440

2.3 Geomorphology :

About 25 % of the area in the Sub-basin (up to Ujani) is hilly & highly dissected,55 % is plateau & 20 % plain & valley filled. About 14 % of the area in Nira Component is hilly & highly dissected, 55 % is moderately dissected & 31 % is undissected and valley filled. Generally 8% of the area in the D / S of Ujani including Man Component is hilly & highly dissected 72 % is moderately dissected & 20 % is undissected and valley filled. In the Sina Component 16 % area is highly dissected & hilly,61% is plateau and 23 % is plains & valley filled.

Chapter -3 Geology And Soils

3.1 GEOLOGY

3.1.1 Introduction

The Upper Bhima Sub Basin (K5) covers an area of **45335** sq km. which includes parts of Pune, Ahmednagar, Solapur, Sangli, Satara, Beed and Osmanabad districts comprising 197 watersheds. Annual rainfall in the Upper Bhima Sub-Basin varies between **415 mm to 4240 mm .** The maximum rainfall occurs in Maval taluka of Pune district and minimum rainfall occurs in Parner taluka of Ahmednagar district. Groundwater availability in the sub-basin is controlled by topography, geomorphology, lithology and geo-hydrology of the surface and sub-surface rocks.

3.1.2 Geology

The Upper Bhima Sub Basin (K5) is mainly covered by Deccan trap lava flows. The Deccan trap is vast pile of volcanic lava flows laying one over the other and is more or less uniform in chemical composition. It includes the other volcanic products such as tuff, breccias, ash beds etc. In current geological literature the stratigraphy of the various rock formations is divided into the following categories. The Deccan Trap lava flows have been considered as horizontal beds. But some of the section indicates that many of the flows have dips ranging between 5 to 40 meters per kilometer. The lava flows can broadly be divided into following categories.

1) Compact and massive basalt
2) Vesicular basalt
3) Amygdaloidal or zeolitic basalt
4) Flow breccias.

Compact, massive and zeolitic trap occur in almost in upper part of the Upper Bhima Sub Basin. The age of lava flows in the sub-basin is from upper cretaceous to lower Eocene. In general individual lava flows, vary gently in thickness from few meters to as much as forty meters.

Western part of the sub-basin (Pune district), the fresh basalts are dark to grey in colour. They vary from being fine grained non-prophyritic to coarsely porphyritic varieties. The porphyritic variety is seen in the villages in Shirur and Ambegaon talukas and the Purandar plateau of the district. Between the successive flows red coloured clay like material is observed and is termed as red bole. These are essentially ferruginous clayey horizons and are useful in marking the flows. Conspicuous Red bole horizons are observed along Pune-Saswad Road in Dive Ghat, in Karha river bed at Saswad, along Pune-Nagar Road . Opposite to temple at Ranjangaon Ganpati, along Pune-Nasik Road, at Eklahare village and along Satara Road in Katraj Ghat.

Thickness of individual flows varies from 5 to 30m. The basalts are intruded by dykes. Dyke is a discordant magma intrusion which cut across the bedding or other structure of invaded rock. The widths vary from one meter to as much as ten meters. Such dykes are observed 3 km. west of Saswad, east of Talegaon-Dabhade near Railway station and in Indrayani river bed,east of Alandi. The dykes are cut by joints parallel to the walls, at right angle to the walls besides horizontal ones, with chilled margins.

Occurrence of flow Breccia is reported from many places of Purandhar taluka (viz. village Vanpuri in Purandar). The district renewed for the rare and beautiful well developed crystals of zeolites of different varieties. These zeolites are found all over the district in excavations, quarries etc.

At northern part of the sub-basin (Ahmednagar district) the thickness of the lava flows varies from 1.5 m to about 20 m, while some sections exceptionally extends up to 30 m. the flow have great lateral extension in comparison to their thickness. Individual flows have been traced for distances of 30KM and more. The lavas are generally horizontal in disposition through slight deep at some places has been reported. These lava flows have been observed to be intruded by discordant intrusions of doleritic rock. These dykes vary considerably in their dimensions and are not evenly distributed. Occurrence of dykes have been observed in Akola (near Rajur), Parner (Pabal) tahsils. Similarly, the occurrence of volcanic breccia (at village Wadzire) and volcanic bombs have also been reported crystals of zeolites are found in various parts of the district.

Porphyritic basalts are found in Parner, Nagar Tahsils. In the ordinary flows, the top is fine grained and the lower portion coarser, sometimes having a concentration of basic minerals. Vesicular and non- vesicular flows may alternate with each other or may be separated by thin beds of red-boles.

Columnar, joints of considerable dimensions (1.5 to 2 m in diameter and upto 3 m in height) are reported at village Kotul of Shrigonda tahsil, occurrence of such columnar joints is also reported in villages namely, Supa, Kadus in Parner tahsil, Akolner and Jeur village of Nagar tahsils. In the basin colluviums are also observed along the sina and Bhima rivers in Nagar, Karjat, Jamkhed and Shrigonda tahsils.

As moving towards the south and south-east of the sub-basin (Solapur district) the 27 flows have been reported so far. At places, red bole, separating the two flows has been observed. It is predominantly seen in Sangola Taluka and in parts of Malshiras and Karmala Talukas. Generally the basalts are either massive with grey colour, pinkish with vesicles and of amygdaloidal nature. In most of the cases the vesicles are filled with zeolites and secondary silica group minerals. In typical flow unit the lower portion is generally massive which passes upwards in a vesicular or amygdaloidal horizon. Vesicles and amygdules increase towards the top of the flow unit which merges into red bole and in-turn is overlain by the massive zone of the next younger flow unit. The Red bole, which is found on the upper portion of pink zeolitic basalt, varies in thickness from few cms. to about 8 metres. The origin of Red bole is controversial. However, it is of great importance in the district from the point of view of groundwater occurrence. At some places, e.g. in Sangola taluka, vesicular basalt is of brecciated nature which is not favorable from groundwater point of view.

In the south-west part of sub-basin (Sangali and Satara district), at some places thin lava flows are broken in innumerable blocks mostly the orientation of the joints are at right angle to the cooling surface of the lava flows. The top most layer of the lava flow is pinkish in colour and give rise to appearance clay like material. This top most layer when weathered is known as red bole. At few places the red bole formation was noticed in the form of columnar nodule like structure at the contact of two flows. In some of the villages porphyritic basalt are also noticed.

At the north-east area (Osmanabad and Beed district) of Sub-basin the Deccan Trap have the tendency to form flat top hills giving rise to plateau comprising of lava flows each ranging from few meters upto 30 meters in thickness. The traps when fresh, are dark gray to pale brown in colour and are fine-grained in their texture. The individual flow units in some areas are separated by thick layers of red clay material named as red bole. The occurrence of such red bole formation is widely seen in this area of sub-basin.

[Source: - 1.1 An Appraisal of Hydrogeological conditions of Sangali (1975). 1.2 An Appraisal of Hydrogeological conditions of Pune (1975), 1.3 An Appraisal of Hydrogeological conditions of Ahmednagar(1975), 1.4 An Appraisal of Hydrogeological conditions of Solapur (1975), 1.5 An Appraisal of Hydrogeological conditions of Satara, Sangali (1975) 1.6 An Appraisal of Hydrogeological conditions of Osmanabad, Beed (1978). Directorate of Groundwater Survey and Development Agency, Government of Maharashtra.]

Map showing Faults and Lineaments in Upper Bhima Sub Basin (K-5) is attached as Map no 3.1.

3.2 SOILS

3.2.1 Introduction :

The Krishna river rises in the Western Ghats, at an elevation of about 1337 m just north of Mahabaleshwar. It flows for about 1400 km and outfalls into the Bay of Bengal. The principal tributaries joining Krishna are the Ghataprabha, the Malaprabha, the Bhima, the Tungabhadra and the Musi.

Most of this basin comprises rolling and undulating country, except for the western border, which is formed by an unbroken line of the Western Ghat. The important soil types found in the basin are black soils, red soils, laterite and lateritic soils, alluvium, mixed soils, red and black soils and saline and alkaline soils.

3.2.2 Land Capability Classification in Upper Bhima Sub Basin (K5)

Land capability Classification of Upper Bhima Sub Basin (K5) is given in table .below. The suitable land for cultivation of this sub-basin is 82.18% with very good cultivable land of 0.12 % ,then 22.74 % good cultivable land, 21.93 % moderately good cultivable lands and 37.39 % is fairly good land suitable for occasional cultivation.

Table-3.2.2 Land capability classification in the area of in Upper Bhima Sub -Basin (K5)

Sr. No.	Land Capability class		K5 Sub Basin (Lakh ha.)	% of total area in each class
1	Class-I	Very good cultivable land	0.05	0.12
2	Class-II	Good cultivable land	10.31	22.74
3	Class-III	Moderately good cultivable land	9.95	21.93
4	Class-IV	Fairly good land suitable for occasional cultivation	16.95	37.39
	Total Area of arable class (useful for crop production)		**37.26**	**82.18**
5	Class-V	Nearly level land not suitable for cultivation because of stoniness wetness etc	0.36	0.80
6	Class-VI	Steep slope highly erosion with shallow soil.	5.64	12.44
7	Class-VII	Steep slope with severe soil erosion resulting in eroded stony and rough soil surfaces with shallow soil depth.	1.82	4.02
8	Class-VIII	Very steep slope with very severe soil erosion resulting in very eroded stony and rough soil surfaces shallow.	0.25	0.56
	Total area of non arable class (useful for live stock production, forestry, recreation, tourism and wildlife)		**8.07**	**17.82**
	Total		**45.33**	**100.00**

3.2.3 – Soil Depth Classification of in Upper Bhima Krishna Sub -Basin (K5)

The soils depths in Middle Krishna Sub Basin (K2) are given in the Table No.2. The percentage of Extremely shallow is 12.22% very shallow to Shallow is 40.90% followed by deep soils, slightly deep to moderately deep and extremely shallow soils is 18.16% and deep soils above 45 cm depth is of 28.72%

Table-3.2.3– Soil Depth Classification of in Upper Bhima Krishna Sub -Basin (K5

Sr.No	Depth Range (cm)		Area (%)
1	Extremely shallow	0 – 7.5	12.22
2	very shallow to Shallow	7.5 - 25	40.90
3	Slightly deep to Moderately deep	25 - 45	18.16
4	Deep	45 & above	28.72

Table 3.2.4 Fertility status of soils in Upper Bhima Krishna Sub -Basin (K5)

Sr. No.	Soil Property	No. of soil sample analyzed	Class	No. of samples observed	%
1	**pH**	302674	Acidic	62950	20.80
			Neutral	223848	73.96
			Alkaline	15876	5.25
2	**EC (ds/m)**	302674	Low	298938	98.77
			Medium	2394	0.80
			High	1342	0.44
3	**N**	302674	Low	-	-
			Medium	1.44	100
			High	-	-
4	**Available P**	302674	Low	1.11	100
			Medium	-	-
			High	-	-
5	**Available K**	302674	Low	-	-
			Medium	-	-
			High	2.60	100

Maps showing (1) Soil Texture & (2) Soil Erosion in Upper Bhima Sub Basin (K-5) are attached as Map no 3.2 & 3.3 resp.

Table-3.2.5 – Soil Series in Upper Bhima Krishna Sub -Basin (K5)

Sr.No.	Soil Properties	Soil Series Shahuwadi	Soil Series Gargoti	Soil Series 3 Ajra	Soil Series Chandgad	Soil Series Satara	Soil Series Phaltan	Soil Series Wai	Soil Series Walwa	Soil Series Shirala	Soil Series Vitha
1	2	3	4	5	3	3	3	3	3		3
1	Physiographic	North Sahyadri : Sprus	North Sahyadri : Eastern hill slopes and naoorw vallies	North Sahyadri : Escarpment	North Sahyadri : Disseceted hills with narrow vallies	North Sahyadri : Disseceted hills with narrow vallies	North Deccan Maharashtra Upper Plateau Plain lands	North Sahyadri : Disseceted hills with narrow vallies	North Deccan Maharashtra Upper Plateau unduleting land	North Deccan Maharashtra Upper Plateau unduleting land	North Deccan Maharashtra Upper Plateau Plain lands
2	Parent material	Basalt & Weathered basalt	Basalt & Weathered basalt	Laterytic Basalt & laterite	Basalt & laterite	Basalt & Weathered basalt	Basalt & Weathered basalt	Basalt & Colluvium	Basalt & basaltic alluvium	Basalt & Weathered basalt	Basalt & Weathered basalt
3	Mode of forma	Weathering	Weathering	Weathering	Weathered laterite basalt	Weathering	Weathering	Rock(Basalt)	Weathered basalt	Weathering basalt	Weathering
4	Soil depth	Ap, B1t, B2t	Ap, B1, B21t, B22t	A, B1, B2, B3	A, B1, B2,B3	A, Cr	Ap	A, R	Ap, Bw,Bss,B2	Ap	Ap, B1, B2
5	Texture	Fine loamy, mixed, isohyperthermic, Udic Rhodustalfs.	Fine, mixed, isohyperthermic, Udic Rhodustalfs.	Fine loamy, mixed, isohyperthermic,Typic Haplustepts	Fine loamy, mixed, isohyperthermic, Typic Haplustepts	loamy, mixed, isohyperthermic, Lichic Ustorthents.	Loamy- skeletal, mixed(cal), isohyperthermic, Typic Ustorthents	Clayey, loamy, mixed, isohyperthermic, Lichic Ustorthents.	Fine montmorillonitic(cal), isohyperthermic, Typic Haplustepts	Clayey - skeletal, mixed(cal), isohyperthermic, Lichic Ustorthents.	Fine montmorillonitic(cal), isohyperthermic, Typic Calciustepts
6	Structure	Sandy clay loam	clay	Clay :loam	clay loam	clay loam	clay loam	Clay loam	clay	Clay Loam	clay
7	Sub surface dra	Well drained & moderate permeability	Somewhat excessive & moderate permeability	Well drained & moderate permeability	Somehot excessively & moderate permeability	Well drained & rapid permeability	Well drained & moderately slow permeability	Well drained & moderate permeability	moderately Well drained & very slow permeability	Well drained & moderate permeability	moderately Well drained & very slow permeability

Sr.No.	Soil Properties	Soil Series Junner	oil Series Ambegao	Soil Series Bhor	il Series Koregao	il Series Purand	Soil Series Mohol	Soil Series Beed
1	Physiographic	North Deccan Maharashtra Upper Plateau unduleting land	North Deccan Maharashtra Upper Plateau unduleting land	North Deccan Maharashtra Upper Plateau Foot Hills	North Deccan Maharashtra Upper Plateau gently sloping lands/Vally	North Sahyadri : highly Disseceted hills ranges with escarpments	North Deccan Maharashtra Upper Plateau unduleting land	North Deccan Maharashtra Lowerr Plateau Summits
2	Parent material	Basalt & Weathered basalt	Basalt & Weathered basalt	Basalt & Weathered basalt	Basalt & alluvium	Basalt	Basalt & basalt	Basalt basalt
3	Mode of formation	Weathered basalt	Weathered basalt	Weathered basalt	Weathering	Hard Basalt	Hard Basalt	Weathering basalt
4	Soil depth	Ap,	Ap,	A	Ap, Aw,Bss1,Bss2,Bss3	A, R	Ap	Ap, B
5	Texture	Loamy- skeletal, mixed(cal), isohyperthermic, Lichic Ustorthents.	Fine loamy, mixed, isohyperthermic, Udic Rhodustalfs.	loamy, mixed, isohyperthermic, Lichic Ustorthents.	Fine montmorillonitic(cal), isohyperthermic, Typic Haplustepts	Clayey - skeletal, mixed(cal), isohyperthermic, Lichic Ustorthents.	loamy, mixed, isohyperthermic, Lichic Ustorthents.	Clayey, montmorillonitic(cal), isohyperthermic, Typic Haplustepts
6	Structure	Sandy clay loam	clay loam	clay loam	clay	clay	loam	clay
7	Sub surface drainage	Somehot excessively & moderate permeability	Well drained & moderate permeability	Well drained & moderate permeability	Well drained & slow permeability	Somehot excessively drained & moderate permeability	Well drained & moderate permeability	Well drained & slow permeability

Chapter-4 – Hydrometeorology

4.1 Introduction

Hydrometeorology is a branch of meteorology that deals with problems involving the hydrologic cycle, the water budget, and the rainfall statistics of storms. Rainfall is the most important input for the water resources of a basin. A clear understanding of the rainfall pattern in the basin and its spatial and temporal variability is thus essential. Other Metrological parameters like wind speed, normal sunshine hours, radiation, humidity, maximum and minimum temperature are important for crop planning.

The Catchment area of Upper Bhima sub basin is 45335 sq.km. The sub basin is roughly fern shaped.

4.2 Rainfall Phenomena

(a) Pattern

The occurrence of water from atmosphere is in form of rain, dew and rarely in hails. However it is mainly in the form of rain in this sub basin. It occurs from formation of monsoon trough mostly in June to October and rarely due cyclonic showers in April & May.

(b) Hydro Meteorological Network

In the Upper Bhima (K5) sub basin, there are 59 raingauge stations, 27 Gauge Discharge stations and 9 Full Climatic Stations, which have been maintained by Hydrology Project, Nasik and Water Resources Department, Government of Maharashtra.

The details of these stations are given in Annexure –4.I

Further GD stations are also setup under CWC and HP (SW) Maharashtra for Interagency validation. List of such stations are as displayed below.

GD Station under CWC

S.No.	Name of station
1	Dhond
2	Sarati
3	Wadakbala
4	Takli

GD Station under HP(SW) Maharashtra

S.No.	Name of station
1	Pargaon
2	Late
3	Bandalgi
4	Barur(Takli)

(c) Rainfall Distribution

i) Temporal Distribution

Most of rainfall occurs between June to October. Rest of the months is mostly dry. The rainfall data for the period of 1980 to 2013 is observed. It is found that the maximum daily rainfall occurred at Shirgaon rain gauge station and it was 502mm.

ii) Spatial Distribution

Rainfall recorded by rain gauge is point observation. However rainfall varies in space. This space variation is accounted for working out weighted average rainfall over the catchment by Thiessen polygon method. The Weighted Annual Rainfall (WAR) over various raingauge stations is summarized below.

Sr. No.	Rainguage Station	Max. Rainfall (mm)	Min. Rainfall (mm)	Avg. Rainfall (mm)
1	Hingani hatiz	1221	331	776
2	Ujjani	1131	431	826
3	Panshet	6414	2505	4460
4	warasgaon	7670	2612	5141
5	Khadakwasla	5085	1973	3529
6	pawana	4762	2109	3436
7	Tata lakes	4888	2226	3557
8	Wadiwale	5330	1569	3450
9	Vir	2162	857	1510
10	Bhatghar	5658	1992	3825
11	Mulshi Tata	5803	1313	3694
12	Andhra Tata	3064	1009.	2344
13	Dimbhe	3558	1438	2470.
14	Wadaj	2497	941	1625
15	Manikdoh	6750	1939	4142
16	Yedgoan	1721	894	1210
17	Ghod	1081	522	851
18	Mhasawad	913	256	536

19	Mangi	1097	212	574
20	Hingani Pangoan	1285	401	752
21	Ekrukh	1161	266	691
22	Sina nimgoan	914	198	513
23	Mulshi tata	5881	1313	3597
24	Waranji RGS	3484	1483	2434
25	Samdoti RGS	2929	908	1454
26	Terwad	3431	1779	2427
27	Vandurs	3614	1633	2790
28	Wastewad RGS	3226	1406	2342
29	Kurund RGS	1788	775	1376
30	Pandegoan RGS	746	209	481
31	Gotur RGS	2993	911	1500
32	Daddi RGS	4022	1819	2489
33	Sarati RGS	1066	355.54	749.14
34	Dound RGS	1920	762	1293
35	Takali RGS	942	486	716
36	Wadakbal RGS	977	245	624

Source ;- Design Division under KWDT cell

4.3 Meteorology

The Upper Bhima (K5) Sub Basin is in semi-arid climate. The major meteorological attributes are temperature, humidity, evaporation, wind direction and speed and sun shine hours. If we observe the metrological data from 2002 to 2013, the minimum temperature observed at these stations was 5 deg Celsius and maximum temperature was 46 deg Celsius.

The hydrological parameters are useful in analysing the quantum of water available in the basin while the meteorological parameters are useful to work out the crop water requirement and seasonal irrigation planning.The various metrological parameter on dated 25/04/2015 are shown below.

Sr N0	Name of station	Location Dist./Taluka	Wind speed (m/sec)	Wind Direction	Atmo spheric pressur e (hpa)	Tempe rature (ºC)	Humi dity (%)	Solar radiation (w/m2)
1	Pimpalwandi	Pune/Junnar	937	2.52	257	35	7.4	1087
2	Chaskaman	Pune/Khed	945	2.41	286	34.4	19.6	986
3	Nighoji (parner)	Ahemednagar/Parner	937.7					
4	Ashti Damsite	Ahemednagar/Karjat	957.3	2.36	223	38.3	8.2	1134
5	Nighoje	Pune/Khed	941.4	2.74	284	35.8	20.7	1041
6	Nimgaon gangurde	Ahemednagar/Karjat	940.1	0.3	320	38.7	7	937
7	Shikrapur	Pune/Shirur	940.8	2.46	206	37.5	10.3	1027
8	paragaon	Pune/Daund	947.6	0.91	139	37.6	24.4	1055
9	kashti	Ahemednagar/Shrigonda	948.3	0.95	22	37.8	10.8	983
10	kolawadi	Ahemednagar/Karjat	947	1.66	214	37.2	7.6	1034
11	kadakwasla	Pune/Haweli	944.1	1.51	260	33.8	26.4	892
12	Sakhar	Pune/Velhe	934.8	1.59	219	33.4	22.1	1180
13	Umbrekasurwadi	Pune/Bhor	936.7	0.52	38	35.7	0	999
14	Nazare	Pune/Purandar	935.2	1.71	351	37.1	8.5	997
15	Barhanpur	Pune/Baramati	946.5	1.63	225	37.5	6.2	1066
16	Late	Pune/Baramati	950.1	0.79	342	38.2	7.8	973
17	Bhigwan	Pune/Indapur	950.4	1.69	228	37.3	9.8	1020
18	Bhimanagar	Solapur/Madha	948.8	0.92	76	38.2	10.8	983
19	Rosa	Solapur/Karmala	954.8	0.61	200	39	8.7	973
20	Malshiras	Solapur/Malshiras	947.3	1.43	322	36.9	6.5	696
21	Nannaj	Solapur/North solapur	952.2	0.87	231	38.3	9.1	1055
22	Mangalwedha	Solapur/Mangalwedha	957.7	0.72	171	39.1	8	1106
23	Sangola	Solapur/Songola	952.3	2.64	264	38.3	6.5	1006
24	Takli Barur	Solapur/south solapur	957	1.71	253	37.9	9.8	1007
25	Bhoom	Osmanabad/Bhoom	943.2	1.81	335	37.5	9	567

Source :- http://www.rtsfros.com/mahakrishna

4.4 Real-time data acquisition system

Real Time Decision Support System: Maharashtra (Tool developed under World Bank aided, India Hydrology Project-II)

Background:

The Water Resources Department (WRD) of Government of Maharashtra (GoM) is entrusted with the surface water resources planning, development and management. A large number of major, medium and minor water resources development projects (reservoirs and weirs) have been constructed in Maharashtra. Though, the reservoirs in Maharashtra are not specifically provided with flood cushion, they have moderated flood peaks to considerable extent by proper reservoir operations. The reservoirs are multipurpose including hydropower, irrigation, domestic and industrial uses and are operated with rigid schedules as single entities based on the historical hydro-meteorological data and experience gained. These methods are often not adequate for establishing optimal operational decisions, especially where integrated operation of multiple reservoirs for flood management is contemplated. In addition, manual data observation and transmission results in a considerable time lag, between data observed in field and its communication to decision making level which sometime leaves little time, for flood forecasts.

The Ministry of Water Resources (MoWR), Government of India (GoI) has initiated Hydrology Project Phase II (HP-II), which is a follow-on to the concluded Hydrology Project-I (HP-I:1995-2003). During HP-I, the Hydrological Information System (HIS) was developed for the entire state of Maharashtra and the data is monitored manually 1-2 times a day. Validated hydro meteorological data is being made available for planning and management of water resources of the state in scientific manner. Data is also being made available for research activities and other water resources purposes. Under HP-II project, Decision Support System (DSS) for water resources planning and management is developed for Upper Bhima basin as a pilot.

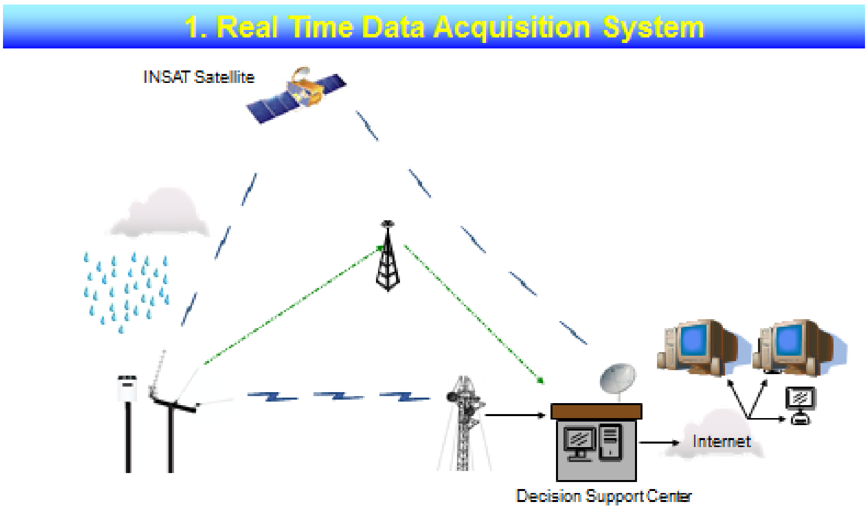
During the Mid-term review taken by World Bank in October 2009 as a part of India Hydrology Project –II, the Real time decision support system comprising of Real Time Stream flow Forecasting and Reservoir Operation System based on real time data acquisition system was proposed for Krishna bhima basin of state.

Under this Hydrology Project-II, Water Resources Department, Government of Maharashtra has now upgraded the existing HIS with real time data acquisition system (RTDAS) for Krishna and Bhima basins. Simultaneously, developed a real time streamflow forecasting (RTSF) and reservoir operation system (ROS) in Krishna and Bhima river basins to manage the floods and operate reservoirs optimally for multiple uses.

The system is facilitating reservoir operators to act on time and prepare stakeholders for the floods. The forecast of river flow and mapping of flood zone will help in taking the decisions such as evacuation of the likely affecting areas well in advance. In addition, the reservoir operation system would facilitate the optimization of the storages for ensuring flood cushion and improving agricultural productivity.

The Basin Simulation Division at SinchanBhavan, Pune is established in April 2008 as one of the recommendation of the committee appointed under chairmanship of Retired Principal Secretary, WRD, GoM,Shri. Nandkumar D. Vadnere for study of floods of 2005 and 2006 in Krishna basin and provide guidance and state of art technology to be used in flood forecasting. The Basin Simulation Division and Hydrology Project Division were involved in installation and commissioning of RTDAS and also RTSF and ROS model development activities.

In **Krishna and Bhima Basins** total 249 Real time hydro meteorological data collection stations (RTDAS) are installed and commissioned under HP II (viz. Automated Rainfall Stations, Automated Full Climate Stations, Automated River /canal Water Level (Stage) & Discharge Station, Automated Reservoir Water Level & Outflow Discharge Stations). Also spillway gates of dams are now equipped with gate sensors. The rainfall, climate parameters (viz. max min temperature, relative humidity, wind velocity, wind direction, barometric pressure, solar radiation), water level of reservoir and river gauging sites, gate sensor opening for spillway gates are measured using sensors. The sensors are installed at prominent locations in the basins (rivers, dams, dam catchments, etc.). The data is collected and transmitted in real time through VSAT/GSM mode. The conceptual picture of RTDAS is shown below.



The important equipment model used in RTDAS is tabulated below;

List of models used in RTDAS

Sr No	Item	Model
1	Data Collection Platform	H5000-S
2	VSAT Radio & Antenna	Sky Edge Pro (XC Band)
3	GSM/GPRS Modem & Antenna	Daul Band EGSM TMA-M37i and TMN-51t
4	Shaft Encoder	SE-1
5	Radar Sensor	FMR 240 (40 & 70 m range)
6	Bubbler Sensor	H3553
7	Full Climate Station Sensors	Xport ET
8	Precipitation/Rainfall Sensor	TB4
9	Gate Sensor	MECH_GMS
10	Solar Power & Battery	MECH_OBCS
11	A/D Expansion Module	MECH_04_04_04
12	VSAT Master Station	Sky Edge Pro (XC Band)
13	Servers	X3100 M4 /Higher
14	Acoustic Doppler Current Profiler (ADCP)	M9

The number of stations in RTDAS network installed for Krishna Bhima basin are as below and station wise details are given in **Annexure 4.2;**

RTDAS Network in Krishna and Bhima River Basins

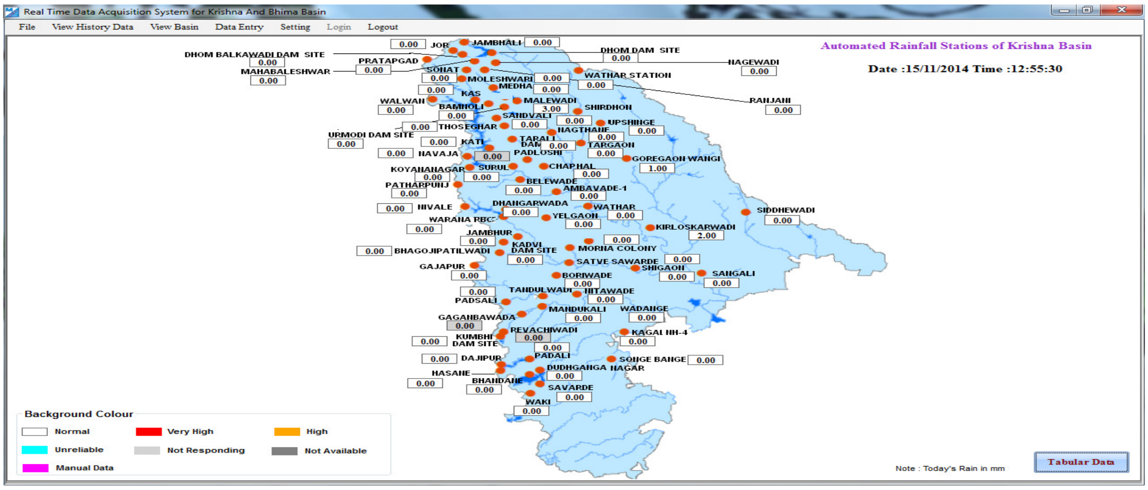
Sr No	Description	Number of stations
1	Automated Rainfall Stations	127
2	Automated Full Climate Stations	39
3	Automated River water Level and River Discharge Stations	31
4	Automated River water Level and River Discharge Stations combined with Automated Rainfall Stations	03
5	Automated River water Level and River Discharge Stations combined with Automated Full Climate Stations	03
6	Automated Reservoir water Level and outflow Discharge Stations	27
7	Automated Reservoir water Level and outflow Discharge Stations combined with Automated Rainfall Stations	19
	Total	249

Real time decision support centre for Krishna and Bhima basin is established at Sinchan Bhavan Pune. Data is being received via VSAT/ GSM communication to servers at Pune. This data is made available to stakeholders on project website; http://www.rtsfros.com/mahakrishna at Real time data menu.

The real time data is useful to know rainfall distribution, climate, water levels or storages of reservoirs, water level and discharges of the rivers on real time basis.

The sample snap shots are shown below;

Automated Rainfall Station



4.4 Action plan for setting up hydro-meteorological stations

We need to predict hydro-meteorological parameters both for designing water resources project as well as for the management of water resources. However, for a given catchment area, we must have sufficient number of meteorological stations so that our predictions stands confirmed.

The current positions of number of stations for Upper Bhima (K5) basin as against the standard norm is given below. We must assure that the norms should be strictly adhered to understand hydro-meteorology of the basin with desired degree of accuracy.

The norm for setting up Hydro-meteorological stations & current scenario

Area of Upper Bhima Sub basin (K5) 45335 Sqkm

S.N.	Type of Station	Present no. of stations	Norm	Required No. of stations
1	Standard Rain Gauge Station	47	1/500 sqkm	91
2	Automated Rain Gauge Station	12	1/5000 sqkm	9
3	Gauge Discharge Station	27	1/1500 sqkm	31
4	Full Climate Station	9	1/5000 sqkm	9

Source :- Design Division under KWDT cell

References for norms:

Sr. no. 1 & 2 : Hydrology Project (Technical Assistance) January 2001
Design Manual, Volume 3 - Hydro-meteorology, (WMO 1994)
Table 3.2 - Minimum density of precipitation stations, Pg 29

Sr. no. 3 : Hydrology Project (Technical Assistance) January 2001
Design Manual, Volume 4 - Hydro-metery,
Table 3.1 - Minimum density of hydrological network according to WMO

Sr. no. 4 : Hydrology Project (Technical Assistance) January 2001
Design Manual, Volume 3 - Hydro-meteorology, (WMO 1994)
Table 3.4 - Minimum evaporation network per state
Para 3.3.3 - Minimum evaporation network

Annexure 4.1

Details of Hydro Metrological Stations in K5 sub basin

1) Gauge Discharge stations

No.	Station	River	Tributary	Stream	Station Setup
1	Aamdabad	Krishna	Bhima	Ghod	GD
2	Ambeghar	Krishna	Bhima	Nira	GD
3	Askheda	Krishna	Bhima	Bhama	GD
4	Bandalgi	Krishna	Bhima	Sina	GD
5	Barhanpur	Krishna	Bhima	Karha	GD
6	Barur	Krishna	Bhima	Bhima	GD
7	Budhawadi	Krishna	Bhima	Kundalika	GD
8	Chaskman	Krishna	Bhima	Bhima	GD
9	Dattawadi	Krishna	Bhima	Mutha	GD
10	DeogharBhor	Krishna	Bhima	Nira	GD
11	Devikavathe	Krishna	Bhima	Bhima	GD
12	Kashti	Krishna	Bhima	Ghod	GD
13	Khamgaon	Krishna	Bhima	Mula-Mutha	GD
14	Late	Krishna	Bhima	Nira	GD
15	Nighoje	Krishna	Bhima	Indrayani	GD
16	PANDHARPUR	Krishna	Bhima	Bhima	GD
17	Pargaon	Krishna	Bhima	Bhima	GD
18	Paud	Krishna	Bhima	Mula	GD
19	PimpaleGurav	Krishna	Bhima	Pawana	GD
20	Rakshewadi	Krishna	Bhima	Bhima	GD
21	Rosa	Krishna	Bhima	Sina	GD
22	Sakhar	Krishna	Bhima	Gunjawani	GD
23	Shirur	Krishna	Bhima	Ghod	GD
24	SidhewadiSol	Krishna	Bhima	Man	GD
25	Umbre	Krishna	Bhima	Gunjawani	GD
26	Velhe	Krishna	Bhima	Kanand	GD
27	Wegre	Krishna	Bhima	Mutha	GD

2) Full climatic Station (FCS)

No.	Station	River	Tributary	Stream	Station Setup
1	Barur	Krishna	Bhima	Bhima	FCS
2	Chaskman	Krishna	Bhima	Bhima	FCS
3	Kashti	Krishna	Bhima	Ghod	FCS
4	Pargaon	Krishna	Bhima	Bhima	FCS
5	PimpaleGurav	Krishna	Bhima	Pawana	FCS
6	Rosa	Krishna	Bhima	Sina	FCS
7	Sakhar	Krishna	Bhima	Gunjawani	FCS
8	SidhewadiSol	Krishna	Bhima	Man	FCS
9	Wegre	Krishna	Bhima	Mutha	FCS

3) Standard Rain Gauge (SRG) Stations

No.	Station	River	Tributary	Stream	Station Setup
1	Alandi	Krishna	Bhima	Indrayani	SRG
2	Ambeghar	Krishna	Bhima	Nira	SRG
3	Askheda	Krishna	Bhima	Bhama	SRG
4	Bandalgi	Krishna	Bhima	Sina	SRG
5	Barhanpur	Krishna	Bhima	Karha	SRG
6	Budhawadi	Krishna	Bhima	Kundalika	SRG
7	ChichondiP	Krishna	Bhima	Sina	SRG
8	Chikhalgi	Krishna	Bhima	Bhima	SRG
9	Devikavathe	Krishna	Bhima	Bhima	SRG
10	Dhavals	Krishna	Bhima	Sina	SRG
11	Hingangaon	Krishna	Bhima	Bhima	SRG
12	Jamkhed	Krishna	Bhima	Sina	SRG
13	KasegaonSol	Krishna	Bhima	Sina	SRG
14	Katphal	Krishna	Bhima	Bhima	SRG
15	KatrajTunnel	Krishna	Bhima	Mula_Mutha	SRG
16	Khamgaon	Krishna	Bhima	Mula-Mutha	SRG
17	Kolgaon	Krishna	Bhima	Palsi	SRG
18	Koliye	Krishna	Bhima	Bhama	SRG
19	Kumbheri	Krishna	Bhima	Mula	SRG
20	Kurwandi	Krishna	Bhima	Vel	SRG
21	Late	Krishna	Bhima	Nira	SRG
22	Mahud	Krishna	Bhima	Man	SRG
23	Malshiras	Krishna	Bhima	Bhima	SRG
24	Mangalvedha	Krishna	Bhima	Bhima	SRG
25	Manikdoundi	Krishna	Bhima	Sina	SRG
26	Mulshi	Krishna	Bhima	Mula	SRG
27	Narsinhpur	Krishna	Bhima	Nira	SRG
28	Nighoje	Krishna	Bhima	Indrayani	SRG
29	Pathari Tank	Krishna	Bhima	DeogaonNalla	SRG
30	Paud	Krishna	Bhima	Mula	SRG
31	PimpalgaonJ	Krishna	Bhima	Arr	SRG
32	Rakshewadi	Krishna	Bhima	Bhima	SRG
33	RanjangaonG	Krishna	Bhima	Bhima	SRG
34	Saswad	Krishna	Bhima	Bhima	SRG
35	Shikrapur	Krishna	Bhima	Vel	SRG
36	Shirgaon	Krishna	Bhima	Nira	SRG
37	Shirur	Krishna	Bhima	Ghod	SRG
38	Supa	Krishna	Bhima	Hanga	SRG
39	Tembhurni	Krishna	Bhima	Bhima	SRG
40	Thitewadi	Krishna	Bhima	Vel	SRG
41	Umadi	Krishna	Bhima	Doddanalla	SRG
42	Umbre	Krishna	Bhima	Gunjawani	SRG
43	Velhe	Krishna	Bhima	Kanand	SRG
44	Whiram	Krishna	Bhima	Bhama	SRG
45	Andhali	Krishna	Bhima	Man	SRG
46	Atpadi	Krishna	Bhima	Man	SRG
47	Rajewadi	Krishna	Bhima	Man	SRG

4) Automatic Rain Gauge (ARG) Station

No.	Station	River	Tributary	Stream	Station Setup
1	DeogharBhor	Krishna	Bhima	Nira	ARG
2	Diksal	Krishna	Bhima	Bhogawati	ARG
3	Ghisar	Krishna	Bhima	Kanand	ARG
4	Khandala	Krishna	Bhima	Indrayani	ARG
5	Khed	Krishna	Bhima	Bhima	ARG
6	Kodapur	Krishna	Bhima	Kanand	ARG
7	Madha	Krishna	Bhima	Sina	ARG
8	Nimgaon G	Krishna	Bhima	Sina	ARG
9	Pangari	Krishna	Bhima	Nira	ARG
10	Pimpalwandi	Krishna	Bhima	Kukadi	ARG
11	Sangola	Krishna	Bhima	Man	ARG
12	Wagholi	Krishna	Bhima	Mula-Mutha	ARG

Source :- http://www.rtsfros.com/mahakrishna

ANNEXURE-4.2

LIST OF RTDAS STATIONS IN BHIMA BASIN

Sr. No	Location	Telemetry	Category	Basin
1	Nighoje	GSM	AFCS	Bhima
2	Ambegahar	GSM	ARS	Bhima
3	UmbreKasurdi	GSM	AFCS	Bhima
4	Barhanpur	GSM	AFCS	Bhima
5	ChinchodiPatil	GSM	ARS	Bhima
6	Nazare	GSM	AFCS	Bhima
7	Katraj Tunnel	GSM	ARS	Bhima
8	NimgaonGangurde	GSM	AFCS	Bhima
9	Dattawadi	GSM	ARWL & RDS	Bhima
10	KoregaonBhima	GSM	ARWL & RDS	Bhima
11	Nighoj (Parner)	GSM	AFCS	Bhima
12	Chaskaman	GSM	AFCS	Bhima
13	Sangvi (Near Dam)	VSAT	ARS	Bhima
14	Manikdoh Dam	VSAT	ARWL & ODS+ARS	Bhima
15	Hirdoshi	VSAT	ARS	Bhima
16	Chaskaman Dam	VSAT	ARWL & ODS+ARS	Bhima
17	Shirgaon	VSAT	ARS	Bhima
18	Paud	GSM	ARWL & RDS	Bhima
19	Kalyani Nagar Bridge	VSAT	ARWL & RDS	Bhima
20	Khadakwasala	VSAT	ARWL & ODS	Bhima
21	Yedgaon	VSAT	ARWL & ODS	Bhima
22	Bhatghar	VSAT	ARWL & ODS	Bhima
23	Pabal	GSM	ARS	Bhima
24	Shikrapur	GSM	AFCS	Bhima
25	Chandoh	GSM	ARS	Bhima
26	Kolawadi (Karjat)	GSM	AFCS	Bhima
27	Shrigonda	GSM	ARS	Bhima
28	Kolgaon	GSM	ARS	Bhima
29	Karmala	GSM	ARS	Bhima
30	Rosa	GSM	AFCS	Bhima
31	Bhoom	GSM	AFCS	Bhima
32	Pangare	GSM	ARS	Bhima
33	Koliye	GSM	ARS	Bhima
34	Kharoshi	GSM	ARS	Bhima
35	Waki Bk.	GSM	ARS	Bhima
36	Ozar	GSM	ARS	Bhima
37	Madh	GSM	ARS	Bhima
38	Bhudhawadi	GSM	ARS	Bhima
39	Khandala (Lonavla)	GSM	ARS	Bhima
40	NimgaonKetki	GSM	ARS	Bhima
41	Khamgaon	GSM	ARS	Bhima

42	Kashti	GSM	AFCS	Bhima
43	Pargaon	GSM	AFCS	Bhima
44	Bori Dam	GSM	AFCS	Bhima
45	Mangalwedha	GSM	AFCS	Bhima
46	Sangola	GSM	AFCS	Bhima
47	Bhalawani	GSM	ARS	Bhima
48	Dharmpuri	GSM	ARS	Bhima
49	Umadi	GSM	ARS	Bhima
50	Malshiras	GSM	AFCS	Bhima
51	Panshet Dam Site	VSAT	ARWL & ODS + ARS	Bhima
52	Vir Dam Site	VSAT	ARWL & ODS + ARS	Bhima
53	Pawana Dam Site	VSAT	ARWL & ODS + ARS	Bhima
54	Wadiwale	VSAT	ARWL & ODS + ARS	Bhima
55	Palasdev	GSM	ARS	Bhima
56	Bhigvan	GSM	AFCS	Bhima
57	Sansar	GSM	ARS	Bhima
58	Dimbe Dam Site	VSAT	ARWL & ODS + ARS	Bhima
59	Warasgaon	VSAT	ARWL & ODS	Bhima
60	Ujjani	VSAT	ARWL & ODS	Bhima
61	Andhali	GSM	ARS	Bhima
62	Chilewadi	VSAT	ARWL & ODS	Bhima
63	Morgaon	GSM	ARS	Bhima
64	Saswad	GSM	ARS	Bhima
65	Temghar Dam Site	VSAT	ARS	Bhima
66	Ashti	GSM	AFCS	Bhima
67	Temghar	VSAT	ARWL & ODS	Bhima
68	Wadaj	VSAT	ARWL & ODS	Bhima
69	Nannaj	GSM	AFCS	Bhima
70	Diksal	GSM	ARS	Bhima
71	Bhimanagar	VSAT	AFCS	Bhima
72	Davadi Camp	VSAT	ARS	Bhima
73	Mulshi	VSAT	ARWL & ODS	Bhima
74	Bhattiwaghdara	VSAT	ARS	Bhima
75	Savale	VSAT	ARS	Bhima
76	Mau	GSM	ARS	Bhima
77	Banganga Dam	GSM	ARS	Bhima
78	Ghisar	VSAT	ARS	Bhima
79	Khodad	GSM	ARS	Bhima
80	BhamaAskheda	VSAT	ARWL & ODS+ARS	Bhima
81	Rajapur	GSM	ARS	Bhima
82	Amboli	GSM	ARS	Bhima
83	KasarSai	VSAT	ARWL & ODS+ARS	Bhima

84	Ghod	VSAT	ARWL & ODS	Bhima
85	Pimpalgaonjoga	VSAT	ARWL & ODS+ARS	Bhima
86	Ambegaon	VSAT	ARS	Bhima
87	Chilewadi	GSM	ARS	Bhima
88	Nira Deoghar	VSAT	ARS	Bhima
89	Bhutonde	VSAT	ARS	Bhima
90	Kurunje	GSM	ARS	Bhima
91	Paragaon	GSM	ARWL & RDS	Bhima
92	Amdabad	GSM	ARWL & RDS	Bhima
93	Pimpale Gurav	VSAT	ARWL & RDS	Bhima
94	Andhara	VSAT	ARWL & ODS+ARS	Bhima
95	Kasthi	GSM	ARWL & RDS	Bhima
96	Pandharpur	VSAT	ARWL & RDS	Bhima
97	Nazare	VSAT	ARWL & ODS	Bhima
98	Umbre Kasurdi	GSM	ARWL & RDS	Bhima
99	Velhe	GSM	ARS	Bhima
100	Nighoje	GSM	ARWL & RDS	Bhima
101	Nira Narsinhpur	VSAT	ARWL & RDS	Bhima
102	Late	GSM	ARWL & RDS+AFCS	Bhima
103	Sina Kolegaon	VSAT	ARWL & ODS	Bhima
104	Nigade	GSM	ARS	Bhima
105	Khamgaon	GSM	ARWL & RDS	Bhima
106	Nira Deoghar	VSAT	ARWL & ODS	Bhima
107	Sina	VSAT	ARWL & ODS	Bhima
108	Kalmodi	VSAT	ARWL & ODS	Bhima
109	Sakhar	GSM	AFCS	Bhima
110	Siddhewadi	GSM	ARWL & RDS+ARS	Bhima
111	Alandi	GSM	ARS	Bhima
112	Ujjani LBC	GSM	ACWL & CDS	Bhima
113	Vir LBC	GSM	ACWL & CDS	Bhima
114	Vir RBC	GSM	ACWL & CDS	Bhima
115	Khadakwasala	GSM	ACWL & CDS +ARS	Bhima
116	Takli	GSM	AFCS	Bhima
117	Khireshawar	GSM	ARS	Bhima
118	Pimpalwandi	GSM	AFCS	Bhima
119	Shirvali	VSAT	ARS	Bhima
120	Whiram	GSM	ARS	Bhima
121	Amboli (junnar)	GSM	ARS	Bhima
122	Bhimashankar	VSAT	ARS	Bhima
123	Ghotewadi	VSAT	ARS	Bhima
124	Khandala (Pargaon)(Mhavashi)	GSM	ARS	Bhima
125	Kole	VSAT	ARS	Bhima
126	Kumbheri	VSAT	ARS	Bhima
127	Pangari	VSAT	ARS	Bhima

128	Warasgaon (Saiu)	VSAT	ARS	Bhima
129	Aundhe	GSM	ARS	Bhima
130	Dasawe(Lawasa)	GSM	ARS	Bhima
131	Ahupe	VSAT	ARS	Bhima
132	Asane	VSAT	ARS	Bhima
133	Mhaswad	GSM	ARS	Bhima
134	Madha	GSM	ARS	Bhima
135	Kivale (Tathwade)	GSM	ARS	Bhima
136	Bhalwadi	GSM	ARS	Bhima
137	Paragaon Tarfe Ale	GSM	ARWL & RDS	Bhima
138	Shirkoli	VSAT	ARS	Bhima
139	Yerwada	GSM	ARS	Bhima
140	Visapur	VSAT	ARWL & ODS	Bhima

Source :- http://www.rtsfros.com/mahakrishna

Sr. No.	Description	Number of station
1	Automated Rainfall Station	69
2	Automated Full climate Stations	24
3	Automated River water Level and River Discharge Stations	14
4	Automated River water level and River Discharge Stations combined with Automated Rainfall Stations	1
5	Automated River water Level and River Discharge Stations combined with Automated Full Climate Station	1
6	Automated Reservoir water Level and Outflow Discharge Stations	16
7	Automated Reservoir water Level and Outflow Discharge Stations combined with Automated Rainfall Stations	11
	Total	136

Chapter-5 AGRICULTURE

5.1 Introduction:

Agriculture is the main source of livelihood for more than 52 % of the population in rural areas. The arrival of monsoon and its distribution over the state of Maharashtra decides the production and productivity of food grains and other crops. Hence, the sustainability of agricultural production relies mainly on arrival of monsoon. It also governs the volume of water in irrigation reservoirs, limiting the area under irrigation in different cropping seasons. Therefore, state has the natural limitations for agricultural production in irrigated and scarcity areas.

The main source of production is expected from the irrigated command areas of major, medium and minor projects. The state government is continuously striving for increasing the production and productivity of rainfed as well as of irrigated agriculture. Accordingly various schemes and projects are initiated and effectively implemented in the State by Agriculture Department. But it was necessary to improve productivity of water of irrigated agriculture by intensification and diversification under irrigation projects.

The need to grow more food was felt during the 19^{th} Century because of the increasing pressure of population. According to the recommendation of Famine Commission(1881), Agriculture Department was established in 1883. Work started with the aim of helping the rural community to achieve higher productivity in agriculture. Agriculture and Land Records Departments were functioning together till 1907. After getting encouraging results in an effort made during 1915-16 to stop soil loss, Mr Kitting, the then Agriculture Director started soil conservation work from 1922.

Agriculture Department took up various land development activities with the enactment in 1942 and subsequent enforcement of Land Development Act in 1943. For the first time in 1943, the then Government prepared a comprehensive Agriculture Policy considering the problems in agriculture and allied sectors. According to this policy, emphasis was given on use of water as irrigation for agricultural crops.

The post independence period from 1950 to 1965 is recognized as pre Green Revolution period. During this period several schemes were launched to boost growth of agriculture sector. Production of quality seeds through Taluka Seed Farms started during 1957. Emphasis was given on increase in irrigated area along with cultivated area during this period. A special campaign was launched in 1961-62 to encourage use of chemical fertilizers.

Development of hybrid varieties of different crops since 1965-66 laid down the foundation of Green Revolution. Five year plans following this period specially emphasized development of agriculture. Nala bunding work was taken up along with land development work by the department since 1974 which led to increase in wells and ground water level. Introduction of intensive agriculture, comprising of large scale use of improved seed, fertilizers, pesticides and available water helped increase in agriculture production. Later on, considering the need for providing guidance to the farmers for proper and judicious use of these inputs, Training and Visit Scheme was launched in 1981-82. Valuable contribution of this scheme through effective implementation of programs like Crop Demonstrations, Field Visits, Corner meetings, Workshops, Fairs, Exhibitions etc. aimed at transfer of technology from Agriculture Universities to farmers fields was evident from the increased agricultural production.

Though we have become self sufficient in food grain production inspite of the tremendous increase in population, self sufficiency in agriculture is not the only aim of the state but assurance of more and more net income to the farmers through the efficient and sustainable use of available resources is more important. To achieve this, commercial agriculture should be practiced. Different schemes are implemented to increase agricultural production, export promotion and to encourage the agro processing industry with a view to take advantage of liberalized economy and Global trade. Thus, agriculture department is firmly stepping towards economic progress along with self sufficiency through agriculture and to achieve important position in the global agriculture produce market. The innovative horticulture plantation scheme under employment guarantee scheme implemented since 1990-91 by the state is a part of this policy.

Recently the Department of Agriculture Government of Maharashtra is using the Information Communication technology to make the agriculture services more farmer driven and accountable.

5.2 Land Use Pattern in Upper Bhima Sub -Basin (K5)

The land use pattern of districts in Upper Bhima Sub basin **(K5)** is given in the Table No.5.1. The total cultivable area of this Sub-basin is 78.41% of the geographical area of total sub basin. It includes the district wise areas spread in this sub basin. Net sown area is 65.70% and area sown more than once is 18.76 % whereas the gross cropped area of this sub-basin is 74.01%

5.2.1 Land Use Pattern in Upper Bhima Sub -Basin (K5) (Area: lakh ha.)

Sr.No.	Land Use Classification	Total K5 Sub Basin	(%)
1	Geographical Area	45.33	100.00
2	Forest	3.18	7.01
3	Barren & uncultivable.	2.98	6.57
4	Land Under Non- Agril use	1.07	2.36
5	Culturable Waste land	0.00	0.00
6	Permanent Pasture	0.00	0.00
7	Misc.Trees & groves	0.00	0.00
8	Current Fallow	5.24	11.56
9	Other Fallow	0.00	0.00
10	Cultivable Area	38.10	84.05
11	Net Area Sown	29.78	65.70
12	Area Sown more than once		
13	Gross Cropped area	33.55	74.01
14	Cropping Intensity %		

5.3 Land Holding in Upper Bhima Sub -Basin (K5):

In Upper Bhima Sub -basin (K5) the percentage of marginal holding is 14.91%, small 25.21% and others is 59.88% to the total land holdings. The average holding of this sub-basin is1.55 ha.

Table-5.3.1 – Land Holding in Upper Bhima Sub -Basin (K5)

Sr.No.	Category	Range of Holding	No. of Farmers	Area (Ha)	Average Area Per Head (Ha)
1	Marginal	0-1	1322000	626472	0.47
2	Small	1 -2	741919	1059236	1.43
3	Other s	Above 2	651514	2516291	3.86
	Total K5		**2715427**	**4201991**	**1.55**

(Source : Agri Census 2010-11)

5.4. Area & Production for various Crops in Upper Bhima Sub -Basin (K5)

Area & Production for various Crops in Upper Bhima Sub Basin (K5) is given in the table below. This sub- basin is having maximum area under cereals (47.40%), oil seeds (13.98%) and sugarcane (19.27%) and pulses (14.91%).

Table-5.4.1 Area & Production for various Crops in Upper Bhima Sub -Basin (K5)

Sr.No	Crop	Total Area of Crop in Sub Basin “00”ha.	Avg. yield of crops in sub basin Kg/ha	State Avg. Kg/ha.
1	Rice	2646	2318	1925
2	Kh. Jowar	1199	1203	1152
3	Bajra	4144	930	1035
4	Ragi	433	1370	1144
5	Kh. Maize	1311	3441	3541
6	Other Kh. cereals	145	494	533
7	**Total Kh. cereals**	**6896**	**2408**	**1860**
8	Tur	987	637	906
9	Mung	236	1062	483
10	Udid	372	607	617
11	Other pulses	764	431	444
12	**Total Kh. Pulses**	**1359**	**608**	**742**
13	Kh Ground Nut	1721	1303	1211
14	Kh seasamum	42	316	272
15	Nigger	70	294	321
16	Kh Sunflower	97	580	609
17	Soybean	3510	1917	1214
18	Castor seed	39	362	369
19	**Total Kh Oil seeds**	**4425**	**2052**	**1187**

Sr.No	**Crop**	**Total Area of Crop in Sub Basin "00"ha.**	**Avg. yield of crops in sub basin Kg/ha**	**State Avg. Kg/ha.**
20	**Sugarcane**	**6666**	**89.52**	**82**
21	**Cotton**	4468	1737	**361**
22	R. Jowar	15145	614	693
23	Wheat	2820	1497	1461
24	R Maize	1180	2415	2472
25	Other Rabi cereals	19	345	396
26	**Total Rabi cereals**	**19164**	**855**	**1041**
27	Gram	2741	803	891
28	Other Rabi pulses	**59**	**464**	**452**
29	**Total Rabi pulses**	**2800**	**795**	**864**
30	Safflower	125	391	576
31	Linseed	32	259	263
32	Rabi seasamum	2	282	284
33	Sunflower	99	746	617
34	Other Rabi oilseeds	9	150	356
35	**Total Rabi oilseeds**	**267**	**498**	**516**
36	Su. rice	2	2954	2292
37	Su.Maize	83	1543	1281
38	Su. cereals	85	1576	1901
39	Su. G nut	171	1705	1364

Sr.No	Crop	Total Area of Crop in Sub Basin “00”ha.	Avg. yield of crops in sub basin Kg/ha	State Avg. Kg/ha.
40	Su. Sunflower	5	1235	890
41	Su. Oilseeds	176	1691	1350
42	**Total Cereals**	**16396**	**2020**	**1481**
43	**Total pulses**	**5159**	**710**	**802**
44	**Total Oilseeds**	**4835**	**1967**	**1160**
45	**Total Foodgrains**	**18625**	**1975**	**1250**

Areas under different fruit crops are given in Table below .The major fruit crops grown in the sub -basin includes mango, custard apple, pomegranate, guava, grape, kagzi lime and banana. The area and productivity and state averages are also given.

Table-5.4.2 Area & Production for Fruit Crops in Upper Bhima Sub -Basin (K5)

Sr.No	Crop	Total Area of Crop in Sub Basin Ha.	Avg. yield of crops in sub basin MT/ha	State Avg. MT/ha.
1	Grape	17883	18.94	24.00
2	Banana	7167	36.36	58.20
3	Mango	12297	7.83	2.50
4	Sapota	4914	10.34	8.57
5	Pomegranate	38003	9.72	10.50
6	Custard apple	4719	9.26	6.51
7	K,lime	9318	12.02	6.80
8	Guava	2518	6.23	8.10
9	Other	13643	12.13	2.99

5.5. Water and Irrigation Requirement of Crops in Upper BhimaSub Basin (K5)

The crop duration, water requirement and irrigation requirement of different crops grown in this sub - basin is given in the Table below

Table-5.5.1– Water and irrigation requirement of crops in Upper Bhima Sub -Basin K5

Sr.No	Crops	Crop Duration Days
1	Paddy	130-135
2	Bajra	90-110
3	Wheat	120-130
4	Maize	90-110
5	Tur	125-170
6	Mung	60-75
7	Soyabean	90-110
8	Udid	60-75
9	RJowar	110-130
10	Gram	100-115
11	Ground nut (Su.)	90-125
12	Sugarcane (suru)	365-395
13	S.cane (Pre- seasonal)	425-456
14	Sugarcane (adsali)	486-548
15	Sugarcane (ratoon)	365-395
16	Tur	140-160
17	Cotton	150-170
18	Onion (Rabi)	120-130
19	Brinjal	60-150
20	Chilli	60-150
21	Ginger	240-300
22	Lucern (fodder)	700-850

5.6. Effect of Irrigation on Crop Yields in Upper Bhima Sub Basin (K5)

The irrigation water is always beneficial for different field crops to increase the production and productivity of crops. The increase in yield of crops is due to irrigation availability during critical growth stages of crops. The comparative yields of major crops are given in the Table below

Table-5.6.1 Effect of Irrigation on Crop Yields (Crop yield Kg./ha.) in Upper Bhima Sub -Basin (K5)

Crop yield under Rainfed and irrigeted conditions for year 2010-11 in Basin K5					Crop yield under Rainfed and irrigeted conditions for year 2013-14 in Basin K5				
Sr. No.	Crop	Average yield in Kg/ha.			Sr. No.	Crop	Average yield in Kg/ha.		
		Irrigated	Rainfed	% increases in yield			Irrigated	Rainfed	% increases in yield
1	Paddy	1850	1308	41.4	1	Paddy	2067	1304	58.5
2	Bajari	1230	682	80.3	2	Bajari	1171	608	92.5
3	Kh. jawar	864	--	--	3	Kh. jawar	834	--	--
4	soyabean	--	1709	--	4	soyabean	--	2035	--
5	Tur	--	566	--	5	Tur	---	670	--
6	Cotton	1033	802	28.7	6	Cotton	930	269	245.8
7	kh. maize	--	2010	---	7	kh. maize	--	2762	---
8	Udid	--	642	---	8	Udid	--	628	---
9	kh. Groud nut	--	897	---	9	kh. Groud nut	--	846	---
10	Sugarcane	87	---	---	10	Sugarcane	75	--	---
12	Wheat	1677	582	188.3	12	Wheat	1609	667	141.1
13	Gram	828	760	8.9	13	Gram	737	668	10.2
14	Rb. jawar	1159	592	95.7	14	Rb. awar	1173	608	92.7

5.7. Water Saving Techniques in Upper Bhima Sub Basin (K5)

The area under micro-irrigation in this sub-basin is of **191948** Ha and projected area up to 2030 is given in the Table below. Upper Bhima Sub Basin consist of Junner, Ghodegaon, Maval, Mulashi, Velha, Bhor, Khed, Purander, Daund, Indapur, Haveli, Shirur, Baramati taluka's of Pune district, Man, Khandala, Phaltan, taluka's of Satara district, Solapur, Mangalavedha, Sangola, Pandharpur, Malshiras, Madha, Barshi, Mohol, taluka's of Solapur district, Parner, Ahmednagar, Shrigondha, Karjat, Jamkhed, Pathardi, taluka's of Ahmednagar district, Ashti, Patoda, taluka's of Beed district, Kalamb, Bhum, Paranda, Osmanabad, Tuljapur, taluka's of Osmanabad district, Atpadi, Kavathe-Mahakal, Jat, taluka's of Sangali district. Total micro irrigation area of k-5 basin is 191948 ha since 1986-87 to 2013-14. About 383897 ha area will be covered under micro irrigation by 2030.

Table 5.7.1 Water Saving Techniques in in Upper Bhima Sub -Basin (K5)

Sr.No	Water Saving Micro -Irrigation Techniques	Area (Ha)
1	Area under Drip & Sprinkler Irrigation	191948
2	Projection -2030 (Drip and Sprinkler)	383897

5.8 Agricultural Research Institutions in Upper Bhima Sub Basin (K5)

District	Name of Research Station	Address
Pune	Indian Agricultural Research Institute Regional Station	Sindhi Colony, Aundh, Pune, Maharashtra 411045 Tel. # 020 2553 7601
	National Research Centre for Grapes	Manjri, Pune
	ICAR - Directorate of Onion and Garlic Research	Directorate of Onion and Garlic Research Rajgurunagar, Pune - 410 505 (MS), India Phone (02135) 222026 Fax 224056 Email : director@dogr.res.in
	Zonal Agricultural Research Station for Plain Zone of Western Maharashtra	Ganeshkhind, Pune
	Agarkar Research Institute,	Gopal Ganesh Agarkar Road, Pune - 411 004 Maharastra, India. Phone: 91-20-25654357, 91-20-25653680 Fax: 91-20-25651542 Telegram: macsciari Email: director at aripune dot org Web Site: www.aripune.org

	Indian Institute of Tropical Meteorology	Indian Institute of Tropical Meteorology Dr. Homi Bhabha Road, Pashan, Pune 411 008 Phone: +91-20-2590-4200 Fax : +91-20-2586-5142
	BAIF Development Research Foundation	BAIF Development Research Foundation BAIF Bhavan, Dr. Manibhai Desai Nagar Warje, Pune 411058, India Phone : 91-20-25231661 / 64700562 / 64700175 Fax : 91-20-25231662 E-mail : baif@baif.org.in
	Vasantdada Sugar Institute	Manjri, Pune
	Institute of Bioinformatics & Biotechnology	Savitribai Phule Pune University, Ganeshkhind Road, Pune - 411007 Maharashtra State, India. Telephone +91-020-25690442 FAX +91-20-25690087 E-mail directoribb@unipune.ac.in
	College of Agriculture	Shivaji Nagar, Pune-411005. Maharashtra, India.Telephone: +91 20 25538489 +91 20 25537033 +91 20 25537038 Fax: +91 20 25537188 E-mail:adacpune@gmail.com

	Agriculture Research Station	Vadhgaon Maval, Dist. Pune
	(SRO) National Horticulture Training centre,	Talegaon Dabhade, Pune
	KVK AFARM,	Raisoni Park,Market Yard ,Dist- Pune
	SRO AFPRO Field Unit-I	Rose Cottage, Station Road Ahmednagar-414001 (Maharashtra)
	BAIF	Development Research Foundation, Pune
	Krishi Vigyan Kendra,	Gramonnati Mandal, Village Narayangaon, Tal.Junnar Distt. Pune-410504
	Krishi Vigyan Kendra,	Sharda Nagar, Malegaon Colony, PO. Baramati, Distt. Pune-413115
Satara	The Central Sugar-cane Research Station, Padegaon.	Dist Satara
	Nimbkar Agricultural Research Institute Sustainable Rural Development through the Application of Science and Technology	Tambmal, Phaltan-Lonand Road, P.O. Box 44, Phaltan-415523, Maharashtra, India Phone numbers: (91)-2166-220945, (91)-2166-222396, (91)-2166-222842 Fax number: (91)-2166-225246 Email: nariphaltan@gmail.com nariphaltan@nariphaltan.org
	Krishi Vigyan Kendra	Satara District, Maharashtra
	Regional Wheat Research station,	Mahabaleswar, Satara
	Krishi Vigyan Kendra,	Borgaon, Tal. Dist. Satara

	Krishi Vigyan Kendra	PO: Kalwade Tal:Karada Dist-Satara - 415 110
	AFARM,	Raisoni Park,Market Yard ,Dist- Pune
Solapur	National Research Centre for Pomegranate, Solapur	NH-9, Solapur-Pune Highway, Kegaon (PO), Solapur District, Maharashtra State, India. PIN Code: 413 255 Telephone: 0217-2354330, 2350263 (Office of NRCP) Fax: 0217-2353533 (Office) Website: http://www.nrcpomegranate.org E-mail: nrcpomegranate@gmail.com director@nrcpomegranate.org rkrishnapal@gmail.com
	ARS,	Mohol
	ARS,	Pandharpur
	KVK Maharshi vivekanand samajkalyan sanstha,	Main road,Near Janta Bank,Akolkot,Dist-solapur
	Krishi Vigyan Kendra	Agricultural Reseaerch Station, Mohol, Distt.- Solapur(Maharashtra)
	Krishi Vigyan Kendra,	Gate No: 52/1/B, At: Khed, PO. Kegaon, Barshi Road, Distt. Solapur 413001
Ahmednagar	ARS,	Chas
	CRS,	Shrirampur
	ARS,	Savl vihir
	Agriculture Research Station	Jeur, Rahuri

	WOTR-	Paryavaran,Behind Market yard, Ahmednagar
	Krishi Vigyan Kendra,	PO Babhleshwar, Tal. Rahata. Distt. Ahmednagar-413 737
	Mahatma Phule Agricultural University	Rahuri, Ahmednagar district
Osmanabad	KVK Bappa Pratishthan (Pune)	Osmanabad
	Krishi Vigyan Kendra,	Ausa Road, PO.Tuljapur Distt. Osmanabad-413601
Beed	Krishi Vigyan Kendra	Post Box No: 28 Post:Ambajogai-431 517 DistBeed
	Krishi Vigyan Kendra Manavlok Sanstha,	Ambajogai, Dist- Beed

5.9 Agricultural Extension Services :

Agriculture department considers farmer as the focal point and the whole department is organized in such a fashion that a single mechanism is working to facilitate the farmer for adoption of advanced technology and sustainable use of available resources. Every agriculture assistant working at village level has a jurisdiction of three to four villages with number of farmers limited to 800 to 900 which facilitates more interaction for easier transfer of technology.

Agriculture Assistant at village level undertakes soil conservation work, horticulture plantation and various extension schemes. He is supervised by Circle Agriculture Officer at circle level. Administrative control, laison with other departments, monitoring and training programs etc. are facilitated by Taluka Agriculture Officer at taluka level, Sub Divisional Agriculture Officer at sub division level, District Superintending Agriculture Officer at district level and Divisional Joint Director at division level. In addition, Agriculture Officer at Panchayat Samiti level, working under Agriculture Development Officer, Zilla Parishad at district level also implement various agro-inputs related schemes.

At district level, an autonomous registered society called, Ägricultural Technology Management Agency"(ATMA) has been created under the chairmanship of District Collector. The main object of this ATMA body is to coordinate all agriculture related research - technology and marketing linkages through convergences and to promote sustainable farming systems for various catagories of farm communities. It is a participatory approach in planning and implementation wherein farmers as stake holders have been nominated at various level to give their valuable inputs in planning and impementation of various agricultural and allied activities considering the existing agro -ecological situations within each agro-climatic zones .

All the schemes implemented in the field are supervised technically and administratively by respective directorates of Soil Conservation, Horticulture, Extension and Training, Inputs and Quality Control, Statistics, Monitoring and Evaluation and Planning and Budget at state level in the Commissionerate of Agriculture. Also separate sections are there for the Establishment and Accounts related matters

5.10.1National Horticulture Mission (NHM):

National Horticulture Mission (NHM) is being implemented to promote holistic growth of the horticulture sector covering fruits,vegetables, roots and tuber crops, mushroom, spices, flowers, aromatic plants, cashew and cocoa. Programme for the development of coconut will be implemented by the Coconut Development Board (CDB), independent of the Mission.

5.11 Dryland Agriculture Mission

The state is having predominently rainfed agriculture system. State is also having limitations to bring more area under irrigation due to its topography. Hence, in coming years about 70 per cent area is still likely to remain rainfed. So it has become imperative to develop dryland agriculture to make it remunerative to farming community. The present constraints are very limited sources of irrigation, drought prone area, degraded and light soils, major area under degraded and light soils limiting the production and productivity. The percentage of drought prone area in the state is 52 per cent and 39 % of the soils are light. This mission is being implemented to minimize risk and to make dryland farming sustainably viable. The main objectives of this mission are to increase the production, productivity of crops thereby income of households. To create sustainable source of irrigation to in-situ soil moisture conservation activities, farm ponds and other water conserving structures. to improve the water use efficiency through use of micro irrigation system, to promote protective irrigation, value addition and marketing to get remenerative prices.

5.12 Extension

1	Accelerated Fodder Development Programme
2	Coarse Cereals Under NFSM Guideline
3	Crop Pest Surveillance and Advisory Project
4	Dr. Vitthalrao Vikhe Patil Krushi Seva Ratna Puraskar
5	Dr. Vitthalrao Vikhe Patil Shetkari Din 29 August
6	Dr.Panjabrao Deshmukh Krushi Ratna Puraskar
7	Dryland Farming Mission
8	National Mission of Oil seed and Oil Palm(NMOOP)
9	National Food Security Mission(Cotton)
10	National Food Security Mission(Sugarcane)
11	RKVY Cotton
12	RKVY Sugarcane
13	Integrated Paddy Production Programme
14	SCP Programme
15	TSP OTSP Programme
16	Jijamata Krishibhushan Puraskar
17	Krushi Din 1st July
18	National Mission on Oilseed and Oil Palm
19	National Food Security Mission(Commercial Crops)
20	National Food Security Mission (Pulses)
21	National Food Security Mission(Rice)
22	National Food Security Mission (Wheat)
23	National Mission on Sastainable Agriculture(NMSA)
24	Parthenium Control Campaign
25	Pest Disease Monittoring Information System(PDMIS}
26	Publicity through R.K.V.Y Preparation of Exhibition Material
27	Rainfed Area Development Under NMSA
28	RKVY Pigeon Pea Prduction Programme
29	Seed Treatment
30	Shetkari Masik
31	Vasantrao Naik Krishibhushan Award
32	Vasantrao Naik Sheti Mitra Award
33	Vasantrao Naik ShetiNisht Shetkari

5.13 Horticulture

1	Banana Leaf Spot Disease Management Programme
2	Coconut Development Board
3	D.P.D.C Sponsored Plant Protection Scheme
4	EGS and MREGES Nursery
5	Employment Guarantee Scheme
6	Plant Protection Scheme for TSP
7	Horticulture Crop Pest and Disease Surveillance and Advisory Project

8 Kitchen Garden Plantation of Fruits and Vegetables Scheme

9 Mahatma Gandhi National Rural Employment Guarantee Scheme

10 Mangonet Vegnet Grapenet Anarnet Guidelines

11 NMSA On Farm Water Management

12 Strengthening of Govt. Nurseries Guidelines

13 Vidharba Intensive Irrigation Development Programme

5.14 Soil Conservation

1 Integrated Watershed Development programme

2 Mahatma jyotiba Phule Jal Bhumi Sandharan Abhiyan Part 1 & part 2

3 Mahatma jyotiba Phule Jalmitra Puraskar

4 Padkai Yojana

5 Water shed Development Programme under R.I.D.F

6 River Valley Project (RVP)

7 Soil and Water Conservation works by Machinary

8 Soil Conservation Training

5.15 Input and Quality Control

1 Agro Polyclinics

2 Establishment of Custom Hiring Centers Under SMAM

3 Sub-Mission on Agricultural Mechanization

4 Supply of Bio Pesticide Under Govt Programme

5 Supply of Chemical Pesticides

6 Taluka Seed Farm 100 Percent State Sponsored Scheme

7 Insecticide Testing Laboratories

8 Bio Pesticide Testing Laboratories

9 Fertilizer Testing Laboratories

10 Seed Testing Laboratories

11 Residue Testing Laboratories

12 Soil Survey and Soil Testing

Chapter 6 – Surface Water Resources

6.1 Preamble

6.1.1 Water being a precious resource without which no life can sustain on earth. The level of availability and development of infrastructure to harness the water influence to a considerable extent the quality of life. The rapid growth of population coupled with increasing economic activities has put a tremendous pressure on the available water resources. Although irrigation is the major consumer of water at present in our country and may continue to be so in the years to come demands from other sectors such as drinking and industries have been growing significantly. Water conservation measures to improve the efficiency of water use are being stressed upon for meeting the ever increasing demands. Inter-basin transfer of water from surplus basins to deficit basins is being studied as one of the long term strategies.

6.1.2 A proper assessment of water resources potential has, therefore, become a prerequisite for its sustainable development and management. Without a precise estimate of the availability of the resource, it is impossible to properly plan, design, construct, operate and maintain water resources projects catering to competing demands like irrigation, drought and flood management, domestic and industrial water supply, and generation of electrical energy, fisheries and navigation. The correctness of assessment of water resource is totally dependent upon the accuracy and length of hydrological data. Thus, the hydrological data such as gauged flows of river, the measurement of abstractions of water in the catchment etc. are essential for proper assessment of water resource for appropriate planning.

6.1.3 An attempt has been made in this chapter to compile the available hydrological data for ascertaining the water availability at nodal point as shown below

Sr.No.	Nodal Point	Taluka	District
1	Sarati	Malshiras	Solapur
2	Daund	Daund	Pune
3	Takali	South Solapur	Solapur
4	Wadakbal	South Solapur	Solapur

6.2 Krishna Basin

6.2.1 The river Krishna rises in the western ghats at an altitude of 1337 meters just north of Mahabaleshwar about 64 Km. from the Arabian Sea and flows from west to east through the States of Maharashtra, Karnataka and Andhra Pradesh before it joins to the bay of Bengal. The major tributaries of Krishna are Koyna, Warna, Panchganga, Dudhganga, Ghatprabha, Malprabha, Bhima, Tungbhadra, Musi, Palleru and Maneru. The Government of India had appointed Krishna Godavari Commission in 1961 to review the position of availability of supplies in Krishna and Godavari rivers. Krishna Godavari Commission divided the Krishna basin into 12 sub-basins designated from K1 to K12, which has since been followed by Krishna Water Disputes Tribunals.

6.3 Krishna Basin in Maharashtra

6.3.1 Out of total drainage area 251369 Sq km of Krishna basin 69425 Sq km area lies in Maharashtra. Krishna basin in Maharashtra consists of part drainage /catchment area of 5 sub basins namely K1, K2, K3, K5 and K6. The sub basin wise drainage/ catchment areas of Krishna basin in Maharashtra as per page 47 of Bachawat Tribunal report are as under **Table-6.3.1 Area in Sq.Km.**

Sr. No.	Sub basin	Drainage/ Catchment area in Maharashtra	Percentage Drainage/ Catchment area
1	K1-Upper Krishna	17128	24.67
2	K2-Middle Krishna (Agrani)	1388	2.00
3	K3-Ghatprabha	2010	2.90
4	**K5-Upper Bhima**	**45335**	**65.30**
5	K6-Lower Bhima	3564	5.13
Total		**69425**	**100**

6.3.2 Upper Bhima Sub Basin – K5

Following are the tributaries of river Bhima.

Sr. No.	River	Originates	Taluka	District
1	Indryani	Apti	Maval	Pune
2	Velwandi	Bhor	Bhor	Pune
3	Pawana	Mula	Maval	Pune
4	Mula	Mazgaon	Mulshi	Pune
5	Mutha	Dawzer	Mulshi	Pune
6	Ghod	Gavadewadi	Ambegaon	Pune
7	Mina	Amboli	Junner	Pune
8	Kukadi	Ghatghar	Junner	Pune
9	Pushpawati	Khireshwar	Junner	Pune
10	Nira	Shirgaon	Velha	Pune
11	Man	Kulakjai	Khatav	Satara
12	Sina	Juar-Ahmednagar	Ahmednagar	Ahmednagar

Drainage area for the above tributaries are in pune ,Satara Ahmednagar District .The CWC has river gauging stations for this sub basin at Sarati,Tal-Malshiras,Dist-Solapur, Daund,Tal-Daund,Dist-Pune,Takali,Tal-South Solapur,Dist-Solapur, Wadakbal,Tal-Sauth Solapur,Dist-Solapur.

6.4 Past Assessments of Availability of Water

6.4.1 Krishna Godavari Commission was appointed by the Government of India on the 1st May, 1961. The first term of reference of the Commission is to report on the availability of supplies in the Krishna for 86 per cent and 75 per cent dependability on the basis of annual flow at Vijaywada and other points taking into account upstream utilization and allowing regeneration. After going through the hydrological data that was available, Commission came to the conclusion that it is not possible to determine the water availability for want of reliable and sufficient hydrological data such as river gauge data and data of upstream extraction

6.4.2 Bachawat Tribunal in 1976 determined the water availability in Krishna river at Vijaywada at 75 % dependability and average. However, it could not determine sub basin wise and State wise water availability. The Tribunal was also not satisfied with the reliability of data used for determining the availability at Vijaywada. It therefore provided in its order for review of availability of water after year 2000.

6.4.3 Bachawat Tribunal directed by its final order that Krishna river and its major tributaries be gauged at key locations. This gauging has since been done by CWC (Central water commission) from 1972 onwards.

6.4.4 Thus, the reliable data of river gauging at key points and the details of upstream extraction are now available for sufficient length of time. On the basis of this observed data a realistic assessment of water availability can be done at various key locations, project sites etc.

6.5 Data Available

6.5.1 River gauge data

The data of annual flows was made available from the river gauging stations by CWC This data is for years 1972-73 to 2007-08 for most of the key locations. The river gauge data from 2005-2007 was obtained from CWC by Executive Engineer, Designs Division, Pune. On the basis of daily river gauge data, Design Division has worked out the annual flows of river gauging stations in Maharashtra.

6.5.2 Data of upstream extraction

Krishna Water Dispute Tribunal (K.W.D.T.) is set up by the Govt. of India in 1969 under the inter state water disput Act of 1956. The Bachawat commission gave its final award in 1973 and Govt. Published the award in its extraordinary gazette dated 31st May 1976.

After Bachawat Tribunal Award the water use data for the projects under operation have been maintained as per the orders of Tribunal. Bachawat Tribunal has classified the projects with annual utilization of 3 TMC or more as Major Projects, of 1 TMC up to 3 TMC as medium projects and of less than 1 TMC as minor projects. The water use data of major and medium projects is maintained in the form of actual tank gauge data i.e. water balance of the project. In case of minor projects the data only in respect of area irrigated is maintained. The quantum of water used is worked out on the basis of area irrigated and the district wise duties as agreed by party States before Bachawat tribunal.

K.W.D.T.-II is set up by the Govt. of India on 2nd April 2004. for reviewing Bachawat Tribunal Award.

6.5.3 The water use data maintained in accordance with the above said orders for the projects in operation in Maharashtra. On the basis of this water use data the parameters like annual water use, change in storage in case of major & medium projects have been extracted and taken in consideration to work out total yield .

In case of Minor Projects the data of annual water use is available the same is taken to work out total yield .

6.6 Methodology adopted for assessment of availability

6.6.1 The annual availability at a location has been worked out using the following formula.

Availability at a Location = Flow gauged at the location + Upstream Uses + Change in upstream Storages

The availability of water worked out as explained above, at various nodal point.

6.7 Water availability

6.7.1 The water availability at nodal point Sarati, Daund, Takali & Wadakbal Gauging station has been worked out on the basis of observed hydrological data. The quantum of available water has been worked out at dependabilities of 50%, average, 65%, 75% & 90%. The lengths of available observed annual inflow at Sarati, Daund, Takali & Wadakbal is from 1972 to 2008 that is for 36 years & for Daund 1972 to 2005 that is for 34 years. Details are given in Annexure 6.1

6.7.2 47 Year Flow Series

K.W.D.T.-II in its report of 30th December 2010 has considered a flow series of 47 years, from 1961-62 to 2007-08 for which the observed hydrological data is available. The dependable flows computed on the basis of this series at dependability of 50%, average, 65%, 75% & 90% . It is thought desirable to have flow series with the length & period identical with the one considered by K.W.D.T.-II

Extending the length of series in the past years upto 1961-62 involves hind-casting the observed series at nodal point in sub basin.

6.7.3 Data availability

The rainfall data of rain-gauge stations listed below in this sub basin maintained by Indian Meteorology Department and Water Resources Department, Maharashtra has been compiled from the year 1960-61 to latest possible date in the office of Designs Division, Pune. This data has been made use of for hind-casting the flow series.

Methodology:

a. Weighted Average Rainfall (WAR) values worked out for catchment at nodal point by adopting Thiessen Polygon Method.(Annexure- 6.2)

b. The continuous period of series for which both the WAR and observed runoff values are available, has been used to develop relation between WAR and Runoff at nodal points.

Given the constraints of the data available the above methodology is the most appropriate and suitable one.

1) 6.7.4 Assesement of water availability using 47 year yield series

It is observed that the assessment of water availability determined with 47 year yield series appears to be well in tune with the assessment of water availability based on observed hydrological data (for short period).The observed data at CWC station Sarati,,Takali & Wadakbal for the year 1972-08 & For Daund for the year 1972 to 2005 is available hence the rainfall-runoff (R-R) relationship has been established as per methodology mentioned above & the yield is hind casted. The results of this water availability study such as water availability determined on the basis of observed annual flow series, water availability determined on the basis of 47 years longer generated annual flow series .(Annexure- 6.3 & 6.4). The relationship & its coefficient of co-relation at various river stations are is below -

1) Sarati Y=.096x+20.45 & coeff. (r) = 0.745) 2)Daund Y=.224x-32.61 & coeff. (r) = 0.880)
3) Takali Y=.523x+13.01 & coeff. (r) = 0.78) 4)Wadakbal Y=0.171x-68.11 & coeff. (r) = 0.855)

6.7.5 water availability on the basis of observed annual flow series

The observed data at Sarati, Takali & Wadakbal 36 Years & For Daund 34 years is available for years resp. i.e. 1972 to 2008 & 1972 to 2005 (Annexure- I)

A) The yield worked out for different dependability's by using this data is as under-

Sr. No.	Sub -basin	Water availability At nodal points In TMC /MCUM				
		50%	Average	65%	75%	90%
1	Upper Bhima Sub-basin (K5)	444.838	414.954	379.719	383.445	233.903
		12595.94	11749.75	10752.04	10857.55	6623.15

.

B) The catchment area for the Lower Bhima sub basin (K-5) at the nodal point Sarati 2680 Sq.Mile(6941.20 Sq.Km.) Daund 4502 Sq.Mile (11660.18 Sq.Km.) Takali 13095 Sq.Mile (33916.25 Sq.Km.) & Wadakbal 4515 Sq.Mile (11693.85 Sq.Km.) .

C) As mentioned in 7.2 the series of yield for longer period i.e. for 47 year is developed as said earlier & the Water availability worked out at different dependabilities (Annexure- V).

The water availability is as under –

Sr. No.	Sub -basin	Water availability At nodal points In TMC /MCUM				
		50%	Average	65%	75%	90%
1	Upper Bhima Sub-basin (K5)	425.427/ 12046.30	403.988/ 11439.24	377.399/ 10686.35	334.878/ 9484	248.985/ 7049.27

6.8 Approval Of Chief Engineer , Planning & Hydrology, Nasik

"The water availability study of Krishna Basin, Maharashtra" was submitted to Chief Engineer planning & hydrology, Nashik for approval which is approved vide their letter no विज / तांशा /(115/2013) /507 /2015 date.10/03/2015
(Annexure V)

All annexures in this chapter are taken from this "The water availability study of Krishna Basin, Maharashtra"

Annexure 6. I(A)

Abstract Showing the Valleywise Yield in Krishna Basin at Nodal Points & Valley

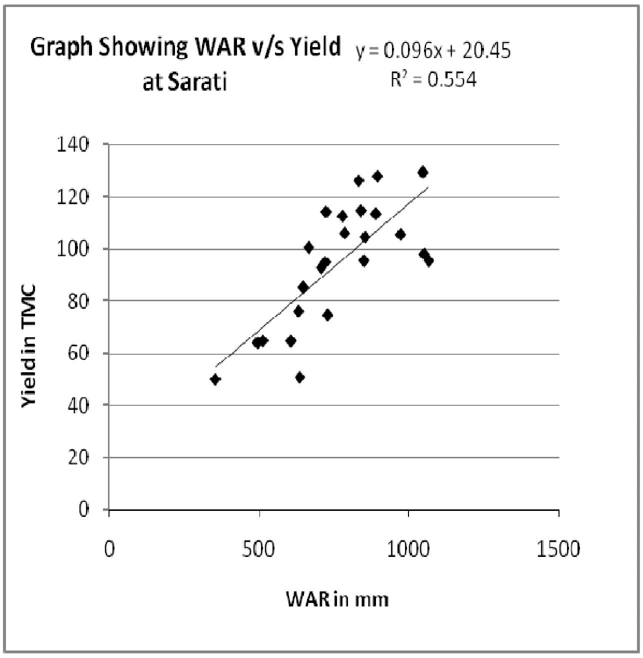
Based On Inflow Series Derived with Observed Hydrological Data

Based on Inflow Series Derived With Observed Hydrological Data									
Sr. No.	**Sub Valley**	**Nodal Point CWC Station**	**Water Availability at Nodal Points**					Series Used	
			50% Dep.	**Avg.Dep.**	**65% Dep.**	**75% Dep.**	**90 % Dep.**	Years	Nos.
1	Nira	Sarati	95.54	93.23	87.073	64.857	49.491	1972-07	36
2	Bhima	Daund	252.42	242.17	217.110	190.409	161.365	1972-05	34
3	Bhima	Takali	389.36	373.48	307.420	277.457	222.270	1972-07	36
4	Sina	Wadakbal	25.254	22.608	15.914	12.39	6.024	1972-07	36
5	Area intercepted by CWC gauging st.Wadakbal &Takli		444.838	414.954	379.719	383.445	233.903	1972-07	36

Annexure 6.3 (1/4)

Water Availability at Sarati C.W.C. Gauging Station on Nira River

Sr. No.	Year			Sarati WAR	Sarati Yield
				mm	TMC
1	2			3	4
1	1961	-	62	839.17	**101.680**
2	1962	-	63	772.69	**95.250**
3	1963	-	64	657.63	**84.110**
4	1964	-	65	778.81	**95.840**
5	1965	-	66	672.31	**85.530**
6	1966	-	67	653.11	**83.670**
7	1967	-	68	762.18	**94.230**
8	1968	-	69	649.43	**83.320**
9	1969	-	70	942.75	**111.710**
10	1970	-	71	621.11	**80.570**
11	1971	-	72	526.28	**71.390**
12	1972	-	73	355.54	50.035
13	1973	-	74	971.62	105.539
14	1974	-	75	708.07	92.909
15	1975	-	76	889.28	113.473
16	1976	-	77	832.36	126.137
17	1977	-	78	853.70	104.520
18	1978	-	79	666.85	100.554
19	1979	-	80	1045.90	129.364
20	1980	-	81	839.87	114.695
21	1981	-	82	895.03	127.819
22	1982	-	83	495.96	64.077
23	1983	-	84	721.38	94.960
24	1984	-	85	647.68	85.353
25	1985	-	86	514.09	64.857
26	1986	-	87	606.79	64.766
28	1988	-	89	785.93	106.049
29	1989	-	90	729.24	74.692
30	1990	-	91	778.56	112.548
31	1991	-	92	723.38	114.226
32	1992	-	93	632.35	76.130
33	1993	-	94	1050.46	98.052
35	1995	-	96	636.57	50.819
36	1996	-	97	1065.90	95.453
37	1997	-	98	849.97	95.535
38	1998	-	99		91.277
39	1999	-	00		88.220
40	2000	-	01		43.107
41	2001	-	02		60.025
42	2002	-	03		48.676
43	2003	-	04		46.212
44	2004	-	05		98.055



$R^2 =$ 0.555

r = 0.745

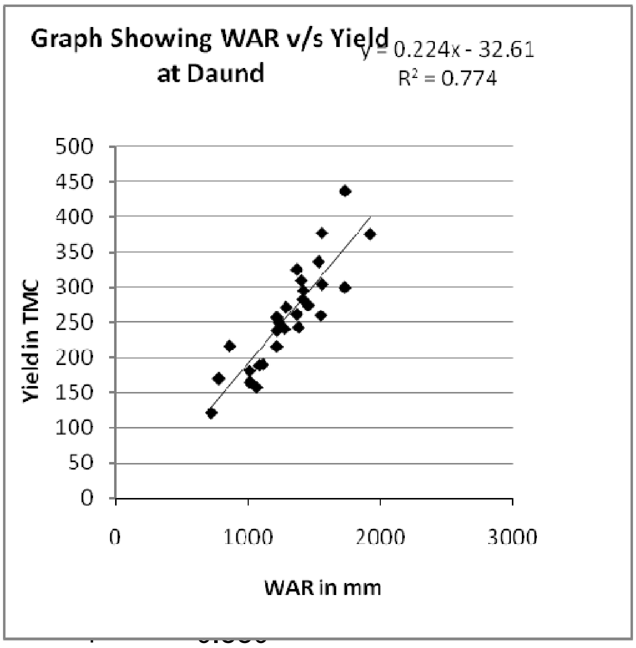
Note: Highlighted data is Estimated using Relation based on Observed Data from 1972-73 to 1997-98 except 1987-88 & 1994-95.

45	2005	-	06
46	2006	-	07
47	2007	-	08
Not Considered for Relation			
27	1987	-	88
34	1994	-	95

Annexure 6.3 (2/4)

Water Availability at Daund C.W.C. Gauging Station on Bhima River

Sr. No.	Year	Bhima Daund	
		WAR	Yield
		mm	TMC
1	2	3	4
1	1961 - 62	1722.53	353.920
2	1962 - 63	1264.04	251.040
3	1963 - 64	1412.85	284.430
4	1964 - 65	1318.17	263.180
5	1965 - 66	672.10	118.200
6	1966 - 67	985.17	188.460
7	1967 - 68	1450.76	292.930
8	1968 - 69	1010.68	194.180
9	1969 - 70	1484.90	300.600
10	1970 - 71	1298.00	258.660
11	1971 - 72	1370.59	274.940
12	1972 - 73	775.88	170.791
13	1973 - 74	1531.80	336.721
14	1974 - 75	1213.16	216.422
15	1975 - 76	1557.28	305.073
16	1976 - 77	1920.16	375.887
17	1977 - 78	1548.70	260.302
18	1978 - 79	1234.23	250.533
19	1979 - 80	1453.50	275.068
20	1980 - 81	1729.54	300.454
21	1981 - 82	1415.62	296.241
22	1982 - 83	1010.56	181.873
23	1983 - 84	1412.17	283.044
24	1984 - 85	1275.25	241.470
25	1985 - 86	1013.48	165.866
26	1986 - 87	1108.48	191.075
27	1987 - 88	721.33	122.218
28	1988 - 89	1213.84	257.422
29	1989 - 90	1215.36	239.103
30	1990 - 91	1555.46	377.445
31	1991 - 92	1367.11	325.761
32	1992 - 93	1082.88	189.743
33	1993 - 94	1366.57	262.170
34	1994 - 95	1731.58	437.257
35	1995 - 96	1060.52	158.365
36	1996 - 97	1380.06	243.710
37	1997 - 98	1401.44	310.068
38	1998 - 99	1286.66	272.081
39	1999 - 0	859.50	217.186
40	2000 - 1		154.177
41	2001 - 2		157.009
42	2002 - 3		192.805
43	2003 - 4		179.263
44	2004 - 5		264.253
45	2005 - 6		483.102

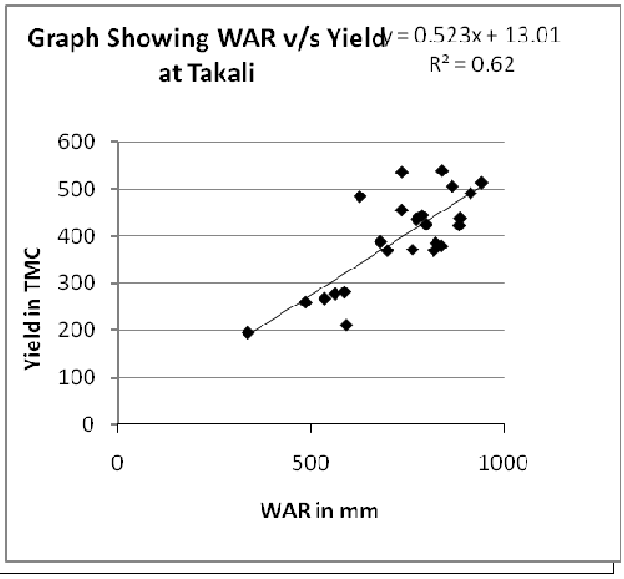


Note: Highlighted data is Estimated using Relation based on Observed Data 1972-73 to 1999-

Annexure 6.3 (3/4)

Water Availability at Takali C.W.C. Gauging Station on Bhima River

Sr. No.	Year			Bhima Takali WAR	Bhima Takali Yield
				mm	TMC
1	2			3	4
1	1961	-	62	766.41	**413.920**
2	1962	-	63	744.00	**402.200**
3	1963	-	64	683.65	**370.630**
4	1964	-	65	784.63	**423.450**
5	1965	-	66	610.21	**332.210**
6	1966	-	67	565.76	**308.960**
7	1967	-	68	693.29	**375.670**
8	1968	-	69	588.57	**320.890**
9	1969	-	70	886.57	**476.770**
10	1970	-	71	626.41	**340.690**
11	1971	-	72	611.89	**333.090**
12	1972	-	73	336.40	195.268
13	1973	-	74	886.22	438.868
14	1974	-	75	818.36	370.437
15	1975	-	76	941.46	514.928
16	1976	-	77	839.42	540.402
17	1977	-	78	823.49	386.298
18	1978	-	79	679.85	389.356
19	1979	-	80	913.42	492.563
20	1980	-	81	798.02	426.017
21	1981	-	82	865.89	507.379
22	1982	-	83	535.26	268.200
23	1983	-	84	735.01	456.611
24	1984	-	85	697.30	370.207
25	1985	-	86	486.19	260.000
26	1986	-	87	586.74	282.212
28	1988	-	89	787.79	445.273
29	1989	-	90	763.34	372.256
30	1990	-	91	735.68	537.359
31	1991	-	92	626.74	485.495
32	1992	-	93	561.66	277.957
33	1993	-	94	837.75	380.094
35	1995	-	96	591.67	211.695
36	1996	-	97	884.02	424.316
37	1997	-	98	773.90	437.060
38	1998	-	99		582.328
39	1999	-	0		345.740
40	2000	-	1		217.904
41	2001	-	2		260.782
42	2002	-	3		225.181
43	2003	-	4		236.266
44	2004	-	5		327.340
45	2005	-	6		657.039
46	2006	-	7		737.972
47	2007	-	8		468.872
Not considered for Relation					
27	1987	-	88	730.55	202.286
34	1994	-	95	694.94	635.312



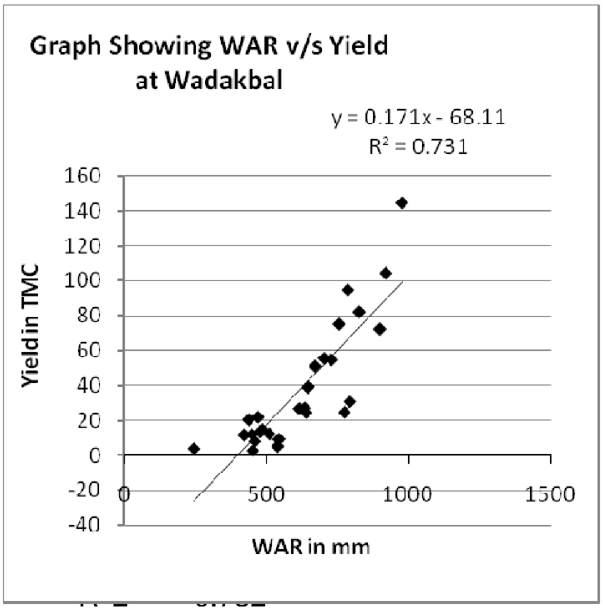
R^2 = 0.62
r = 0.787

Note- Highlighted data is Estimated using Relation based on Observed Data from 1972-73 to 1997- except 1987-88 & 1994-95.

Annexure 6.3 (4/4)

Water Availability at Wadakbal C.W.C. Gauging Station on Sina River

Sr. No.	Year			Wadakbal WAR mm	Wadakbal Yield TMC
1	2			3	4
1	1961	-	62	609.35	**36.270**
2	1962	-	63	698.75	**51.580**
3	1963	-	64	569.98	**29.530**
4	1964	-	65	807.47	**70.210**
5	1965	-	66	594.11	**33.660**
6	1966	-	67	518.41	**20.690**
7	1967	-	68	612.39	**36.790**
8	1968	-	69	489.46	**15.730**
9	1969	-	70	720.60	
10	1970	-	71	694.18	**50.800**
11	1971	-	72	517.14	**20.480**
12	1972	-	73	244.86	4.147
13	1973	-	74	702.56	55.846
14	1974	-	75	671.07	51.342
15	1975	-	76	826.01	82.342
16	1976	-	77	478.28	13.791
17	1977	-	78	634.24	27.394
18	1978	-	79	647.19	39.719
19	1979	-	80	728.22	54.981
20	1980	-	81	645.16	39.153
21	1981	-	82	615.95	26.989
22	1982	-	83	458.47	8.352
23	1983	-	84	919.73	104.575
24	1984	-	85	470.15	22.192
25	1985	-	86	420.62	12.066
26	1986	-	87	448.56	12.390
27	1987	-	88	639.32	24.858
28	1988	-	89	786.38	94.980
29	1989	-	90	898.40	72.582
30	1990	-	91	754.89	75.356
31	1991	-	92	436.88	20.702
32	1992	-	93	539.24	5.488
33	1993	-	94	774.45	24.930
34	1994	-	95	451.10	3.072
35	1995	-	96	510.03	12.628
36	1996	-	97	793.50	31.011
37	1997	-	98	543.81	9.568
38	1998	-	99	976.63	144.759
39	1999	-	00	485.39	14.960
40	2000	-	01		36.013
41	2001	-	02		11.710
42	2002	-	03		3.527
43	2003	-	04		1.100
44	2004	-	05		16.550
45	2005	-	06		25.254
46	2006	-	07		46.307
47	2007	-	08		37.252



r = 0.855

Note: Highlighted data is Estimated using Relation based on Observed Data from 1972-73 to 1997-

Annexure 6.4 (1/5)

Virgin Yield @ Sarati RGS on Nira River

Figures in TMC

Sr. No.	Year			Inflow @ Dam	Inflow @ Dam in Desc. Order	Year			Dep. %
1	2			3	4	5			6
1	1961	-	62	**101.68**	176.93	1994	-	95	2.13
2	1962	-	63	**95.25**	167.233	2006	-	07	4.26
3	1963	-	64	**84.11**	151.008	2005	-	06	6.38
4	1964	-	65	**95.84**	129.364	1979	-	80	8.51
5	1965	-	66	**85.53**	127.819	1981	-	82	10.64
6	1966	-	67	**83.67**	126.137	1976	-	77	12.77
7	1967	-	68	**94.23**	124.325	2007	-	08	14.89
8	1968	-	69	**83.32**	114.695	1980	-	81	17.02
9	1969	-	70	**111.71**	114.226	1991	-	92	19.15
10	1970	-	71	**80.57**	113.473	1975	-	76	21.28
11	1971	-	72	**71.39**	112.548	1990	-	91	23.40
12	1972	-	73	50.035	111.71	1991	-	92	25.53
13	1973	-	74	105.539	106.049	1988	-	89	27.66
14	1974	-	75	92.909	105.539	1973	-	74	29.79
15	1975	-	76	113.473	104.52	1977	-	78	31.91
16	1976	-	77	126.137	101.68	1961	-	62	34.04
17	1977	-	78	104.52	100.554	1978	-	79	36.17
18	1978	-	79	100.554	98.055	2004	-	05	38.30
19	1979	-	80	129.364	98.052	1993	-	94	40.43
20	1980	-	81	114.695	95.84	1994	-	95	42.55
21	1981	-	82	127.819	95.535	1997	-	98	44.68
22	1982	-	83	64.077	95.453	1996	-	97	46.81
23	1983	-	84	94.96	95.25	1997	-	98	48.94
24	1984	-	85	85.353	94.96	1983	-	84	51.06
25	1985	-	86	64.857	94.23	1984	-	85	53.19
26	1986	-	87	64.766	92.909	1974	-	75	55.32
27	1987	-	88	42.059	91.277	1998	-	99	57.45
28	1988	-	89	106.049	88.22	1999	-	00	59.57
29	1989	-	90	74.692	85.53	2000	-	1	61.70
30	1990	-	91	112.548	85.353	1984	-	85	63.83
31	1991	-	92	114.226	84.11	1985	-	86	65.96
32	1992	-	93	76.13	83.67	1986	-	87	68.09
33	1993	-	94	98.052	83.32	1987	-	88	70.21
34	1994	-	95	176.93	80.57	1988	-	89	72.34
35	1995	-	96	50.819	76.13	1992	-	93	74.47
36	1996	-	97	95.453	74.692	1989	-	90	76.60
37	1997	-	98	95.535	71.39	1990	-	91	78.72
38	1998	-	99	91.277	64.857	1985	-	86	80.85
39	1999	-	00	88.22	64.766	1986	-	87	82.98
40	2000	-	01	43.107	64.077	1982	-	83	85.11
41	2001	-	02	60.025	60.025	2001	-	02	87.23
42	2002	-	03	48.676	50.819	1995	-	96	89.36
43	2003	-	04	46.212	50.035	1972	-	73	91.49
44	2004	-	05	98.055	48.676	2002	-	03	93.62
45	2005	-	06	151.008	46.212	2003	-	04	95.74
46	2006	-	07	167.233	43.107	2000	-	01	97.87
47	2007	-	08	124.325	42.059	1987	-	88	100.00

50% Dep.	**95.11**	**TMC**	**65% Dep.**	**84.67**		**90% Dep.**	**50.58**	**TMC**
57.9% Dep.	**90.63**	**TMC**	**75% Dep.**	**75.77**	**TMC**			

Annexure 6.4 (2/5)

Virgin Yield @ Daund RGS on Bhima River

Figures in TMC

Year			Inflow @ Dam	Inflow @ Dam in Desc. Order	Year			Dep. %
1961	-	62	**353.92**	483.102	2005	-	06	2.22
1962	-	63	**251.04**	437.257	1994	-	95	4.44
1963	-	64	**284.43**	377.445	1990	-	91	6.67
1964	-	65	**263.18**	375.887	1976	-	77	8.89
1965	-	66	**118.2**	353.92	1961	-	62	11.11
1966	-	67	**188.46**	336.721	1973	-	74	13.33
1967	-	68	**292.93**	325.761	1991	-	92	15.56
1968	-	69	**194.18**	310.068	1997	-	98	17.78
1969	-	70	**300.6**	305.073	1975	-	76	20.00
1970	-	71	**258.66**	300.6	1969	-	70	22.22
1971	-	72	**274.94**	300.454	1980	-	81	24.44
1972	-	73	170.791	296.241	1981	-	82	26.67
1973	-	74	336.721	292.93	1967	-	68	28.89
1974	-	75	216.422	284.43	1963	-	64	31.11
1975	-	76	305.073	283.044	1983	-	84	33.33
1976	-	77	375.887	275.068	1979	-	80	35.56
1977	-	78	260.302	274.94	1971	-	72	37.78
1978	-	79	250.533	272.081	1998	-	99	40.00
1979	-	80	275.068	264.253	2004	-	05	42.22
1980	-	81	300.454	263.18	1964	-	65	44.44
1981	-	82	296.241	262.17	1993	-	94	46.67
1982	-	83	181.873	260.302	1977	-	78	48.89
1983	-	84	283.044	258.66	1970	-	71	51.11
1984	-	85	241.47	257.422	1988	-	89	53.33
1985	-	86	165.866	251.04	1962	-	63	55.56
1986	-	87	191.075	250.533	1978	-	79	57.78
1987	-	88	122.218	243.71	1996	-	97	60.00
1988	-	89	257.422	241.47	1984	-	85	62.22
1989	-	90	239.103	239.103	1989	-	90	64.44
1990	-	91	377.445	217.186	1999	-	00	66.67
1991	-	92	325.761	216.422	1974	-	75	68.89
1992	-	93	189.743	194.18	1968	-	69	71.11
1993	-	94	262.17	192.805	2002	-	03	73.33
1994	-	95	437.257	191.075	1986	-	87	75.56
1995	-	96	158.365	189.743	1992	-	93	77.78
1996	-	97	243.71	188.46	1966	-	67	80.00
1997	-	98	310.068	181.873	1982	-	83	82.22
1998	-	99	272.081	179.263	2003	-	04	84.44
1999	-	00	217.186	170.791	1972	-	73	86.67
2000	-	01	154.177	165.866	1985	-	86	88.89
2001	-	02	157.009	158.365	1995	-	96	91.11
2002	-	03	192.805	157.009	2001	-	02	93.33
2003	-	04	179.263	154.177	2000	-	01	95.56
2004	-	05	264.253	122.218	1987	-	88	97.78
2005	-	06	483.102	118.2	1965	-	66	100.00

50% Dep.	**259.481**	**TMC**
57.9% Dep.	**250.158**	**TMC**
65% Dep.	**233.624**	**TMC**
75% Dep.	**191.508**	**TMC**
90% Dep.	**162.116**	**TMC**

Annexure 6.4 (3/5)
Virgin Yield @ Takali RGS on Bhima River

Figures in TMC

Sr. No.	Year			Inflow @ Dam	Inflow @ Dam in Desc. Order	Year			Dep. %
1	1961	-	62	413.92	737.972	2006	-	07	2.13
2	1962	-	63	402.2	657.039	2005	-	06	4.26
3	1963	-	64	370.63	635.312	1994	-	95	6.38
4	1964	-	65	423.45	582.328	1998	-	99	8.51
5	1965	-	66	332.21	540.402	1976	-	77	10.64
6	1966	-	67	308.96	537.359	1990	-	91	12.77
7	1967	-	68	375.67	514.928	1975	-	76	14.89
8	1968	-	69	320.89	507.379	1981	-	82	17.02
9	1969	-	70	476.77	492.563	1979	-	80	19.15
10	1970	-	71	340.69	485.495	1991	-	92	21.28
11	1971	-	72	333.09	476.77	1969	-	70	23.40
12	1972	-	73	195.268	468.872	2007	-	08	25.53
13	1973	-	74	438.868	456.611	1983	-	84	27.66
14	1974	-	75	370.437	445.273	1988	-	89	29.79
15	1975	-	76	514.928	438.868	1973	-	74	31.91
16	1976	-	77	540.402	437.06	1997	-	98	34.04
17	1977	-	78	386.298	426.017	1980	-	81	36.17
18	1978	-	79	389.356	424.316	1996	-	97	38.30
19	1979	-	80	492.563	423.45	1964	-	65	40.43
20	1980	-	81	426.017	413.92	1961	-	62	42.55
21	1981	-	82	507.379	402.2	1962	-	63	44.68
22	1982	-	83	268.2	389.356	1978	-	79	46.81
23	1983	-	84	456.611	386.298	1977	-	78	48.94
24	1984	-	85	370.207	380.094	1993	-	94	51.06
25	1985	-	86	260	375.67	1967	-	68	53.19
26	1986	-	87	282.212	372.256	1989	-	90	55.32
27	1987	-	88	202.286	370.63	1963	-	64	57.45
28	1988	-	89	445.273	370.437	1974	-	75	59.57
29	1989	-	90	372.256	370.207	1984	-	85	61.70
30	1990	-	91	537.359	345.74	1999	-	00	63.83
31	1991	-	92	485.495	340.69	1970	-	71	65.96
32	1992	-	93	277.957	333.09	1971	-	72	68.09
33	1993	-	94	380.094	332.21	1965	-	66	70.21
34	1994	-	95	635.312	327.34	2004	-	05	72.34
35	1995	-	96	211.695	320.89	1968	-	69	74.47
36	1996	-	97	424.316	308.96	1966	-	67	76.60
37	1997	-	98	437.06	282.212	1986	-	87	78.72
38	1998	-	99	582.328	277.957	1992	-	93	80.85
39	1999	-	00	345.74	268.2	1982	-	83	82.98
40	2000	-	01	217.904	260.782	2001	-	02	85.11
41	2001	-	02	260.782	260	1985	-	86	87.23
42	2002	-	03	225.181	236.266	2003	-	04	89.36
43	2003	-	04	236.266	225.181	2002	-	03	91.49
44	2004	-	05	327.34	217.904	2000	-	01	93.62
45	2005	-	06	657.039	211.695	1995	-	96	95.74
46	2006	-	07	737.972	202.286	1987	-	88	97.87
47	2007	-	08	468.872	195.268	1972	-	73	100.00

50% Dep.	**383.196**	**TMC**
57.9% Dep.	**370.5889**	**TMC**
65% Dep.	**342.963**	**TMC**
75% Dep.	**317.908**	**TMC**
90%Dep.	**232.941**	**TMC**

Note - Highlighted inflow figures are estimated using Relation

Figures in TMC

Sr. No.	Year			Inflow @ Dam	Inflow @ Dam in Desc. Order	Year			Dep. %
1	1961	-	62	**36.27**	144.759	1998	-	99	2.13
2	1962	-	63	**51.58**	104.575	1983	-	84	4.26
3	1963	-	64	**29.53**	94.98	1988	-	89	6.38
4	1964	-	65	**70.21**	82.342	1975	-	76	8.51
5	1965	-	66	**33.66**	75.356	1990	-	91	10.64
6	1966	-	67	**20.69**	72.582	1989	-	90	12.77
7	1967	-	68	**36.79**	70.21	1964	-	65	14.89
8	1968	-	69	**15.73**	55.846	1973	-	74	17.02
9	1969	-	70	**55.33**	55.33	1969	-	70	19.15
10	1970	-	71	**50.8**	54.981	1979	-	80	21.28
11	1971	-	72	**20.48**	51.58	1962	-	63	23.40
12	1972	-	73	4.147	51.342	1974	-	75	25.53
13	1973	-	74	55.846	50.8	1970	-	71	27.66
14	1974	-	75	51.342	46.307	2006	-	07	29.79
15	1975	-	76	82.342	39.719	1978	-	79	31.91
16	1976	-	77	13.791	39.153	1980	-	81	34.04
17	1977	-	78	27.394	37.252	2007	-	08	36.17
18	1978	-	79	39.719	36.79	1967	-	68	38.30
19	1979	-	80	54.981	36.27	1961	-	62	40.43
20	1980	-	81	39.153	36.013	2000	-	01	42.55
21	1981	-	82	26.989	33.66	1965	-	66	44.68
22	1982	-	83	8.352	31.011	1996	-	97	46.81
23	1983	-	84	104.575	29.53	1963	-	64	48.94
24	1984	-	85	22.192	27.394	1977	-	78	51.06
25	1985	-	86	12.066	26.989	1981	-	82	53.19
26	1986	-	87	12.39	25.254	2005	-	06	55.32
27	1987	-	88	24.858	24.93	1993	-	94	57.45
28	1988	-	89	94.98	24.858	1987	-	88	59.57
29	1989	-	90	72.582	22.192	1984	-	85	61.70
30	1990	-	91	75.356	20.702	1991	-	92	63.83
31	1991	-	92	20.702	20.69	1966	-	67	65.96
32	1992	-	93	5.488	20.48	1971	-	72	68.09
33	1993	-	94	24.93	16.55	2004	-	05	70.21
34	1994	-	95	3.072	15.73	1968	-	69	72.34
35	1995	-	96	12.628	14.96	1999	-	00	74.47
36	1996	-	97	31.011	13.791	1976	-	77	76.60
37	1997	-	98	9.568	12.628	1995	-	96	78.72
38	1998	-	99	144.759	12.39	1986	-	87	80.85
39	1999	-	00	14.96	12.066	1985	-	86	82.98
40	2000	-	01	36.013	11.71	2001	-	02	85.11
41	2001	-	02	11.71	9.568	1997	-	98	87.23
42	2002	-	03	3.527	8.352	1982	-	83	89.36
43	2003	-	04	1.1	5.488	1992	-	93	91.49
44	2004	-	05	16.55	4.147	1972	-	73	93.62
45	2005	-	06	25.254	3.527	2002	-	03	95.74
46	2006	-	07	46.307	3.072	1994	-	95	97.87
47	2007	-	08	37.252	1.1	2003	-	04	100.00

50% Dep. 28.462 TMC
57.9% Dep. 24.91466 TMC
65% Dep. 20.695 TMC
75% Dep. 14.668 TMC
90%Dep. 7.493 TMC

Note - Highlighted inflow figures are estimated using Relation

Annexure 6.4 (5/5)

Water Availability of the Area Intercepted by C.W.C. Gauging Stations at Wadakbal & Takali in Bhima Basin

Figures in TMC

Sr. No.	Year	K-5 Annual Yield at Wadakbal	K-5 Annual Yield at Takali	K-5 Total Yield (Col. 3 + 4)	Total Annual Yield in Desc. Order	Year	Dep. %
1	2	3	4	5	6	7	8
1	1961 - 62	**36.270**	**413.920**	**450.190**	784.279	2006 - 07	2.13
2	1962 - 63	**51.580**	**402.200**	**453.780**	727.087	1998 - 99	4.26
3	1963 - 64	**29.530**	**370.630**	**400.160**	682.293	2005 - 06	6.38
4	1964 - 65	**70.210**	**423.450**	**493.660**	638.384	1994 - 95	8.51
5	1965 - 66	**33.660**	**332.210**	**365.870**	612.715	1990 - 91	10.64
6	1966 - 67	**20.690**	**308.960**	**329.650**	597.270	1975 - 76	12.77
7	1967 - 68	**36.790**	**375.670**	**412.460**	561.186	1983 - 84	14.89
8	1968 - 69	**15.730**	**320.890**	**336.620**	554.193	1976 - 77	17.02
9	1969 - 70	**55.330**	**476.770**	**532.100**	547.544	1979 - 80	19.15
10	1970 - 71	**50.800**	**340.690**	**391.490**	540.253	1988 - 89	21.28
11	1971 - 72	**20.480**	**333.090**	**353.570**	534.368	1981 - 82	23.40
12	1972 - 73	4.147	195.268	199.415	532.100	1969 - 70	25.53
13	1973 - 74	55.846	438.868	494.714	506.197	1991 - 92	27.66
14	1974 - 75	51.342	370.437	421.779	506.124	2007 - 08	29.79
15	1975 - 76	82.342	514.928	597.270	494.714	1973 - 74	31.91
16	1976 - 77	13.791	540.402	554.193	493.660	1964 - 65	34.04
17	1977 - 78	27.394	386.298	413.692	465.170	1980 - 81	36.17
18	1978 - 79	39.719	389.356	429.075	455.327	1996 - 97	38.30
19	1979 - 80	54.981	492.563	547.544	453.780	1962 - 63	40.43
20	1980 - 81	39.153	426.017	465.170	450.190	1961 - 62	42.55
21	1981 - 82	26.989	507.379	534.368	446.628	1997 - 98	44.68
22	1982 - 83	8.352	268.200	276.552	444.838	1989 - 90	46.81
23	1983 - 84	104.575	456.611	561.186	429.075	1978 - 79	48.94
24	1984 - 85	22.192	370.207	392.399	421.779	1974 - 75	51.06
25	1985 - 86	12.066	260.000	272.066	413.692	1977 - 78	53.19
26	1986 - 87	12.390	282.212	294.602	412.460	1967 - 68	55.32

Sr. No.	Year	K-5			Total Annual Yield in Desc. Order	Year	Dep. %
		Annual Yield at Wadakbal	Annual Yield at Takali	Total Yield (Col. 3 + 4)			
1	2	3	4	5	6	7	8
27	1987 - 88	24.858	202.286	227.144	405.024	1993 - 94	57.45
28	1988 - 89	94.980	445.273	540.253	400.160	1963 - 64	59.57
29	1989 - 90	72.582	372.256	444.838	392.399	1984 - 85	61.70
30	1990 - 91	75.356	537.359	612.715	391.490	1970 - 71	63.83
31	1991 - 92	20.702	485.495	506.197	365.870	1965 - 66	65.96
32	1992 - 93	5.488	277.957	283.445	360.700	1999 - 00	68.09
33	1993 - 94	24.930	380.094	405.024	353.570	1971 - 72	70.21
34	1994 - 95	3.072	635.312	638.384	343.890	2004 - 05	72.34
35	1995 - 96	12.628	211.695	224.323	336.620	1968 - 69	74.47
36	1996 - 97	31.011	424.316	455.327	329.650	1966 - 67	76.60
37	1997 - 98	9.568	437.060	446.628	294.602	1986 - 87	78.72
38	1998 - 99	144.759	582.328	727.087	283.445	1992 - 93	80.85
39	1999 - 00	14.960	345.740	360.700	276.552	1982 - 83	82.98
40	2000 - 01	36.013	217.904	253.917	272.492	2001 - 02	85.11
41	2001 - 02	11.710	260.782	272.492	272.066	1985 - 86	87.23
42	2002 - 03	3.527	225.181	228.708	253.917	2000 - 01	89.36
43	2003 - 04	1.100	236.266	237.366	237.366	2003 - 04	91.49
44	2004 - 05	16.550	327.340	343.890	228.708	2002 - 03	93.62
45	2005 - 06	25.254	657.039	682.293	227.144	1987 - 88	95.74
46	2006 - 07	46.307	737.972	784.279	224.323	1995 - 96	97.87
47	2007 - 08	37.252	468.872	506.124	199.415	1972 - 73	100.00

50% Dep.	**425.427**	**TMC**
57.9% Dep.	**403.988**	**TMC**
65% Dep.	**377.399**	**TMC**
75% Dep.	**334.878**	**TMC**
90% Dep	**248.952**	**TMC**

Annexure 6.1 (5/5)

Water Availability of the Area Intercepted by C.W.C. Gauging Stations at Wadakbal & Takali in Bhima Basin

Figures in TMC

Sr. No.	Year	K-5			Total Annual Yield in Desc. Order	Year	Dep. %
		Annual Yield at Wadakbal	Annual Yield at Takali	Total Yield (Col. 3 + 4)			
1	2	3	4	5	6	7	8
1	1972 - 73	4.147	195.268	199.415	784.279	2006 - 07	2.78
2	1973 - 74	55.846	438.868	494.714	727.087	1998 - 99	5.56
3	1974 - 75	51.342	370.437	421.779	682.293	2005 - 06	8.33
4	1975 - 76	82.342	514.928	597.270	638.384	1994 - 95	11.11
5	1976 - 77	13.791	540.402	554.193	612.715	1990 - 91	13.89
6	1977 - 78	27.394	386.298	413.692	597.270	1975 - 76	16.67
7	1978 - 79	39.719	389.356	429.075	561.186	1983 - 84	19.44
8	1979 - 80	54.981	492.563	547.544	554.193	1976 - 77	22.22
9	1980 - 81	39.153	426.017	465.170	547.544	1979 - 80	25.00
10	1981 - 82	26.989	507.379	534.368	540.253	1988 - 89	27.78
11	1982 - 83	8.352	268.200	276.552	534.368	1981 - 82	30.56
12	1983 - 84	104.575	456.611	561.186	506.197	1991 - 92	33.33
13	1984 - 85	22.192	370.207	392.399	506.124	2007 - 08	36.11
14	1985 - 86	12.066	260.000	272.066	494.714	1973 - 74	38.89
15	1986 - 87	12.390	282.212	294.602	465.170	1980 - 81	41.67
16	1987 - 88	24.858	202.286	227.144	455.327	1996 - 97	44.44
17	1988 - 89	94.980	445.273	540.253	446.628	1997 - 98	47.22
18	1989 - 90	72.582	372.256	444.838	444.838	1989 - 90	50.00
19	1990 - 91	75.356	537.359	612.715	429.075	1978 - 79	52.78
20	1991 - 92	20.702	485.495	506.197	421.779	1974 - 75	55.56
21	1992 - 93	5.488	277.957	283.445	413.692	1977 - 78	58.33
22	1993 - 94	24.930	380.094	405.024	405.024	1993 - 94	61.11
23	1994 - 95	3.072	635.312	638.384	392.399	1984 - 85	63.89
24	1995 - 96	12.628	211.695	224.323	360.700	1999 - 00	66.67
25	1996 - 97	31.011	424.316	455.327	343.890	2004 - 05	69.44

Sr. No.	Year			K-5 Annual Yield at Wadakbal	K-5 Annual Yield at Takali	K-5 Total Yield (Col. 3 + 4)	Total Annual Yield in Desc. Order	Year			Dep. %
1	2			3	4	5	6	7			8
26	1997	-	98	9.568	437.060	446.628	294.602	1986	-	87	72.22
27	1998	-	99	144.759	582.328	727.087	283.445	1992	-	93	75.00
28	1999	-	00	14.960	345.740	360.700	276.552	1982	-	83	77.78
29	2000	-	01	36.013	217.904	253.917	272.492	2001	-	02	80.56
30	2001	-	02	11.710	260.782	272.492	272.066	1985	-	86	83.33
31	2002	-	03	3.527	225.181	228.708	253.917	2000	-	01	86.11
32	2003	-	04	1.100	236.266	237.366	237.366	2003	-	04	88.89
33	2004	-	05	16.550	327.340	343.890	228.708	2002	-	03	91.67
34	2005	-	06	25.254	657.039	682.293	227.144	1987	-	88	94.44
35	2006	-	07	46.307	737.972	784.279	224.323	1995	-	96	97.22
36	2007	-	08	37.252	468.872	506.124	199.415	1972	-	73	100.00

50% Dep.	**444.838**	**TMC**
57.9% Dep.	**414.954**	**TMC**
65% Dep.	**379.719**	**TMC**
75% Dep.	**283.445**	**TMC**
90% Dep.	**233.903**	**TMC**

Annexure 6.2 /A

LIST OF RAINGAGE STATIONS FOR K-5 SUB BASIN

Sr.No	Rain-gauge station	Taluka	District
1	Koregaon	Koregaon	Satara
2	Phaltan	Phaltan	Satara
3	Baramati	Baramati	Pune
4	Daund	Daund	Pune
5	Dhaiwadi	Dhaiwadi	Satara
6	Mhaswad	Mhaswad	Satara
7	Malshiras	Malshiras	Solapur
8	Indapur	Indapur	Pune
9	Akluj	Malshiraj	Solapur
10	Jeur	Karmala	Solapur
11	Karmala	Karmala	Solapur
12	Karjat	Karjat	Ahmednagar
13	Shrigonda	Shrigonda	Ahmednagar
14	Parner	Parner	Ahmednagar
15	Shirur	Shirur	Pune
16	Junner	Junner	Pune
17	Khed	Khed	Pune
18	Khandala	Khandala	Satara
19	Wadgaon	Haveli	Pune
20	Paud	Mulshi	Pune
21	Velha	Velha	Pune
22	Khadkwasala	Haveli	Pune
23	Pune	Haveli	Pune
24	Jejuri	Purandar	Pune
25	Mahabaleshwer	Wai	Satara
26	Pachgani	Wai	Satara
27	Wai	Wai	Satara
28	Bhor	Bhor	Pune
29	Waduj	Khatav	Satara
30	Atpadi	Atpadi	Sangali
31	Vita	Vita	Sangali
32	Kavathemahankal	Kavathemahankal	Sangali
33	Sangola	Sangola	Solapur
34	Pandharpur	Pandharpur	Solapur
35	Jat	Jat	Sangali
36	Mangalweda	Mangalweda	Solapur
37	Madha	Madha	Solapur
38	Mohal	Madha	Solapur
39	Solapur	Solapur	Solapur
40	Ahmednagar	Ahmednagar	Ahmednagar
41	Ashti	Pandharpur	Solapur
42	Barshi	Barshi	Solapur
43	Bhoom	Bhoom	Osmanabad
44	Jamkhed	Jamkhed	Ahmednagar
45	Paranda	Paranda	Osmanabad
46	Patoda	Patoda	Beed
47	Osmanabad	Osmanabad	Osmanabad
48	Tuljapur	Tuljapur	Solapur

Chapter 7 - GROUNDWATER RESOURCES

7.1 Hydrogeology

Groundwater is an important component of hydrological cycle. The ultimate source of all groundwater is the meteoric precipitation taking place over the land surface. The disposal of rainwater after it falls over the land surface involves the process of surface runoff (causing soil erosion) downward infiltration for soil moisture recharge, evaporation, evapotranspiration and lastly deep percolation into the subsurface strata to replenish the ultimate groundwater storage.

Just as the meteorological aspects have a direct bearing on the mode of occurrence of groundwater. The physiographic features also play a very important role towards runoff and infiltration of precipitated water and hence for groundwater recharge. The physiographic features also control the climatic conditions and when related to the lithological conditions migration of water into the ground is largely controlled by the peculiarities of the land forms. The chief physiographic feature which affects the distribution of rainfall is the existence of Sahyadri Hill ranges which comes directly in the path of southwest monsoon. These Sahyadri Hill ranges act as a major climatic divide.

In order to study the mode of occurrence of groundwater in a particular region, hydro-meteorological aspects, involving rainfall, run-off, infiltration, evaporation and evapotranspiration, soil moisture are of great significance. Out of these, run-off and infiltration of precipitated water have direct bearing with the physiographical conditions. While evaporation, evapotranspiration and soil moisture are to be studied in the light of climatic conditions of the area under study climatic conditions which in turn are also linked with the physiography.

Physiographically, the area can be broadly sub-divided into four sub-divisions namely 1) Hills and Ghats, 2) Foothills, 3) Plateau, 4) Plains and Valleys.

In the hilly area though the rainfall is very high it is unworthy for future groundwater development as it has a rugged topography, steep gradient and thin soil cover, which results in heavy run-off and poor infiltration.

The average gradient in the foothill zones varies between 6.00 mtr. and 30.00 mtr./km. resulting into high run-off, less infiltration. These form moderately favorable area for groundwater development.

The third physiographic division consists of flat table lands, is not much favorable for groundwater resources due to heavy seepage losses. Occasionally groundwater occurs in the form of perched aquifer.

The optimum development of groundwater can be achieved in the valleys and plains of the river basins, because of gentle gradient of ground, moderately higher rate of infiltration and least run-off and adequate thickness of soil cover.

The above classification on the basis of the physiographic divisions reveals the relationship between the groundwater worthy and non-worthy areas with physiographical conditions prevailing in the sub-basin.

[Source: - An Appraisal of Hydrogeological conditions of Sangali (1975), An Appraisal of Hydrogeological conditions of Ahmednagar (1975), Directorate of Groundwater Survey and Development Agency, Government of Maharashtra.]

7.2 Groundwater occurrence in the Upper Bhima Sub Basin (K-5):-

The porosity, permeability and the hydraulic-gradient decides the behavior of groundwater. It is important to note that the crystalline hard rock formations do not by themselves have any primary porosity. However the basaltic lava flows do develops some porosity due to vesicularity but the secondary process like weathering, jointing, sheeting and fracturing allow to developing space for storage in such formation. The intensity of the fracturing, jointing and weathering both in lateral and vertical extend will ultimately decide the storage capacity of the lava flows. Since the intensity of these factors vary widely from place to place, from one lava flow to another and even within the same lava flow both in lateral and vertical extent, the value of storage capacity will necessarily vary greatly from place to place and from area to area. An important feature of fracturing and jointing in the hard rock is that they form interconnection systems of opening which induced secondary permeability and make them capable of transmitting water. The degree of such interconnections will decide the features of permeability, transmissibility and ultimately the yield of water. Such degree of interconnections also varies from place to place both in lateral and vertical directions.

Groundwater in Deccan trap lava formation occurs in basins and depression of various sizes and controlled by the nature of weathering, jointing and fracturing which ultimately depend upon the physico-chemical properties of the original lava flows. The individual nature of parameters like porosity and permeability vary widely from basin to basin and even within the same basin also. These basins again, may or may not be interconnected hydraulically. If they are interconnected, then the hydraulic connection may be very strong or very weak. All these things indicate that there does not exist any uniform nature of porosity, permeability and transmissibility and hence it is expected that such rock would display great variations in productivity. In Deccan trap terrain, the ground-water is always on the move along the hydraulic gradient unless it is stopped for want of any hydraulic connection. A total absence of such connection is very rarely seen. This means that the areas in the lower reaches of the topographic flow of a valley will be progressively rich and richer than the areas in the higher reaches; even if the rainfall remains the same all over the watershed area.

As in south and south-east part of sub-basin (Solapur district) it is observed that in the two successive flows thin red colored clay like material is observed and is termed as red bole. These are essentially ferruginous clayey horizons and are useful in marking the flows. At places the Red bole are coarse in nature and is mixed with calcareous material which is generally relatively more permeable in nature, while at other places it forms a confining layer underlying which the pink zeolitic basalts acts as "Confined aquifer". It is interesting to note that the lava flows observed in the district behaves as multi aquifer system. A water bearing horizon (vesicular, jointed or weathered basalt) is found to be sandwiched between comparatively massive basaltic flows; the former behaving as confined aquifer and a later as aquifuge or aquitard. As a result of this it is found that groundwater in such a aquifer is found under confined condition but the piezometric surface is usually below ground surface.

The Upper Bhima Sub Basin, Nira and Sina river is acting as a major tributary. All soils and substrata in Sina basin are characterized by deposition of large quantities of Calcium Carbonate (CaCO3). This is released by the decomposition of basalt and is carried in solution by groundwater. When groundwater is drawn to the surface capillary action during long dry season, it evaporates and deposits its load of CaCO3 either on the surface or in the soil zone as Kankar. This CaCO3 brings about cementation of alluvial deposits thus reducing the porosity and converts them in hard strata. The very presence of Kankar in large quantities indicates inadequate groundwater storage. This is observed at village Chas near Ahmednagar district.

[Source: - An Appraisal of Hydrogeological conditions of Solapur (1975), An Appraisal of Hydrogeological conditions of Ahmednagar(1975), Directorate of Groundwater Survey and Development Agency, Government of Maharashtra.]

7.3 Ground Water Availability

The Groundwater Estimation Committee 1984 methodology was modified in the light of enhanced database and new findings of experimental studies in the field of hydrogeology. The present methodology used for resources assessment is known as Ground Water Resources Methodology - 1997 (GEC'97). In GEC'97, two approaches are recommended-water level fluctuation method and norms of rainfall infiltration method. The water level fluctuation method is based on the concept of storage change due to difference between various input and output components. Input refers to recharge from rainfall and other sources and subsurface inflow into the unit of assessment. Output refers to ground water draft, ground water evapotranspiration, and base flow to streams and subsurface outflow from the unit. Since the data on subsurface inflow / outflow are not readily available, it is advantageous to adopt the unit for ground water assessment as basin / sub-basin / watershed, as the inflow / outflow across these boundaries may be taken as negligible.

Thus in general the ground water resources assessment unit is Watershed, particularly in hard rock areas. In case of alluvial areas, administrative block can also be the assessment unit. In each assessment unit, hilly areas having slope more than 20% is deleted from the total area to get the area suitable for recharge. Further areas where the quality of groundwater is beyond the usable limits should be identified and handled separately. The remaining area after deleting the hilly area and separating the area with poor quality groundwater quality is to be delineated into command and non-command areas and the assessment is done separately for monsoon an non-monsoon seasons. The same is shown in the annexure 7.4, 7.5 & 7.6

7.4 Ground water recharge

7.4.1 Monsoon Season

The resources assessment during monsoon season is estimated as the sum total of the change in storage and gross draft. The change in storage is computed by multiplying groundwater level fluctuation between pre and post monsoon periods with the area of assessment and specific yield. Monsoon recharge can be expressed as:-

$R = h \times Sy \times A + DG$

Where,

h = rise in water level in the monsoon season, Sy = specific yield

A = area for computation of recharge, DG = gross ground water draft

The monsoon ground water recharge has two components: - rainfall recharge and recharge from other sources. Mathematically it can be represented as-

R(Normal) = Rrf(normal)+Rc + Rsw + Rt + Rgw + Rwc

Where,

Rrf is the normal monsoon rainfall recharge. The other sources of groundwater recharge during monsoon season include Rc, Rsw, Rt, Rgw, Rwcs which are recharged from canals, surface water irrigation, tanks and ponds, ground water irrigation, and water conservation structures respectively.

The rainfall recharge during monsoon season computed by "Water Level Fluctuation" (WLF) method is compared with recharge figures from Rainfall Infiltration Factor (RIF) method.

In case the difference between the two sets of data are more than 20%, then RIF figure is considered, otherwise monsoon recharge from WLF is adopted. While adopting the rainfall recharge figures, weightage is to be given to the WLF method over "Adhoc norms method" of RIF. Hence, wherever the difference between RIF and WLF is more than 20%, data have to be scrutinized and corrected accordingly.

7.4.2 Non- Monsoon season

During the non-monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-monsoon recharge. In case of areas receiving less than 10% of the annual rainfall during non-monsoon season, the rainfall recharge is ignored.

7.4.3 Total annual ground water recharge

The total annual groundwater recharge of the area is the sum-total of monsoon and non-monsoon recharge. An allowance is kept for natural discharge in the non-monsoon season by deducting 5% of total annual ground water recharge, if WLF method is employed to compute rainfall recharge during monsoon season and 10% of total annual ground water recharge if RIF method is employed. The balance ground water available accounts for existing ground water withdrawal for various uses and potential for future development. This quantity is termed as Net Groundwater Availability.

$$\text{Net Groundwater Availability} = \left[\begin{array}{c}\text{Annual Ground Water} \\ \text{Recharge}\end{array}\right] - \left[\begin{array}{c}\text{Natural discharge during non} \\ \text{monsoon season}\end{array}\right]$$

7.4.4 Norms for estimation of recharge

GEC97 Methodology has recommended norms for various parameters being used in ground water recharge estimation. These norms vary depending up on water bearing formations and agro-climatic conditions. While norms for specific yield and recharge from rainfall values are to be adopted within the guidelines of GEC'97, in case of other parameters like seepage from canals, return flow from irrigation, recharge from tanks and ponds, water conservation structures, result of specific case studies may replace the ad-hoc norms.Watershed wise recharge in this basin is given in annexure 7.1.

7.5 Ground water draft

The gross yearly ground water draft is to be calculated for irrigation, domestic and industrial uses. The gross ground water draft would include the ground water extraction from all existing ground water structures during monsoon as well as during non-monsoon period. While the number of ground water structures should preferably be based on the latest well census, the average unit draft from different types of structures should be based on specific studies or ad -hoc norms in GEC'97 report.Ground water draft for non command area & command area is given in the annexure 7.2 & 7.3, resp.

7.6 Stage of groundwater development and categorization of units

The stage of ground water Development is defined by:

$$\text{Stage of groundwater Development (\%)} = \left(\frac{\text{Existing Gross Ground water draft for all uses}}{\text{Net annual Groundwater Availability}} \right) \times 100$$

7.7 Categorizations of areas for groundwater development

The units of assessment are categorized for groundwater development based on two criteria - a. stage of groundwater development, and b. long term trend of pre and post monsoon groundwater levels. Four categories are- Safe areas which have groundwater potential for development; Semi-Critical areas where cautious groundwater development is recommended; Critical areas; and Over-exploited areas where there should be intensive monitoring and evaluation and future ground water development be linked with water conservation measures. The criteria for categorisation of assessment units are as follows:

Sr. No.	Stage Of GW Development	Significant Long Term Decline		Category
		Pre-Monsoon	Post-Monsoon	
1	< 70 %	No	No	Safe
2	> 70 to < 90 %	No	No	Safe
		Yes/No	No/Yes	Semi Critical
3	> 90 to < 100 %	Yes/No	No/Yes	Semi Critical
		Yes	Yes	Critical
4	> 100 %	Yes/No	No/Yes	Over Exploited
		Yes	Yes	Over Exploited

The long-term ground water level data should preferably be for the period of 10 years. The significant rate of water level decline/rise may be taken greater than +5 or less than -5 cm per year depending upon the local hydrogeological conditions. If this rate is between -5 to +5 cm per year then the trend will be treated as "Neither Rise nor Fall".

7.8 Allocation of ground water resource for utilization

The net annual ground water availability is to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, 2002, requirement for domestic water supply is to be accorded priority. The requirement for domestic and industrial water supply is to be kept based on the population as projected to the year 2025. The water available for irrigation use is obtained by deducting the allocation for domestic and industrial use, from the net annual ground water availability.

7.9 Poor quality ground water

Computation of ground water recharge in poor quality ground water is to be done on the same line as described above. However, in saline areas, there may be practical difficulty due to non-availability of data, as there will usually be no observation wells in such areas. Recharge assessment in such cases may be done based on Rainfall Infiltration Factor method.

7.10 Apportioning of ground water assessment from watershed to development unit

Where the assessment unit is a watershed, the ground water assessment is converted in terms of an administrative unit such as Block/Taluka/Mandal. This is done by converting the volumetric resource in to depth unit and then multiplying this depth with the corresponding area of the Block.

7.11 Additional Potential Recharge

In shallow water table areas, particularly in discharge areas rejected recharge would be considerable and water level fluctuation area subdued resulting in underestimation of recharge component. In the area where the ground water level is less than 5 m below ground level or in water logged areas, ground water resources have to be estimated up to 5m below ground level, only based on the following equations:

Potential ground water recharge = (5-D) x A x Specific yield

where, D = depth to water table below ground surface in pre monsoon in shallow aquifers A = area of shallow water table zone

7.12 Recommendations of R&D Advisory Committee

To get a more appropriate methodology for groundwater resources estimation for hard rock terrain, which will supplement GEC – 1997, the GoI has decided to constitute a Committee for Estimation of Ground Water Resources in Hard Terrain. The Ministry of Water Resources, Govt. of India, constituted a committee vide circular No. 3/7/2001-GW II dated 03.09.2001. The committee after detailed deliberations recommended following modifications in the GEC1997 methodology.

7.13 Criterion for Categorization of Assessment Units

The criterion for categorization of assessment units as recommended by GEC-1997 methodology has been modified. The modified criteria as given in the protocol are as follows;

a) Long – term ground water level trend--- The long-term ground water level data should preferably be for the period of 10 years. The significant rate of water level decline may be taken between 10 and 20 cm per year depending upon the local hydrogeological conditions. Accordingly in Detailed Guidelines for Implementing the Ground Water Estimation Methodology - 1997 page 153-154, the value of 'Z' would be read as 10 to 20 cm per year.

b) Categorization of Units -- In order to remove ambiguities in the categorization by the existing methodology, the following procedure is suggested.

Sr. No.	Stage Of GW Development	Significant Long Term Decline		Category
		Pre-Monsoon	Post- Monsoon	
1	< 70 %	No	No	Safe
		Yes/No	Yes/No	To be re-assessed
		Yes	Yes	To be re-assessed
2	> 70 to < 90 %	No	No	Safe
		Yes/No	Yes/No	Semi Critical
		Yes	Yes	To be re-assessed
3	> 90 to < 100 %	No	No	To be re-assessed
		Yes/No	Yes/No	Semi Critical
		Yes	Yes	Critical
4	> 100 %	No	No	To be re-assessed
		Yes/No	Yes/No	Over Exploited
		Yes	Yes	Over Exploited

[Note: 'To be re-assessed' means that data is to be checked for the purpose of categorization.The above modifications are to be adopted in all type of rock formations including soft rock and hard rock terrains.]

7.14 Future allocation of groundwater resources -The criteria given in the GEC-1997 has been modified and the modified criterion for future allocation of groundwater resources for utilization to be computed as given below

Case I, when GWav > Dgi + Alld

In such cases allocation for future domestic requirement = Alld

Case II, When GWav < Dgi + Alld

In such cases Allocation for future domestic requirement = (GWav-Dgi) or Dgd, whichever is more. where,

GWav = Net Annual Ground Water Availability

Dgi = Existing Ground Water draft for Irrigation

Dgd = Existing Ground Water draft for Domestic use

Dg = Existing Ground Water draft for all uses

Alld = Computed value of allocation for domestic use

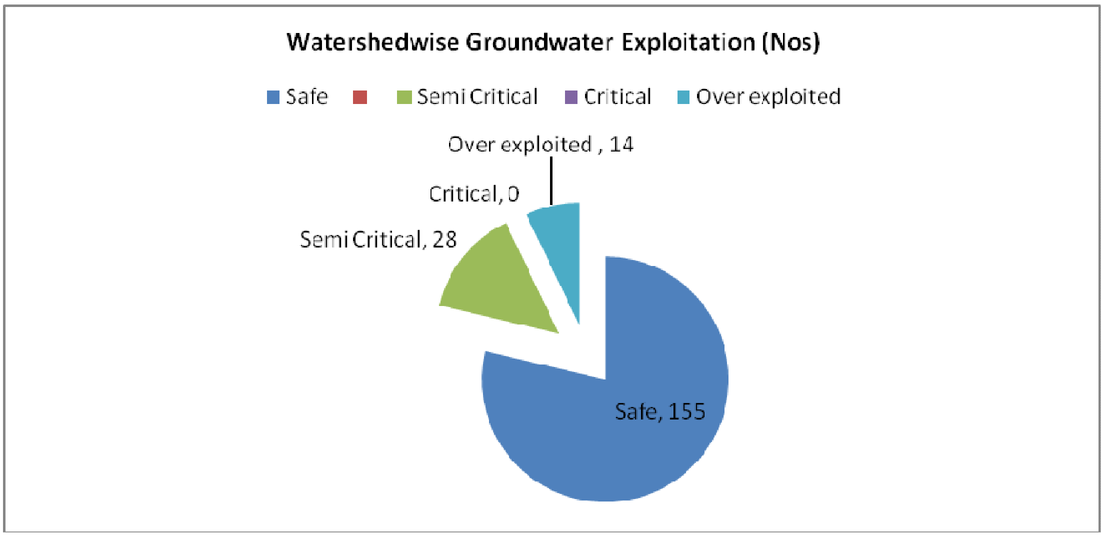
(based on projected population, fractional load and per capita requirement)

[Sources: 3.1 GEC 1997 methodology]

7.15 Watershed-wise Exploitation of Groundwater is given below –

Category	Watershed Nos.	Total
Safe	BM-1,BM-5,BM-14,BM-15,BM-28,BM-30,BM-31,BM-32,BM 47,SA-1,SA-3,SA-6,SA-7,SA-8,SA-10,SA-11,SA-12,SA-16,SA-14,SA-15,SA-21,SA-23,SA-24,SA-25,SA-27A,SA-28A,SA-29A,SA-33BSA-37A,SA-38A,SA-39,SA-40,SA-43A,BM-2,BM-3,BM-6,BM-7,BM-8,BM-10,BM-13,BM-17,BM-19,BM-21,BM-22,BM-23,BM-24,BM-25,BM-26,BM-27,BM-34,BM-35,BM-36,BM-37,BM-38,BM-39,BM-40,BM-41,BM-42,BM-43,BM-44,BM-45,BM-46,BM-48,BM-50,BM-52,BM-53,BM-54,BM-55,BM-56,BM-57,BM-61,BM-66,BM-67,BM-68,BM-71,BM-72,BM-73,BM-78,BM-81,BM-103,BM-104,BM-105,BM-112,BM-114,BM-116BM-117,BM-118,BM-119,BM-120,BM-121,BM-122,BM-123,BM-81,BM-82,BM-83,BM-84,BM-87,BM-88,BM-89,BM-100,BM-102,BM-103,BM-104,BM-47,BM-62,BM-63,BM-64,BM-65,BM-80,BM-88,BM91,BM-94,BM-96,BM-97,BM-98,BM-99,BM-105,BM-106,BM-107,BM-108,BM-109,BM-110,BM-112,BM-115,BM-116,BM-117,BM-119,SA-15,SA-20,SA-21,SA-26,SA-28,SA-30,SA-31,SA-32,SA-33,SA-34,SA-35,SA-36,SA-37,SA-38,SA-39,SA-40,SA-41	155
Semi Critical	BM-16 BM-33,SA-2,SA-4,SA-5,BM-1BM-9,BM-11,BM-12, BM-20,BM-49BM-51,BM-58,BM-60,BM-70BM-74,BM-75,BM-113,BM-115,BM-85,BM-86,BM-101,BM-79,BM-92,BM-95,BM-111,SA-22,SA-27,	28
Critical	Nil	00
Over exploited	BM-29,BM-4,MB-5,BM-18,BM-59, BM-69,BM-76,BM-77,BM-87,BM-89,BM-90,BM-93,SA-16,SA-29	14
	Total	**197**

[Source Groundwater Assessment 2011-12]



Groundwater assessment is carried out by the State Groundwater Agency with the help of data collected from various other state agencies and data available with them. In Upper Bhima sub basin, particularly in 197 watersheds, as per the Groundwater Assessment 2011-12 there are 436902 dug wells were considered for groundwater assessment. All these 436902 dug wells are spread in geographical area 4533500 ha. (Density one well for 10.38 ha.). All wells are energized and water is being withdrawn for the irrigation and drinking purpose.

7.16 Groundwater Status: –

District	Nos. of Watersheds	Net Groundwater availability Mm^3. (2011-12)	Utilizable Groundwater Mm^3 (70% of Availability)	Groundwater Use Mm^3
Pune	65	1720	1192	1287
Ahmednagar	29	639	426	441
Solapur	53	1421	1092	1136
Osmanabad	13	283	177	181
Beed	08	175	88	96
Satara	14	392	278	291
Sangli	15	276	187	193
Total	**197**	**4906**	**3440**	**3627**

[Source Groundwater Assessment 2011-12]

In the Upper Bhima Sub-basin the utilizable groundwater availability is 3440 Mm^3 but the actual use is 3627 Mm^3 hence there is no scope of future development.

7.17 Groundwater Quality

7.17.1 Pre-monsoon Contamination of Iron, Nitrate and Fluorite

The map 7.1 is showing pre-monsoon contamination of groundwater of Iron, Nitrate and Fluorite in Upper Bhima Sub-basin. Most of the water sample shows the values above permissible limit. There are some pockets which show the Fluorite contamination in the sun-basin.

7.17.2 Post-monsoon Contamination of Iron, Nitrate and Fluorite

The Map 7.2 is showing post-monsoon contamination of groundwater of Iron, Nitrate and Fluorite in Upper Bhima Sub-basin. Most of the water sample shows the values above permissible limit. There are some pockets which show the Fluorite contamination in the sun-basin.

7.17.3 Post-monsoon TDS

The Map 7.3 is showing post-monsoon TDS contamination of groundwater in Upper Bhima Sub-basin. Most of the water sample shows the values 500 to 2000 mg/l. There are some pockets which show the above 2000 mg/l TDS values.

In general it is noticed that there is no such contamination of groundwater is observed due to insitu parent rock. But the contamination is overall due to anthropogenic or man made activities like industrialwaste or agricultural activites, high use of chemical fertilizers.

The groundwater quality problem villages are tackled by Rural water suplly division zilla parishad under different schemes like NRDWP or under DPDC etc.

In over exploited, critical or semi critical watersheds the groundwater has to be managed by using minor irrigation practices like drip irrigation, sprinklers or rain gun etc and also by taking less water requirement crops so as to maintain the groundwater quality.

The areas where there is a scope for groundwater development, the new wells has to be excavated or constructed by government aid or by finance by government or other financial institutions.

7.18 Maharashtra Groundwater (Development and Management) Act 2009

7.18.1 Maharashtra is probably the first State in the country to enact a community driven tool named The Maharashtra Groundwater (Development and Management) Act 2009 (Act No. XXVI of 2013) for the sustainable groundwater development and management in the State. The Act came in force from 1st June 2014.

a. The groundwater resource in the State will be treated as a common property resource and the community will take care of their resource with GoM support. i.e. the will be acting as trustee of this precious natural resource.

7.18.2 The objective is to facilitate and ensure sustainable and adequate supply of groundwater of prescribed quality, for various category of users, through supply and demand management measures, protecting public drinking water sources and to establish the State Groundwater Authority, District Level Authority and Watershed Water Resources Committee to manage and to regulate, with community participation, the exploitation of groundwater within the State of Maharashtra. In the non-notified areas the powers of groundwater planning and development are with the *Grampanchayat*.

7.18.3 Now there will be one Authority in the State for the surface water and groundwater. The Maharashtra Water Resources Regulatory Authority established by the Maharashtra Water Resources Regulatory Authority Act 2005 will act as the **State Groundwater Authority** in the State.

7.18.4 The State will now be statutorily following the principle of Integrated Water Resources Management

7.18.5 Protection of Public Drinking Water Sources along with the polluters pays principle for protection of public drinking water sources due to contaminations.

7.18.6 Preparation of prospective crop plan based on groundwater use plan is mandatory in notified areas.

7.18.10 Prohibition on the sale of groundwater from the notified areas along with the cess on groundwater withdrawal from the deep wells.

7.18.11 Water scarcity declaration and mitigation measures along with preventive management are integral part.

7.18.12 The State Authority shall constitute a Watershed Water Resources Committee as per Section 29 of the Act for each notified area declared by the State Authority. Separate Watershed Water Resources Committee for each Notified area shall be constituted immediately in 6 Over - Exploited and 11 Semi- critical watersheds and then in 85 safe Watersheds in Purna - Tapi Basin.

7.18.13 The Watershed Water Resources Committee constituted for the notified area shall be responsible for regulating the available replenishable groundwater recharge for sustainable management by the different users of groundwater by exercising controls to reduce groundwater extraction as well as taking measures to augment groundwater recharge structures.

7.18.14 The Watershed Water Resources Committee constituted under this Act shall be responsible for regulating groundwater utilization for different user sectors and for development and management of annually replenishable groundwater recharge available for utilization.

7.18.15 The District Authority shall organize workshops in the taluka having Over-Exploited and Semi - critical watersheds , on rain water harvesting at the District Collectors with the participation of the Tahsildars, Block Development Officers, Municipal Engineers, Chief Educational Officers and public representatives for motivating communities, groups, associations, industries and commercial establishments to adopt rainwater harvesting to meet their water requirements.

7.19 Recommendations:-

The main objective is to make the groundwater resource more sustainable, to recharge the existing ground water system using surface water, which otherwise drained as untreated runoff. To maximize the utility of existing irrigation infrastructure developed for agriculture development in the project area. To improve the socio-economic condition in the project area, to establish the ground water management & regulation practice through public participation. To build the capacity of beneficiaries for post project ground water management & regulation practices. To enhance the recharge in Upper Bhima sub basin or to enhance the yield of the aquifers, aquifer delineation projects, groundwater recharge projects and community based water management projects has to be taken on large basis

In order to make the drinking water sources or the aquifer system more sustainable the unconventional measures like bore blast techniques, stream blasting, fracture seal cementation, or dugwell recharge has to be implemented on large basis. Conventional measures like check dams cement bandharas or K.T.Weir has to be constructed on suitable feasible sites. similarly for the direct recharge of the confined aquifers the structures like recharge shafts, trench cum recharge shafts, or the aquifer recharge shaft system has to be implemented.

Mega Recharge:

The geology of the sub basin is predominantly occupied by the basaltic rocks. The basalt is hard, compact and heterogeneous in nature. The groundwater occurs in weathered zone and through fractures, joints and plane of weakness. The specific capacity of the basalt in the area is ranges from 1 - 3 %. Hence, the area of the sub basin is not feasible for mega recharge projects.

Annexure 7.1 Watershed wise recharge

Sr. No.	Watershed No.		Type of Area	Watershed Wise recharge in the Upper Bhima Sub Basin (K5)						
				Recharge in Ham from						
				Rain Fall (mm)	Canal	Surface Irrigation	GW Irrigation	Tanks	Conservation Struc.	Total
1	2		3	4	5	6	7	8	9	10
1	SA	21	Non-Command	1066.94	0	0	100.85	0	164.44	1332.2
2	SA	23	Command	270.26	76.86	263.46	42.43	0	0	653.01
3	SA	23	Non-Command	1976.18	0	0	313.46	0	264.95	2554.6
4	SA	24	Command	189.48	74.55	231.08	87.93	0	0	583.04
5	SA	24	Non-Command	3071.62	0	0	235.05	0	403.41	3710.1
6	SA	25	Command	197.48	32.26	176.07	99.36	0	0	505.16
7	SA	25	Non-Command	1963.3	0	0	361.67	178.2	211.83	2715
8	SA	27 A	Command	93.66	47.44	132.03	11.88	0	0	285.02
9	SA	27 A	Non-Command	1098.26	0	0	193.3	0	106.24	1397.8
10	SA	28 A	Non-Command	2345.84	0	0	344.67	0	390.93	3081.5
11	SA	29 A	Command	159.97	43.9	236.01	65.77	0	0	505.65
12	SA	29 A	Non-Command	1203.86	0	0	127.02	0	29.69	1360.6
13	SA	33 B	Non-Command	344.06	0	0	63.92	0	50.51	458.48
14	SA	37 A	Command	86.61	34.4	57.49	98.5	0	0	277
15	SA	37 A	Non-Command	1738.83	0	0	190.17	6	305.23	2240.2
16	SA	38 A	Command	82.32	8.76	58.32	166.5	0	0	315.9
17	SA	38 A	Non-Command	1400.54	0	0	267.33	0	172.71	1840.6
18	SA	39 A	Command	25.52	0.98	10.94	0.95	0	0	38.4
19	SA	39 A	Non-Command	884.69	0	0	98.78	24.33	63.15	1071
20	SA	40 A	Non-Command	517	0	0	37.01	0	35.14	589.15
21	SA	43 A	Command	84.23	17.14	149.15	117	0	0	367.52
22	SA	43 A	Non-Command	3201.31	0	0	267.85	26.27	409.85	3905.3
23	BM	47	Non-Command	431.64	0	214.19	53.65	0	10.2	709.67
24	BM	62	Non-Command	1097.86	0	671.02	276.57	0	41.86	2087.3
25	BM	63	Non-Command	1644.94	0	532.57	371.83	6.85	77.16	2633.3
26	BM	64	Non-Command	2162.15	0	73.38	224.72	0	41	2501.3
27	BM	65	Non-Command	1470.89	0	486.89	260.17	14.22	52	2284.2
28	B	79	Command	177.61	153.72	197.28	74.06	0	36.85	639.52

	M									
29	B M	79	Non-Command	2435.65	0	126.26	688.74	5.75	32.62	3289
30	B M	80	Command	153.54	150.68	188.65	110.4	0	31.03	634.3
31	B M	80	Non-Command	2507.59	0	0	736.13	6.31	236.38	3486.4
32	B M	87	Command	104.83	50.44	192.76	316.25	0	0	664.27
33	B M	87	Non-Command	266.76	0	0	128.73	0	3.8	399.29
34	B M	88	Command	560.75	208.56	1972.8	278.85	0	21.55	3042.5
35	B M	88	Non-Command	2228.84	0	0	574.64	0	123.56	2927
36	B M	89	Command	865.42	90.77	1031.61	328.59	0	16.25	2332.6
37	B M	89	Non-Command	1791.88	0	0	1077.49	0	38.54	2907.9
38	B M	90	Command	1562.63	122.54	871.32	767.12	0	1.5	3325.1
39	B M	90	Non-Command	1583.38	0	384.7	1219.65	0	3.7	3191.4
40	B M	91	Command	372.39	337.09	314.42	87.07	0	8.13	1119.1
41	B M	91	Non-Command	1356.16	0	0	185.43	0	13.16	1554.8
42	B M	92	Command	487.73	37.85	394.97	157.36	1.05	5.3	1084.3
43	B M	92	Non-Command	1185.78	0	0	420.56	0	49.65	1656
44	B M	93	Command	217.84	8.33	50.55	1016.27	0	91.57	1384.6
45	B M	93	Non-Command	2090.55	0	0	828.54	0	587.32	3506.4
46	B M	94	Command	1031.36	42.09	272.8	248.54	0	0	1594.8
47	B M	94	Non-Command	697.71	0	425.39	265.24	0	219.98	1608.3
48	B M	95	Command	275.89	136.37	161.99	129.86	0	42.39	746.49
49	B M	95	Non-Command	919.03	0	65.6	331.74	0	119.93	1436.3
50	B M	96	Command	1976.19	98.66	1339.45	657.09	0	6.68	4078.1
51	B M	97	Command	476.43	167.07	338.66	269.84	0	0.6	1252.6
52	B M	97	Non-Command	2523.97	0	682.26	437.01	0	94.16	3737.4
53	B M	98	Command	401.78	204.21	281.95	136.29	0	58.87	1083.1
54	B M	98	Non-Command	638.94	0	0	154.66	0	38.92	832.51
55	B M	99	Command	1019.92	123.71	241.67	254.22	0	126.6	1766.1
56	B M	99	Non-Command	1671.76	0	0	512.21	0	115.56	2299.5
57	B M	105	Non-Command	1349.69	0	120.2	341.67	0	93.25	1904.8

58	B M	106	Non-Command	1837.89	0	0	342.24	22.52	144.9	2347.6
59	B M	107	Command	957.23	124.48	124.12	304.99	0	12.69	1523.5
60	B M	107	Non-Command	3381.07	0	0	887.52	0	102	4370.6
61	B M	108	Command	545.35	41.67	563.07	165.72	0	22.55	1338.4
62	B M	108	Non-Command	1047.41	0	612.39	263.4	9.57	45.39	1978.2
63	B M	109	Command	559.55	63.67	323.05	152.55	0	3.56	1102.4
64	B M	109	Non-Command	1232.32	0	0	239.8	0	5.71	1477.8
65	B M	110	Non-Command	1549.13	0	439.77	358.81	0	27.05	2374.8
66	B M	111	Non-Command	824.26	0	0	301.81	10.18	217.62	1353.9
67	B M	112	Non-Command	1416.7	0	0	386.8	8.79	130.77	1943.1
68	B M	115	Non-Command	980.04	0	0	256.45	11.48	139.18	1387.2
69	B M	116	Command	968.01	64.79	254.82	208.47	9.16	51.54	1556.8
70	B M	116	Non-Command	2011.01	0	0	396.12	9.16	182.92	2599.2
71	B M	117	Non-Command	880.41	0	0	298.85	11.73	275.41	1466.4
72	B M	119	Non-Command	1695.29	0	0	523.79	46.92	414.41	2680.4
73	SA	15	Non-Command	521.33	0	0	129.49	0	47.66	698.49
74	SA	16	Non-Command	584.62	0	0	279.34	0	174.9	1038.9
75	SA	20	Non-Command	1081.52	0	0	282.61	0	103.48	1467.6
76	SA	21	Non-Command	326.66	0	0	86.59	0	25.2	438.45
77	SA	22	Non-Command	1234.96	0	0	349.76	0	41.49	1626.2
78	SA	26	Non-Command	1100.32	0	0	337.42	0	247.48	1685.2
79	SA	27	Non-Command	1653.15	0	0	490.66	0	67.5	2211.3
80	SA	28	Non-Command	5186.32	0	0	590.31	0	175.73	5952.4
81	SA	29	Non-Command	1689.6	0	0	783.05	0	240.29	2712.9
82	SA	30	Non-Command	1727.86	0	0	291.79	0	73.81	2093.5
83	SA	31	Non-Command	1334.38	0	0	399.56	0	260.57	1994.5
84	SA	32	Non-Command	2127.9	0	0	378.29	0	27.73	2533.9
85	SA	33	Non-Command	1375.6	0	0	379.2	0	165.95	1920.8
86	SA	34	Non-Command	1569.5	0	0	200.63	0	72.73	1842.9
87	SA	35	Non-	1448.78	0	0	233.03	0	40.2	1722

			Command							
88	SA	36	Command	147.83	14.9	382.23	66.13	0	88.35	699.43
89	SA	36	Non-Command	595.26	0	0	124.09	7.98	209.49	936.82
90	SA	37	Command	182.34	106.88	344.01	110.11	0	48.85	792.19
91	SA	37	Non-Command	1119.78	0	0	313.35	0	254.81	1687.9
92	SA	38	Command	749.08	122.9	124.12	305.02	0	39.34	1340.5
93	SA	38	Non-Command	5650.11	0	0	766.77	0	69.9	6486.8
94	SA	39	Command	873.75	105.05	212.49	305.16	0	12	1508.4
95	SA	39	Non-Command	1762.07	0	0	342.37	0	270.99	2375.4
96	SA	40	Non-Command	1284.43	0	0	163.53	0	36.22	1484.2
97	SA	41	Non-Command	2787.87	0	0	381.63	0	70.42	3239.9
98	BM	1	Non-Command	327.28	0	0	21.23	5.86	0	354.37
99	BM	5	Command	535.05	29.88	296.49	73.42	7	14.75	956.59
100	BM	5	Non-Command	828.09	0	0	122.12	47.12	68.25	1065.6
101	BM	14	Command	1096.15	67.45	1147.61	262.14	15.93	8.75	2598
102	BM	14	Non-Command	725.57	0	0	270.83	77.85	74.75	1149
103	BM	15	Non-Command	3092.64	0	0	538.13	165.63	219.5	4015.9
104	BM	16	Command	1201.13	181.5	218.02	414.76	32.33	25.5	2073.2
105	BM	16	Non-Command	404.45	0	0	174.76	49.83	30.26	659.31
106	BM	28	Command	1228.06	119.94	612.99	220.43	13.68	6.25	2201.4
107	BM	29	Command	152.67	141.62	408.84	499.75	3.97	0	1206.9
108	BM	29	Non-Command	1646.59	0	0	275.01	20	85.05	2026.7
109	BM	30	Command	182.09	19.64	86.8	129.82	0	0	418.35
110	BM	30	Non-Command	1229.99	0	0	169.34	28.68	42.4	1470.4
111	BM	31	Non-Command	2096.7	0	0	456.54	23.11	40.5	2616.9
112	BM	32	Non-Command	2396.95	0	0	646.22	13.24	180.3	3236.7
113	BM	33	Command	95.67	28.85	204.12	243.53	5.31	0	577.48
114	BM	33	Non-Command	1889.69	0	0	337.36	6.22	0	2233.3
115	BM	33	Poor Quality	483.21	0	0	117.89	0	0	601.1
116	BM	47	Non-Command	3023.34	0	0	618.33	23.7	255.25	3920.6
117	SA	1	Non-Command	1291.67	0	0	346.21	101.26	40.81	1780
118	SA	1	Poor Quality	0	0	0	0	5.73	511.18	
119	SA	2	Non-	2964.74	0	0	739.21	60.32	159.05	3923.3

			Command							
120	SA	3	Non-Command	1273.82	0	0	335.51	80.19	38.55	1728.1
121	SA	4	Non-Command	2063.61	0	0	534.24	92.79	137.35	2828
122	SA	5	Non-Command	1402.52	0	0	463.53	67.39	136.7	2070.1
123	SA	6	Non-Command	1039.54	0	0	253.5	0	68.19	1361.2
124	SA	7	Non-Command	425.02	0	0	45.79	0	17.31	488.12
125	SA	8	Non-Command	1026.39	0	0	287.28	0	80.13	1393.8
126	SA	10	Non-Command	658.61	0	0	52.52	31.15	12.3	754.58
127	SA	11	Non-Command	1323.59	0	0	215.42	30.16	128.89	1698.1
128	SA	12	Non-Command	2565.72	0	0	413.79	0	374.74	3354.3
129	SA	14	Non-Command	477.02	0	0	93.54	0	61.15	631.71
130	SA	15	Non-Command	2003.46	0	0	196.6	7.05	192.5	2399.6
131	SA	16	Command	466.69	81.8	408.24	52.31	2.38	44.75	1056.2
132	SA	16	Non-Command	1335.65	0	0	323.28	7	122.5	1788.4
133	SA	17	Non-Command	2677.32	0	0	298.48	23.52	187.36	3186.7
134	SA	18	Non-Command	1071.65	0	0	152.19	20.3	131.17	1375.3
135	SA	19	Non-Command	2141.29	0	0	362.88	7.73	202.15	2714.1
136	BM	103	Non-Command	534.53	0	0	107.86	2.14	172.76	817.29
137	BM	104	Command	93.43	27.12	301.63	80.01	101.09	33.5	636.77
138	BM	104	Non-Command	1292.56	0	0	229.1	7.43	324.43	1853.5
139	BM	105	Non-Command	183.1	0	0	55.38	6.22	41.04	285.74
140	BM	112	Non-Command	105.79	0	0	16.74	0	19.8	142.33
141	BM	113	Command	102.2	75.24	65.14	45.41	6.22	13.2	307.41
142	BM	113	Non-Command	1162.87	0	0	415.58	1.9	269.46	1849.8
143	BM	114	Command	42.08	9.76	21.96	25.4	3.97	36.3	139.48
144	BM	114	Non-Command	1062.68	0	0	459.9	14.52	820.76	2357.9
145	BM	115	Command	24.5	10.78	6.91	40.88	0	31.11	114.18
146	BM	115	Non-Command	409.9	0	0	101.23	1.47	78.03	590.62
147	BM	116	Command	46.84	17.19	16.85	23.43	0	0	104.3
148	BM	116	Non-Command	712.48	0	0	137.86	2.07	124.45	976.87
149	B	117	Non-	803.94	0	0	205.39	2.07	296.48	1307.9

	M		Command							
150	B M	118	Command	11.01	67.64	51.39	7.19	0	0.5	137.72
151	B M	118	Non-Command	2980.16	0	0	518.13	4.15	633.96	4136.4
152	B M	119	Command	6.6	6.14	6.48	3.13	0	0	22.35
153	B M	119	Non-Command	1168.27	0	0	271.45	0	135.9	1575.6
154	B M	120	Non-Command	508.16	0	0	96.67	0	63.32	668.15
155	B M	121	Command	15.79	15.37	84.71	214.83	0	10.8	341.5
156	B M	121	Non-Command	2956.4	0	0	376.2	2.07	324.02	3658.7
157	B M	122	Non-Command	2361.59	0	0	693.53	14	464.76	3533.9
158	B M	123	Command	8.96	66.84	3.72	6.85	0	0	86.36
159	B M	123	Non-Command	2939.03	0	0	550.58	3.72	507.61	4000.9
160	B M	1	Non-Command	965.26	0	79	448.88	111.5	32.4	1637.1
161	B M	2	Command	63.89	14.19	108.99	121.22	0	6.28	314.57
162	B M	2	Non-Command	1026.12	0	72.68	124.82	0	45.25	1268.9
163	B M	3	Command	280.26	57.67	392.93	95.83	0	1.99	828.68
164	B M	3	Non-Command	1049.56	0	69.75	403.38	0	72.12	1594.8
165	B M	4	Command	143.41	71.88	36.7	94.41	0	0	346.4
166	B M	4	Non-Command	1664.47	0	200.15	308.29	0	87.52	2260.4
167	B M	5	Command	173.33	133.91	78.11	121.57	0	0	506.93
168	B M	5	Non-Command	365.71	0	72.12	192.53	0	48.75	679.11
169	B M	6	Command	586.2	54.12	401.54	400.57	0	9.66	1452.1
170	B M	6	Non-Command	786.65	0	348.21	146.87	0	25.09	1306.8
171	B M	7	Command	454.5	101.85	588.72	408.06	0	0	1553.1
172	B M	7	Non-Command	772.08	0	134.7	769.74	0	26.02	1702.5
173	B M	8	Command	94.7	36.39	369.92	155.04	19.01	4.43	679.47
174	B M	8	Non-Command	1636.83	0	106.12	406.29	0	80.07	2229.3
175	B M	9	Command	699.25	124.75	283.37	207.49	0	30.72	1345.6
176	B M	9	Non-Command	1291.73	0	362.62	462.35	0	145.91	2262.6
177	B M	10	Non-Command	1081.11	0	0	55.39	0	77.97	1214.5
178	B M	11	Command	84	40.61	47.52	41.33	0	3.84	217.31

179	B M	11	Non-Command	817.64	0	23.11	183.05	0	75.63	1099.4
180	B M	12	Command	1072.6	302.57	22.68	492.21	0	119.88	2009.9
181	B M	12	Non-Command	1583.48	0	161.27	597.01	0	131.77	2473.5
182	B M	13	Non-Command	806.16	0	229.18	343.11	0	15.26	1393.7
183	B M	17	Non-Command	2333.69	0	659.17	507.65	0	431.18	3931.7
184	B M	18	Command	279.21	40.61	0	308.67	0	15.6	644.09
185	B M	18	Non-Command	1192.92	0	48.21	846.85	57.08	234.58	2379.7
186	B M	19	Command	625.63	15.23	0	567.01	0	13.39	1221.3
187	B M	19	Non-Command	739.55	0	70.65	193.5	0	121.45	1125.2
188	B M	20	Command	994.41	194.61	0	345.01	0	21.08	1555.1
189	B M	20	Non-Command	999.2	0	148.74	219.17	0	79.42	1446.5
190	B M	21	Command	127.46	248.27	21.6	144.68	13.39	24.38	579.79
191	B M	21	Non-Command	2181.44	0	10.86	289.82	9.53	15.85	2507.5
192	B M	22	Non-Command	1967.5	0	176.02	404.9	19.07	106.59	2674.1
193	B M	23	Non-Command	2037.5	0	113.1	461.18	23.12	105.08	2740
194	B M	24	Non-Command	3068.43	0	18.66	140.33	10.56	71.47	3309.5
195	B M	25	Non-Command	1236.37	0	126.3	401.41	25.81	73.92	1863.8
196	B M	26	Command	1419.15	111.69	26.4	509	0	2.7	2068.9
197	B M	26	Non-Command	715.77	0	143.34	375.12	35.38	87.24	1356.8
198	B M	27	Non-Command	1363.54	0	224.62	552.39	41.57	72.67	2254.8
199	B M	34	Command	1125.94	94.32	179.98	398.37	0	107.4	1906
200	B M	35	Command	1153.45	50.7	89.71	409.53	0	78.13	1781.5
201	B M	35	Non-Command	748.88	0	408.91	86.51	14.98	20.94	1280.2
202	B M	36	Non-Command	1237.06	0	418.87	470.79	0	57.28	2184
203	B M	37	Non-Command	1051.61	0	224.4	142.38	46.11	45.34	1509.8
204	B M	38	Command	90.39	13.3	31.95	6.94	0	0.76	143.34
205	B M	38	Non-Command	912.5	0	0	22.11	0	18.83	953.44
206	B M	39	Non-Command	1501.21	0	0	69.04	0	2.62	1572.9
207	B M	40	Non-Command	0	0	0	0	64.99	1154.76	
208	B	41	Command	292.47	15	127.71	46.75	0	0.51	482.44

	M									
209	B M	41	Non-Command	766.97	0	280.3	76.32	6.99	15.35	1145.9
210	B M	42	Non-Command	998.36	0	0	24.85	0	10.76	1034
211	B M	43	Command	302.99	44.87	110.88	63.55	43.53	0	565.81
212	B M	43	Non-Command	1166.74	0	268.75	24.45	0	113.9	1573.8
213	B M	44	Non-Command	1129.52	0	247.8	43.41	0	0	1420.7
214	B M	45	Non-Command	1924.6	0	188.7	140.91	0	58.1	2312.3
215	B M	46	Non-Command	1847.77	0	1418.69	652.96	0	54.96	3974.4
216	B M	48	Command	1716.47	333.08	20	548.73	0	8.76	2627
217	B M	48	Non-Command	60.81	0	868.56	61.14	0	0	990.51
218	B M	48	Poor Quality	441.84	0	0	66.36	0	0	508.21
219	B M	49	Command	461.51	720.04	91.19	406.61	16.65	1.17	1697.2
220	B M	49	Non-Command	1021.7	0	12.14	248.95	0	53.18	1336
221	B M	49	Poor Quality	239.44	0	0	34.02	0	0	273.47
222	B M	50	Command	757.8	461.79	84.46	370.42	4.33	31.48	1710.3
223	B M	50	Non-Command	783.19	0	626.9	210.75	17.99	23.75	1662.6
224	B M	50	Poor Quality	273.44	0	0	56.27	0	0	329.7
225	B M	51	Command	793.8	600.83	37.23	457.84	0.51	0	1890.2
226	B M	51	Non-Command	1269.43	0	2.81	179.23	0	70.25	1521.7
227	B M	52	Command	545.92	283.37	52.57	183.83	0	0	1065.7
228	B M	52	Non-Command	845.44	0	153.96	198.62	0	32.9	1230.9
229	B M	53	Non-Command	2064.08	0	113.77	20.31	0	4.93	2203.1
230	B M	54	Non-Command	3664.91	0	1.06	1.5	4.98	1.52	3674
231	B M	55	Command	52.91	169.53	234	4.45	8.5	0	469.4
232	B M	55	Non-Command	812.93	0	5.29	73.28	0	16.19	907.69
233	B M	56	Non-Command	2653.14	0	66.94	14.85	14.19	9.98	2759.1
234	B M	57	Non-Command	1218.62	0	145.45	358.07	0	107.87	1830
235	B M	58	Non-Command	2840.95	0	13	878.11	5.29	231.65	3969
236	B M	59	Non-Command	2040.57	0	7.67	845.04	9.88	235.41	3138.6
237	B M	60	Non-Command	1764.81	0	10.06	446.85	1.56	103	2326.3

238	B M	61	Command	568.38	284.68	1447.2	248.8	10.8	1.73	2561.6
239	B M	61	Non-Command	1058.85	0	16.29	376.13	0	50.23	1501.5
240	B M	66	Command	906.56	224.45	2412	329.81	18.29	5.3	3896.4
241	B M	66	Non-Command	95.62	0	0	28.19	0	27.42	151.22
242	B M	67	Command	450.14	249.95	2412	250.32	21.99	74.36	3458.8
243	B M	67	Non-Command	737.17	0	92.77	192.79	0	33.54	1056.3
244	B M	68	Command	651.48	317.69	11.59	315.51	33.87	22.35	1352.5
245	B M	68	Non-Command	764.96	0	32.46	157.07	0	55.89	1010.4
246	B M	69	Command	460.9	423.96	499.06	855.19	3.41	0	2242.5
247	B M	69	Non-Command	1779	0	0	354.07	0	278.02	2411.1
248	B M	69	Poor Quality	134.07	0	0	23.86	0	0	157.93
249	B M	70	Command	241.75	120.67	24.46	156.14	20.36	0	563.38
250	B M	70	Non-Command	1128.25	0	177.75	353.36	0	223.56	1882.9
251	B M	71	Non-Command	949.7	0	8.86	22.57	0	1.15	982.27
252	B M	72	Command	20.21	87.16	19.46	10.85	8.1	0	145.79
253	B M	72	Non-Command	1282.76	0	65.02	733.92	0	133.48	2215.2
254	B M	73	Command	74.32	303.07	1412.47	246.35	0	13.44	2049.6
255	B M	73	Non-Command	1452.75	0	432.71	586.39	0	81.34	2553.2
256	B M	74	Command	317.38	229.34	135.76	107.14	8.94	0	798.55
257	B M	74	Non-Command	752.96	0	98.26	346.81	0	89.38	1287.4
258	B M	74	Poor Quality	28.33	0	0	20.61	0	0	48.94
259	B M	75	Command	684.53	443.31	2583.25	984.15	0	11.42	4706.7
260	B M	75	Non-Command	719.04	0	478.81	333.06	0	53.46	1584.4
261	B M	75	Poor Quality	108.94	0	0	82.9	0	0	191.84
262	B M	76	Command	678.18	159.71	4698	1702.23	0	30.23	7268.4
263	B M	76	Non-Command	885.85	0	270.45	819.8	0	79.02	2055.1
264	B M	76	Poor Quality	325.24	0	0	246.53	0	0	571.77
265	B M	77	Command	857.45	256.97	1263.6	632.27	0	14.06	3024.4
266	B M	77	Non-Command	500.13	0	188.09	396.65	14.49	48.5	1147.9
267	B	77	Poor Quality	42.91	0	0	83.17	0	0	126.08

	M									
268	B M	78	Command	2427.95	120.71	60.48	523	0	18.57	3150.7
269	B M	78	Non-Command	72.26	0	542.98	9.05	0	13.45	637.73
270	B M	81	Command	106.36	6.56	265.32	1.22	5.53	0.72	385.71
271	B M	81	Non-Command	1236.57	0	100.35	46.03	0	28.38	1411.3
272	SA	5 B	Command	123.78	27.38	401.76	34.37	27.14	0	614.43
273	SA	5 B	Non-Command	1631.11	0	0	195.35	2.75	126.06	1955.3
274	SA	9	Command	206.93	45.74	176.58	68.73	3.07	28.62	529.66
275	SA	9	Non-Command	1392.53	0	0	224.84	3.02	211.28	1831.7
276	SA	10	Command	136.34	33.56	277.99	29.94	0	0	477.82
277	SA	10	Non-Command	1582.25	0	0	231.39	5.57	116.53	1935.7
278	SA	11	Command	53.28	19.86	316.22	29.31	0	34.69	453.36
279	SA	11	Non-Command	896.74	0	0	137.54	1.71	64.32	1100.3
280	SA	12	Command	121.43	14.89	237.17	35.14	0	7.69	416.32
281	SA	12	Non-Command	1892.58	0	0	303.04	18.2	137.55	2351.4
282	SA	13	Command	171.09	15.43	189.54	50.55	0	0	426.61
283	SA	13	Non-Command	1478.27	0	0	280.97	7.78	81.52	1848.5
284	SA	14	Command	145.05	15.65	174.47	39.48	1.12	0	375.78
285	SA	14	Non-Command	1431.09	0	0	241.77	14.1	134.47	1821.4
286	SA	15	Command	39.87	0.32	73.6	7.98	0	0	121.77
287	SA	15	Non-Command	1813.34	0	0	285.36	0	130.04	2228.7
288	B M	81	Non-Command	378.03	0	0	19.62	0.83	18.68	417.15
289	B M	82	Command	48.73	116.41	91.53	5.76	0	0.95	263.37
290	B M	82	Non-Command	3460.22	0	0	475.3	15.69	409.22	4360.4
291	B M	83	Command	33.87	176.61	1200.42	70.46	0	7.85	1489.2
292	B M	83	Non-Command	1549.69	0	0	475.43	7.86	139.39	2172.4
293	B M	84	Command	193.94	239.31	411.32	249.96	0	0	1094.5
294	B M	84	Non-Command	1876.61	0	0	490.44	18.49	174.2	2559.7
295	B M	85	Command	302.59	68.59	197.78	194.76	0	0	763.72
296	B M	85	Non-Command	2001.6	0	0	456.21	27.24	196.78	2681.8
297	B M	86	Command	729	302.51	488.19	471.93	0	46.15	2037.8
298	B M	86	Non-Command	1599.71	0	0	486.95	14.47	157.99	2259.1
299	B M	87	Command	205.27	137.32	493.86	300.8	0	0	1137.3
300	B	87	Non-	993.62	0	0	201.58	9.79	99.12	1304.1

	M		Command							
301	B M	88	Non-Command	106.98	0	0	4.69	0.05	10.53	122.24
302	B M	89	Non-Command	172.38	0	0	4.39	2.27	14.4	193.43
303	B M	100	Command	84.54	21.31	41.16	40.32	2.34	4	193.67
304	B M	100	Non-Command	3666.5	0	0	633.75	3.11	327.75	4631.1
305	B M	101	Non-Command	3770.71	0	0	1152.13	14.74	369.92	5307.5
306	B M	102	Non-Command	2872.35	0	0	483.08	7.41	258.61	3621.4
307	B M	103	Non-Command	2058.64	0	0	420.94	15.43	173.54	2668.5
308	B M	104	Non-Command	1648.07	0	0	219.16	10.18	145.88	2023.3
Total				332843.2	12677.8	57311.67	87650.01	2672.58	27994.99	519413
Total (Values in Mm^3)				**3328.43**	**126.77**	**573.11**	**876.50**	**26.72**	**279.94**	**5194.13**

[Source Groundwater Assessment 2011-12]

Annexure 7.2- Ground water draft in Non-Command Area

Groundwater Draft in the Upper Bhima Sub Basin (K5)									
Sr. No.	Watershed No.		Type of Area	Area (ha.)	Total Recharge	Existing Irrigation Wells	Natural Dishcharge. (Ham)	Net Annual GW Availability (Ham)	Gross Draft (Ham)
1	SA	21	Non-Command	11346	1332.23	799	66.61	1265.62	699.31
3	SA	23	Non-Command	21015	2554.59	2213	127.73	2426.86	2136.21
5	SA	24	Non-Command	32664	3710.07	2667	185.5	3524.57	1614.32
7	SA	25	Non-Command	20878	2715	2021	135.75	2579.25	1503
9	SA	27 A	Non-Command	11679	1397.79	1296	69.89	1327.9	1318.95
10	SA	28 A	Non-Command	24946	3081.45	1768	154.07	2927.37	1418.72
12	SA	29 A	Non-Command	12802	1360.56	484	68.03	1292.53	523.87
13	SA	33 B	Non-Command	3178	458.48	348	22.92	435.56	267.4
15	SA	37 A	Non-Command	16061	2240.23	1632	112.01	2128.22	1271.6
17	SA	38 A	Non-Command	10974	1840.58	1183	92.03	1748.55	1095.66
19	SA	39 A	Non-Command	6932	1070.95	612	53.55	1017.4	673.54
20	SA	40 A	Non-Command	4051	589.15	218	29.46	559.69	250.75
22	SA	43 A	Non-Command	25084	3905.27	1363	195.26	3710.01	1842.49
23	BM	47	Non-Command	8532	709.67	251	35.48	674.19	229.56
24	BM	62	Non-Command	21701	2087.31	1173	104.37	1982.94	1150.84
25	BM	63	Non-Command	24983	2633.34	1379	131.67	2501.68	1535.84
26	BM	64	Non-Command	23013	2501.25	1028	125.06	2376.19	944.04
27	BM	65	Non-Command	17307	2284.16	1050	114.21	2169.96	1092.98
29	BM	79	Non-Command	25924	3289.01	2854	164.45	3124.56	2789.09
31	BM	80	Non-Command	24792	3486.41	2864	174.32	3312.09	3028.23
33	BM	87	Non-Command	5326	399.29	580	19.96	379.32	522.87
35	BM	88	Non-Command	24227	2927.04	3487	146.35	2780.69	2393.87
37	BM	89	Non-Command	19345	2907.91	3191	145.4	2762.51	4369.86
39	BM	90	Non-Command	17094	3191.42	3816	159.57	3031.85	4974.07
41	BM	91	Non-Command	12717	1554.75	1141	77.74	1477.01	787.33
43	BM	92	Non-Command	15839	1655.98	2340	82.8	1573.18	1682.22
45	BM	93	Non-Command	38385	3506.42	5262	175.32	3331.09	3345.11
47	BM	94	Non-Command	8708	1608.31	1823	80.42	1527.9	1080.09
49	BM	95	Non-Command	18518	1436.3	1980	71.81	1364.48	1382.86
52	BM	97	Non-Command	27723	3737.39	2872	186.87	3550.52	1825.49
54	BM	98	Non-Command	11127	832.51	570	41.63	790.89	634.65
56	BM	99	Non-Command	19327	2299.52	2663	114.98	2184.54	2083.43
57	BM	105	Non-Command	16270	1904.81	1646	95.24	1809.57	1403.39
58	BM	106	Non-Command	28420	2347.55	1924	117.38	2230.17	1861.31
60	BM	107	Non-Command	36220	4370.59	4363	218.53	4152.06	3654.04
62	BM	108	Non-Command	26106	1978.16	1395	98.91	1879.25	1096.43
64	BM	109	Non-Command	18891	1477.84	1351	73.89	1403.94	984.58

65	BM	110	Non-Command	14997	2374.76	1373	118.74	2256.02	1511.35
66	BM	111	Non-Command	17021	1353.86	1442	67.69	1286.17	1260.46
67	BM	112	Non-Command	31716	1943.07	1930	97.15	1845.91	1628.97
68	BM	115	Non-Command	11814	1387.15	1206	69.36	1317.79	1067.39
70	BM	116	Non-Command	24242	2599.21	1606	129.96	2469.25	1696.79
71	BM	117	Non-Command	19710	1466.4	1978	73.32	1393.08	1242.26
72	BM	119	Non-Command	34460	2680.42	2785	134.02	2546.4	2209.42
73	SA	15	Non-Command	10305	698.49	532	34.92	663.57	539.89
74	SA	16	Non-Command	11556	1038.87	1448	51.94	986.92	1164.17
75	SA	20	Non-Command	21378	1467.6	1150	73.38	1394.22	1183.74
76	SA	21	Non-Command	6457	438.45	416	21.92	416.53	361.82
77	SA	22	Non-Command	24411	1626.22	2122	81.31	1544.91	1465.25
78	SA	26	Non-Command	18091	1685.22	1723	84.26	1600.96	1420.74
79	SA	27	Non-Command	27149	2211.3	2256	110.57	2100.74	2073.1
80	SA	28	Non-Command	51276	5952.36	3312	297.62	5654.74	2521.35
81	SA	29	Non-Command	31023	2712.93	3170	135.65	2577.29	3338.59
82	SA	30	Non-Command	17083	2093.46	1588	104.67	1988.79	1215.63
83	SA	31	Non-Command	25837	1994.51	1803	99.73	1894.78	1657.46
84	SA	32	Non-Command	34986	2533.93	1569	126.7	2407.23	1599.2
85	SA	33	Non-Command	22617	1920.75	1567	96.04	1824.72	1612.22
86	SA	34	Non-Command	25805	1842.85	1492	92.14	1750.71	1152.5
87	SA	35	Non-Command	15656	1722.01	918	86.1	1635.91	968.81
89	SA	36	Non-Command	9201	936.82	674	46.84	889.98	523.06
91	SA	37	Non-Command	22563	1687.93	1662	84.4	1603.54	1308.64
93	SA	38	Non-Command	48012	6486.78	2953	324.34	6162.44	3188.41
95	SA	39	Non-Command	19118	2375.43	1412	118.77	2256.66	1418.74
96	SA	40	Non-Command	15580	1484.17	674	74.21	1409.96	678.63
97	SA	41	Non-Command	23690	3239.92	1504	162	3077.92	1609.47
98	BM	1	Non-Command	6780	354.37	212	17.72	336.65	111.84
100	BM	5	Non-Command	8943	1065.57	1462	53.28	1012.3	506.9
102	BM	14	Non-Command	9029	1149	1401	114.9	1034.1	1108.7
103	BM	15	Non-Command	37110	4015.9	4001	200.8	3815.11	2224.08
105	BM	16	Non-Command	5937	659.31	897	32.97	626.34	717.31
108	BM	29	Non-Command	19948	2026.65	1087	101.33	1925.32	1129.06
110	BM	30	Non-Command	19859	1470.42	820	73.52	1396.9	702.87
111	BM	31	Non-Command	25401	2616.86	2172	130.84	2486.01	1863.04
112	BM	32	Non-Command	26760	3236.7	3014	161.83	3074.86	2608.52
114	BM	33	Non-Command	22893.07	2233.27	853	111.66	2121.6	1373.17
116	BM	47	Non-Command	36259	3920.61	2747	196.03	3724.58	2508.72
117	SA	1	Non-Command	15133.49	1779.95	2608	89	1690.95	1445.8
119	SA	2	Non-Command	28540	3923.31	3469	196.17	3727.15	3038.6
120	SA	3	Non-Command	12690	1728.08	1696	86.4	1641.67	1380.55
121	SA	4	Non-Command	20558	2827.98	3260	141.4	2686.58	2170.91
122	SA	5	Non-Command	18895	2070.14	2005	103.51	1966.63	1893.54
123	SA	6	Non-Command	10356	1361.23	916	68.06	1293.17	1043.39

124	SA	7	Non-Command	4428	488.12	424	24.41	463.72	189
125	SA	8	Non-Command	10225	1393.79	1120	69.69	1324.1	1182.52
126	SA	10	Non-Command	9080	754.58	404	37.73	716.85	230.7
127	SA	11	Non-Command	16035	1698.06	1496	84.9	1613.16	882.34
128	SA	12	Non-Command	31079	3354.25	2914	167.71	3186.53	1692.56
129	SA	14	Non-Command	5279	631.71	547	31.59	600.12	387.29
130	SA	15	Non-Command	22402	2399.6	1548	119.98	2279.62	818.32
132	SA	16	Non-Command	14998	1788.43	1885	89.42	1699.01	1323.04
133	SA	17	Non-Command	25363	3186.68	2132	159.33	3027.35	1266.37
134	SA	18	Non-Command	10152	1375.3	890	68.77	1306.54	621.17
135	SA	19	Non-Command	27809	2714.05	2880	135.7	2578.35	1524.34
136	BM	103	Non-Command	9158	817.29	554	40.86	776.42	448.51
138	BM	104	Non-Command	23374	1853.51	1593	92.68	1760.84	928.5
139	BM	105	Non-Command	3137	285.74	307	14.29	271.45	228.83
140	BM	112	Non-Command	1161	142.33	102	7.12	135.22	72.36
142	BM	113	Non-Command	23908	1849.81	2239	184.98	1664.83	1689.66
144	BM	114	Non-Command	21848	2357.85	2690	235.79	2122.07	1877.13
146	BM	115	Non-Command	5769	590.62	568	29.53	561.09	417
148	BM	116	Non-Command	11935	976.87	900	48.84	928.02	570.87
149	BM	117	Non-Command	13467	1307.88	1847	65.39	1242.48	864.8
151	BM	118	Non-Command	37807	4136.38	2958	413.64	3722.75	2139.11
153	BM	119	Non-Command	14821	1575.62	1396	157.56	1418.06	1109.89
154	BM	120	Non-Command	6811	668.15	519	33.41	634.74	396.34
156	BM	121	Non-Command	31822	3658.69	2166	182.93	3475.76	1548.43
157	BM	122	Non-Command	34385	3533.88	3308	176.69	3357.18	2846.2
159	BM	123	Non-Command	45392.65	4000.93	2717	200.05	3800.89	2281.35
160	BM	1	Non-Command	9157	1637.05	2139	81.85	1555.19	1424.06
162	BM	2	Non-Command	11601.44	1268.88	687	63.44	1205.43	482.41
164	BM	3	Non-Command	14769.8	1594.8	2495	79.74	1515.06	1677.61
166	BM	4	Non-Command	17070.97	2260.42	2542	113.02	2147.4	2107.57
168	BM	5	Non-Command	4129.14	679.11	723	67.91	611.2	787.6
170	BM	6	Non-Command	7179.69	1306.81	613	65.34	1241.47	611.62
172	BM	7	Non-Command	6620.57	1702.54	2802	85.13	1617.41	1778.02
174	BM	8	Non-Command	19673.59	2229.3	2251	111.47	2117.84	1682.03
176	BM	9	Non-Command	12037.13	2262.62	1901	113.13	2149.48	1920.03
177	BM	10	Non-Command	10074.39	1214.47	295	60.72	1153.75	266.53
179	BM	11	Non-Command	11290.96	1099.43	1059	54.97	1044.46	783.45
181	BM	12	Non-Command	14755.83	2473.54	1710	123.68	2349.86	1949.03
182	BM	13	Non-Command	10380	1393.71	1347	69.69	1324.02	1059.43
183	BM	17	Non-Command	19858.24	3931.68	2834	196.58	3735.1	2104.07
185	BM	18	Non-Command	17746.4	2379.65	4230	118.98	2260.67	3711.64
187	BM	19	Non-Command	11885.47	1125.15	1035	56.26	1068.89	633.35
189	BM	20	Non-Command	11534.49	1446.53	1742	72.33	1374.2	967.84
191	BM	21	Non-Command	23738.65	2507.5	1142	125.37	2382.12	1240.85
192	BM	22	Non-Command	21080	2674.07	2096	133.7	2540.37	1817.95

193	BM	23	Non-Command	21830	2739.98	1635	137	2602.98	2032.27
194	BM	24	Non-Command	26800	3309.45	540	165.47	3143.97	469.62
195	BM	25	Non-Command	19870	1863.81	1671	93.19	1770.62	1348.31
197	BM	26	Non-Command	10648.12	1356.84	1972	67.84	1289	1620.85
198	BM	27	Non-Command	20284.63	2254.78	2690	112.74	2142.04	1750.15
201	BM	35	Non-Command	11140.72	1280.22	483	64.01	1216.21	357.41
202	BM	36	Non-Command	19300	2183.99	1984	109.2	2074.8	1486.16
203	BM	37	Non-Command	15300	1509.84	382	75.49	1434.35	451.33
205	BM	38	Non-Command	7969.84	953.44	67	47.67	905.77	82.5
206	BM	39	Non-Command	13111.75	1572.86	391	78.64	1494.22	414.82
207	BM	40	Non-Command	9518.24		1089	57.74	1097.03	46.33
209	BM	41	Non-Command	6698.51	1145.93	239	57.3	1088.63	222
210	BM	42	Non-Command	16287.83	1033.97	106	51.7	982.27	120.52
212	BM	43	Non-Command	7615.67	1573.83	148	78.69	1495.14	193.44
213	BM	44	Non-Command	7372.72	1420.72	193	71.04	1349.69	241.07
214	BM	45	Non-Command	12562.48	2312.31	617	115.62	2196.69	641.25
215	BM	46	Non-Command	27290	3974.38	2988	198.72	3775.66	1985.77
217	BM	48	Non-Command	905.42	990.51	271	49.53	940.99	250.84
220	BM	49	Non-Command	14476.4	1335.96	1321	66.8	1269.16	1045.71
223	BM	50	Non-Command	11097.02	1662.58	1446	83.13	1579.45	883.52
226	BM	51	Non-Command	14068.54	1521.72	1224	76.09	1445.63	753.72
228	BM	52	Non-Command	13905.66	1230.93	659	61.55	1169.38	813.41
229	BM	53	Non-Command	13472.92	2203.09	176	110.15	2092.94	154.51
230	BM	54	Non-Command	13092.42	3673.96	11	183.7	3490.26	35.42
232	BM	55	Non-Command	12510.16	907.69	501	45.38	862.31	451.12
233	BM	56	Non-Command	9478	2759.11	118	137.96	2621.15	105.86
234	BM	57	Non-Command	13033.97	1830.02	2621	91.5	1738.52	1503.91
235	BM	58	Non-Command	32620	3968.99	3828	198.45	3770.54	3623.06
236	BM	59	Non-Command	23430	3138.57	3209	156.93	2981.64	3468.68
237	BM	60	Non-Command	24620	2326.28	2815	116.31	2209.96	1864.36
239	BM	61	Non-Command	15882.86	1501.49	1645	75.07	1426.42	1526.29
241	BM	66	Non-Command	1444.31	151.22	176	7.56	143.66	131.12
243	BM	67	Non-Command	11963.22	1056.28	1176	52.81	1003.46	771.45
245	BM	68	Non-Command	11427.59	1010.38	615	50.52	959.86	636.19
247	BM	69	Non-Command	24817.99	2411.09	2385	120.55	2290.53	1455.44
250	BM	70	Non-Command	21817.45	1882.92	2164	94.15	1788.78	1473.35
251	BM	71	Non-Command	10157.64	982.27	92	49.11	933.16	159.44
253	BM	72	Non-Command	16440.73	2215.18	1968	110.76	2104.42	1699.36
255	BM	73	Non-Command	19094.78	2553.2	1939	127.66	2425.54	2374.61
257	BM	74	Non-Command	12250.45	1287.4	2119	64.37	1223.03	1432.16
260	BM	75	Non-Command	11698.58	1584.37	1248	79.22	1505.15	1367.48
263	BM	76	Non-Command	13233.52	2055.12	3025	102.76	1952.37	3316.91
266	BM	77	Non-Command	7471.39	1147.86	2057	57.39	1090.47	1619.95
269	BM	78	Non-Command	1079.41	637.73	41	31.89	605.84	40.41
271	BM	81	Non-Command	13225.88	1411.33	388	70.57	1340.77	298.63

273	SA	5 B	Non-Command	19359	1955.27	967	97.76	1857.51	883.33
275	SA	9	Non-Command	15255	1831.68	987	91.58	1740.09	1001.4
277	SA	10	Non-Command	20392	1935.73	1131	96.79	1838.94	993.22
279	SA	11	Non-Command	9713	1100.31	657	55.02	1045.29	595.06
281	SA	12	Non-Command	18971	2351.37	1351	117.57	2233.8	1313.4
283	SA	13	Non-Command	14818	1848.54	1270	92.43	1756.11	1222.33
285	SA	14	Non-Command	14345	1821.42	1190	91.07	1730.35	1042.17
287	SA	15	Non-Command	22651	2228.74	1363	111.44	2117.3	1175.72
288	BM	81	Non-Command	3510	417.15	140	20.86	396.29	94.18
290	BM	82	Non-Command	28316	4360.43	2500	218.02	4142.41	2000.89
292	BM	83	Non-Command	21082	2172.37	2043	108.62	2063.75	1994.42
294	BM	84	Non-Command	23834	2559.74	2675	127.99	2431.75	2066.53
296	BM	85	Non-Command	27974	2681.82	3320	134.09	2547.73	2344.2
298	BM	86	Non-Command	22398	2259.12	2610	112.96	2146.16	2009.85
300	BM	87	Non-Command	13912	1304.11	970	65.21	1238.9	823.26
301	BM	88	Non-Command	1006	122.24	50	6.11	116.13	39.17
302	BM	89	Non-Command	1621	193.43	26	9.67	183.76	34.85
304	BM	100	Non-Command	34479	4631.11	2980	231.56	4399.55	2628.26
305	BM	101	Non-Command	35459	5307.5	4603	265.37	5042.12	4806.34
306	BM	102	Non-Command	27011	3621.44	2210	181.07	3440.37	1999.9
307	BM	103	Non-Command	19359	2668.54	2260	133.43	2535.12	1745.95
308	BM	104	Non-Command	16323	2023.29	920	101.16	1922.12	989.35
				3423285	389823.8	312895	20136.35	370842.3	259979.3

Annexure 7.3- Ground water draft in Command Area

				Groundwater Draft in the Upper Bhima Sub Basin (K5)					
Sr. No.	Watershed No.		Type of Area	Area (ha.)	Total Recharge	Existing Irrigation Wells	Natural Dishcharge. (Ham)	Net Annual GW Availability (Ham)	Gross Draft (Ham)
2	SA	23	Command	2874	653.01	285	32.65	620.36	288.11
4	SA	24	Command	2015	583.04	1002	29.15	553.88	593.47
6	SA	25	Command	2100	505.16	552	25.26	479.9	405.24
8	SA	27 A	Command	996	285.02	71	14.25	270.77	82.27
11	SA	29 A	Command	2424	505.65	246	25.28	480.37	267.97
14	SA	37 A	Command	800	277	634	13.85	263.15	441.37
16	SA	38 A	Command	645	315.9	740	15.8	300.11	670.14
18	SA	39 A	Command	200	38.4	7	1.92	36.48	10.28
21	SA	43 A	Command	660	367.52	650	18.38	349.14	783.17
28	BM	79	Command	1756	639.52	281	31.98	607.54	326.74
30	BM	80	Command	1518	634.3	435	31.71	602.58	463.71
32	BM	87	Command	2093	664.27	1404	33.21	631.06	1288.63
34	BM	88	Command	7586	3042.51	1617	152.13	2890.38	1193.11
36	BM	89	Command	10011	2332.63	1254	116.63	2216	1354.49
38	BM	90	Command	16870	3325.1	3339	166.26	3158.85	3178.19
40	BM	91	Command	3492	1119.09	610	55.95	1063.14	381.02
42	BM	92	Command	5761	1084.26	924	54.21	1030.04	669.95
44	BM	93	Command	4703	1384.57	6742	138.46	1246.11	4104.59
46	BM	94	Command	11190	1594.78	1955	79.74	1515.05	1025.72
48	BM	95	Command	5559	746.49	854	37.32	709.17	561.96
50	BM	96	Command	34415	4078.07	3001	203.9	3874.16	2728.34
51	BM	97	Command	4537	1252.6	1017	62.63	1189.97	1115.94
53	BM	98	Command	6997	1083.1	574	54.15	1028.94	567.66
55	BM	99	Command	15393	1766.11	1592	88.31	1677.8	1055.11
59	BM	107	Command	10865	1523.51	1906	76.18	1447.34	1303.31
61	BM	108	Command	11327	1338.36	965	66.92	1271.44	697.44
63	BM	109	Command	7453	1102.37	1200	55.12	1047.25	803.93
69	BM	116	Command	13598	1556.8	1026	155.68	1401.12	952
88	SA	36	Command	2285	699.43	417	34.97	664.45	292.53
90	SA	37	Command	3674	792.19	686	39.61	752.58	496.53
92	SA	38	Command	6723	1340.45	1104	67.02	1273.43	1288.46
94	SA	39	Command	9480	1508.44	1424	75.42	1433.02	1269.65
99	BM	5	Command	7854	956.59	863	47.83	908.76	304.83
101	BM	14	Command	11838	2598.03	1515	129.9	2468.13	1062.45
104	BM	16	Command	16077	2073.24	1852	103.66	1969.57	1679.66
106	BM	28	Command	17352	2201.35	1228	110.07	2091.28	907.3
107	BM	29	Command	2465	1206.86	2610	60.34	1146.52	2004.11
109	BM	30	Command	2206	418.35	621	20.92	397.44	526.23

113	BM	33	Command	1159	577.48	1132	28.87	548.6	994.01
131	SA	16	Command	6259	1056.17	484	52.81	1003.36	218.36
137	BM	104	Command	2401	636.77	328	31.84	604.94	340.3
141	BM	113	Command	1751	307.41	188	15.37	292.04	190.65
143	BM	114	Command	721	139.48	124	6.97	132.51	124.31
145	BM	115	Command	395	114.18	232	11.42	102.76	179.12
147	BM	116	Command	755	104.3	151	10.43	93.87	98.18
150	BM	118	Command	170	137.72	43	6.89	130.84	45.87
152	BM	119	Command	71	22.35	24	1.12	21.23	25.77
155	BM	121	Command	170	341.5	1220	17.08	324.43	887.16
158	BM	123	Command	138.35	86.36	53	4.32	82.05	45.46
161	BM	2	Command	619.83	314.57	821	15.73	298.84	443.49
163	BM	3	Command	3955.41	828.68	613	41.43	787.24	394.15
165	BM	4	Command	1609.03	346.4	695	17.32	329.08	410.41
167	BM	5	Command	1630.86	506.93	515	25.35	481.58	517.7
169	BM	6	Command	6391.92	1452.1	1889	72.6	1379.49	1628.54
171	BM	7	Command	5598.01	1553.13	1478	77.66	1475.47	911.16
173	BM	8	Command	1166.41	679.47	835	33.97	645.5	644.64
175	BM	9	Command	7819.25	1345.58	752	134.56	1211.03	886.51
178	BM	11	Command	884.47	217.31	268	10.87	206.44	191.6
180	BM	12	Command	11994.17	2009.94	1768	200.99	1808.95	2053.48
184	BM	18	Command	4153.6	644.09	1141	32.2	611.88	774.49
186	BM	19	Command	8234.53	1221.26	2110	61.06	1160.2	1330.16
188	BM	20	Command	15975.51	1555.11	2997	77.76	1477.35	1432
190	BM	21	Command	1791.35	579.79	784	28.99	550.8	735.08
196	BM	26	Command	21111.88	2068.93	1503	103.45	1965.49	1224.43
199	BM	34	Command	16750	1906.01	2443	95.3	1810.71	1609.97
200	BM	35	Command	17159.28	1781.53	2185	89.08	1692.45	1800.25
204	BM	38	Command	789.45	143.34	26	7.17	136.17	26.03
208	BM	41	Command	2554.49	482.44	184	24.12	458.32	130
211	BM	43	Command	1977.69	565.81	231	28.29	537.52	158.64
216	BM	48	Command	25713.86	2627.04	3290	131.35	2495.69	2233.15
219	BM	49	Command	7995.77	1697.18	2211	84.86	1612.32	1710.01
222	BM	50	Command	10737.21	1710.27	2286	85.51	1624.76	1520.62
225	BM	51	Command	11131.46	1890.21	2976	94.51	1795.69	1986.42
227	BM	52	Command	8224.34	1065.7	1016	53.28	1012.41	798.79
231	BM	55	Command	870.31	469.4	27	23.47	445.93	44.32
238	BM	61	Command	8462.57	2561.59	1268	128.08	2433.51	1021.2
240	BM	66	Command	16525.69	3896.41	2051	194.82	3701.59	1491.29
242	BM	67	Command	10086.78	3458.75	1577	172.94	3285.81	1221.03
244	BM	68	Command	9732.41	1352.5	1433	67.63	1284.88	1281.99
246	BM	69	Command	6429.78	2242.51	3286	112.13	2130.39	3478.07
249	BM	70	Command	3372.55	563.38	1062	28.17	535.21	674.73
252	BM	72	Command	327.43	145.79	41	7.29	138.5	41.18
254	BM	73	Command	1465.22	2049.64	1194	102.48	1947.16	996.82

256	BM	74	Command	6196.37	798.55	812	79.86	718.7	452.74
259	BM	75	Command	13364.59	4706.67	3890	470.67	4236	4011.01
262	BM	76	Command	14786.06	7268.35	6749	363.42	6904.93	6883.14
265	BM	77	Command	12809.35	3024.35	3694	151.22	2873.13	2903.83
268	BM	78	Command	36280.59	3150.71	3111	157.54	2993.17	2337.34
270	BM	81	Command	1137.62	385.71	12	19.29	366.42	23.97
272	SA	5 B	Command	1723	614.43	168	30.72	583.71	156.17
274	SA	9	Command	2478	529.66	274	26.48	503.18	315.79
276	SA	10	Command	1621	477.82	143	23.89	453.93	142.14
278	SA	11	Command	621	453.36	140	45.34	408.02	130.16
280	SA	12	Command	1463	416.32	143	20.82	395.5	175.01
282	SA	13	Command	1715	426.61	210	21.33	405.28	226.38
284	SA	14	Command	1454	375.78	187	18.79	356.99	182.59
286	SA	15	Command	555	121.77	38	6.09	115.68	37.15
289	BM	82	Command	568	263.37	27	13.17	250.21	23.02
291	BM	83	Command	518	1489.21	325	148.92	1340.29	303.9
293	BM	84	Command	2938	1094.52	1045	54.73	1039.8	1048.37
295	BM	85	Command	4229	763.72	1013	38.19	725.54	821.2
297	BM	86	Command	10207	2037.78	2210	101.89	1935.89	1946.76
299	BM	87	Command	2874	1137.25	1506	56.86	1080.38	1243.53
303	BM	100	Command	795	193.67	172	9.68	183.99	179.38
			Total	653358.5	126780.2	124007	7037.21	119743	99640.73

Annexure 7.4 -Groundwater availability and Stage of Development in the Upper Bhima Sub Basin (K5) [Source Groundwater Assessment 2011-12]

Sr. No.	Watershed No.		Type of Area	Net Annual GW Availability (Ham)	Gross Draft (Ham)	Stage of Devel. (%)	Water Table Trend		Category of Water--shed	Net GW avail. For Future Irri. Use (Ham)
							Pre Mon--soon	Post Mon--soon		
1	2		3	4	5	6	7	8	9	10
1	SA	21	Non-Command	1265.62	699.31	55.25	RISING	RISING	SAFE	539.3
2	SA	23	Command	620.36	288.11	79.56	RISING	RISING	SAFE	571.18
3	SA	23	Non-Command	2426.86	2136.21					
4	SA	24	Command	553.88	593.47	54.13	RISING	RISING	SAFE	1816.04
5	SA	24	Non-Command	3524.57	1614.32					
6	SA	25	Command	479.9	405.24	62.38	RISING	RISING	SAFE	1086.77
7	SA	25	Non-Command	2579.25	1503					
8	SA	27 A	Command	270.77	82.27	87.65	RISING	RISING	SAFE	163.13
9	SA	27 A	Non-Command	1327.9	1318.95					
10	SA	28 A	Non-Command	2927.37	1418.72	48.46	RISING	RISING	SAFE	1468.62
11	SA	29 A	Command	480.37	267.97	44.66	RISING	RISING	SAFE	960.4
12	SA	29 A	Non-Command	1292.53	523.87					
13	SA	33 B	Non-Command	435.56	267.4	61.39	RISING	RISING	SAFE	156.43
14	SA	37 A	Command	263.15	441.37	71.63	RISING	RISING	SAFE	647.74
15	SA	37 A	Non-Command	2128.22	1271.6					
16	SA	38 A	Command	300.11	670.14	86.19	RISING	RISING	SAFE	252.39
17	SA	38 A	Non-Command	1748.55	1095.66					
18	SA	39 A	Command	36.48	10.28	64.89	RISING	RISING	SAFE	351.07
19	SA	39 A	Non-Command	1017.4	673.54					
20	SA	40 A	Non-Command	559.69	250.75	44.8	RISING	RISING	SAFE	304.93
21	SA	43 A	Command	349.14	783.17	64.68	RISING	RISING	SAFE	1373.5
22	SA	43 A	Non-Command	3710.01	1842.49					
23	BM	47	Non-Command	674.19	229.56	34.05	RISING	RISING	SAFE	429.66
24	BM	62	Non-Command	1982.94	1150.84	58.04	RISING	RISING	SAFE	787.57
25	BM	63	Non-Command	2501.68	1535.84	61.39	RISING	RISING	SAFE	917.3
26	BM	64	Non-Command	2376.19	944.04	39.73	RISING	RISING	SAFE	1387
27	BM	65	Non-Command	2169.96	1092.98	50.37	RISING	RISING	SAFE	1024.68
28	BM	79	Command	607.54	326.74	83.49	FALLING	RISING	SEMI	551.64
29	BM	79	Non-Command	3124.56	2789.09					
30	BM	80	Command	602.58	463.71	89.2	RISING	RISING	SAFE	316.88
31	BM	80	Non-Command	3312.09	3028.23					
32	BM	87	Command	631.06	1288.63	179.29	FALLING	RISING	OVER	0
33	BM	87	Non-Command	379.32	522.87					
34	BM	88	Command	2890.38	1193.11	63.25	RISING	RISING	SAFE	1911.06
35	BM	88	Non-Command	2780.69	2393.87					
36	BM	89	Command	2216	1354.49	114.98	FALLING	RISING	OVER	0
37	BM	89	Non-Command	2762.51	4369.86					
38	BM	90	Command	3158.85	3178.19	131.69	FALLING	RISING	OVER	0
39	BM	90	Non-Command	3031.85	4974.07					
40	BM	91	Command	1063.14	381.02	46	RISING	RISING	SAFE	1293.44
41	BM	91	Non-Command	1477.01	787.33					
42	BM	92	Command	1030.04	669.95	90.36	FALLING	RISING	SEMI	210.52
43	BM	92	Non-Command	1573.18	1682.22					
44	BM	93	Command	1246.11	4104.59	162.76	FALLING	RISING	OVER	0

45	BM	93	Non-Command	3331.09	3345.11					
46	BM	94	Command	1515.05	1025.72	69.2	RISING	RISING	SAFE	886.43
47	BM	94	Non-Command	1527.9	1080.09					
48	BM	95	Command	709.17	561.96	93.79	FALLING	RISING	SEMI	30.43
49	BM	95	Non-Command	1364.48	1382.86					
50	BM	96	Command	3874.16	2728.34	70.42	RISING	RISING	SAFE	1045.84
51	BM	97	Command	1189.97	1115.94	62.05	RISING	RISING	SAFE	1685.05
52	BM	97	Non-Command	3550.52	1825.49					
53	BM	98	Command	1028.94	567.66	66.07	RISING	RISING	SAFE	579.03
54	BM	98	Non-Command	790.89	634.65					
55	BM	99	Command	1677.8	1055.11	81.26	RISING	RISING	SAFE	650.95
56	BM	99	Non-Command	2184.54	2083.43					
57	BM	105	Non-Command	1809.57	1403.39	77.55	RISING	RISING	SAFE	369.46
58	BM	106	Non-Command	2230.17	1861.31	83.46	RISING	RISING	SAFE	287.09
59	BM	107	Command	1447.34	1303.31	88.53	RISING	RISING	SAFE	454.75
60	BM	107	Non-Command	4152.06	3654.04					
61	BM	108	Command	1271.44	697.44	56.94	RISING	RISING	SAFE	1279.41
62	BM	108	Non-Command	1879.25	1096.43					
63	BM	109	Command	1047.25	803.93	72.96	RISING	RISING	SAFE	599.54
64	BM	109	Non-Command	1403.94	984.58					
65	BM	110	Non-Command	2256.02	1511.35	66.99	RISING	RISING	SAFE	668.58
66	BM	111	Non-Command	1286.17	1260.46	98	FALLING	RISING	SEMI	0
67	BM	112	Non-Command	1845.91	1628.97	88.25	RISING	RISING	SAFE	135.18
68	BM	115	Non-Command	1317.79	1067.39	81	RISING	RISING	SAFE	208.83
69	BM	116	Command	1401.12	952	68.44	RISING	RISING	SAFE	991.14
70	BM	116	Non-Command	2469.25	1696.79					
71	BM	117	Non-Command	1393.08	1242.26	89.17	RISING	RISING	SAFE	103.96
72	BM	119	Non-Command	2546.4	2209.42	86.77	RISING	RISING	SAFE	222.74
73	SA	15	Non-Command	663.57	539.89	81.36	RISING	RISING	SAFE	101.77
74	SA	16	Non-Command	986.92	1164.17	117.96	FALLING	RISING	OVER	0
75	SA	20	Non-Command	1394.22	1183.74	84.9	RISING	RISING	SAFE	157.17
76	SA	21	Non-Command	416.53	361.82	86.87	RISING	RISING	SAFE	39.24
77	SA	22	Non-Command	1544.91	1465.25	94.84	FALLING	RISING	SEMI	13.46
78	SA	26	Non-Command	1600.96	1420.74	88.74	RISING	RISING	SAFE	109.15
79	SA	27	Non-Command	2100.74	2073.1	98.68	FALLING	RISING	SEMI	0
80	SA	28	Non-Command	5654.74	2521.35	44.59	RISING	RISING	SAFE	2973.28
81	SA	29	Non-Command	2577.29	3338.59	129.54	RISING	FALLING	OVER	0
82	SA	30	Non-Command	1988.79	1215.63	61.12	RISING	RISING	SAFE	724.71
83	SA	31	Non-Command	1894.78	1657.46	87.47	RISING	RISING	SAFE	178.11
84	SA	32	Non-Command	2407.23	1599.2	66.43	RISING	RISING	SAFE	722.01
85	SA	33	Non-Command	1824.72	1612.22	88.35	RISING	RISING	SAFE	117.09
86	SA	34	Non-Command	1750.71	1152.5	65.83	RISING	RISING	SAFE	507.35
87	SA	35	Non-Command	1635.91	968.81	59.22	RISING	RISING	SAFE	630.4
88	SA	36	Command	664.45	292.53	52.47	RISING	RISING	SAFE	684.11
89	SA	36	Non-Command	889.98	523.06					
90	SA	37	Command	752.58	496.53	76.62	RISING	RISING	SAFE	439.61
91	SA	37	Non-Command	1603.54	1308.64					
92	SA	38	Command	1273.43	1288.46	60.21	RISING	RISING	SAFE	2769.3
93	SA	38	Non-Command	6162.44	3188.41					
94	SA	39	Command	1433.02	1269.65	72.86	RISING	RISING	SAFE	903.01
95	SA	39	Non-Command	2256.66	1418.74					
96	SA	40	Non-Command	1409.96	678.63	48.13	RISING	RISING	SAFE	706.81
97	SA	41	Non-Command	3077.92	1609.47	52.29	RISING	RISING	SAFE	1385.5

98	BM	1	Non-Command	336.65	111.84	33.22	RISING	RISING	SAFE	197.87
99	BM	5	Command	908.76	304.83	42.25	RISING	RISING	SAFE	1079.76
100	BM	5	Non-Command	1012.3	506.9					
101	BM	14	Command	2468.13	1062.45	61.99	RISING	RISING	SAFE	1291.84
102	BM	14	Non-Command	1034.1	1108.7					
103	BM	15	Non-Command	3815.11	2224.08	58.3	RISING	RISING	SAFE	1519.49
104	BM	16	Command	1969.57	1679.66	92.34	FALLING	RISING	SEMI	160.07
105	BM	16	Non-Command	626.34	717.31					
106	BM	28	Command	2091.28	907.3	43.38	RISING	RISING	SAFE	1158.39
107	BM	29	Command	1146.52	2004.11	102	FALLING	RISING	OVER	0
108	BM	29	Non-Command	1925.32	1129.06					
109	BM	30	Command	397.44	526.23	68.5	RISING	RISING	SAFE	532.81
110	BM	30	Non-Command	1396.9	702.87					
111	BM	31	Non-Command	2486.01	1863.04	74.94	RISING	RISING	SAFE	586.11
112	BM	32	Non-Command	3074.86	2608.52	84.83	RISING	RISING	SAFE	442.69
113	BM	33	Command	548.6	994.01	88.65	FALLING	RISING	SEMI	259.41
114	BM	33	Non-Command	2121.6	1373.17					
115	BM	33	Poor Quality	540.99	471.57					
116	BM	47	Non-Command	3724.58	2508.72	67.36	RISING	RISING	SAFE	1180.46
117	SA	1	Non-Command	1690.95	1445.8	85.5	RISING	RISING	SAFE	184.2
118	SA	1	Poor Quality	460.06	0					
119	SA	2	Non-Command	3727.15	3038.6	81.53	FALLING	RISING	SEMI	606.79
120	SA	3	Non-Command	1641.67	1380.55	84.09	RISING	RISING	SAFE	222.61
121	SA	4	Non-Command	2686.58	2170.91	80.81	FALLING	RISING	SEMI	481.73
122	SA	5	Non-Command	1966.63	1893.54	96.28	FALLING	RISING	SEMI	33.67
123	SA	6	Non-Command	1293.17	1043.39	80.68	RISING	RISING	SAFE	220.39
124	SA	7	Non-Command	463.72	189	40.76	RISING	RISING	SAFE	268.89
125	SA	8	Non-Command	1324.1	1182.52	89.31	RISING	RISING	SAFE	108.19
126	SA	10	Non-Command	716.85	230.7	32.18	RISING	RISING	SAFE	465.52
127	SA	11	Non-Command	1613.16	882.34	54.7	RISING	RISING	SAFE	710.18
128	SA	12	Non-Command	3186.53	1692.56	53.12	RISING	RISING	SAFE	1456.56
129	SA	14	Non-Command	600.12	387.29	64.53	RISING	RISING	SAFE	199.7
130	SA	15	Non-Command	2279.62	818.32	35.9	RISING	RISING	SAFE	1429.36
131	SA	16	Command	1003.36	218.36	57.04	RISING	RISING	SAFE	1121.91
132	SA	16	Non-Command	1699.01	1323.04					
133	SA	17	Non-Command	3027.35	1266.37	41.83	RISING	RISING	SAFE	1688.52
134	SA	18	Non-Command	1306.54	621.17	47.54	RISING	RISING	SAFE	672.96
135	SA	19	Non-Command	2578.35	1524.34	59.12	RISING	RISING	SAFE	981.19
136	BM	103	Non-Command	776.42	448.51	57.77	RISING	RISING	SAFE	310.84
137	BM	104	Command	604.94	340.3	53.63	RISING	RISING	SAFE	1064.6
138	BM	104	Non-Command	1760.84	928.5					
139	BM	105	Non-Command	271.45	228.83	84.3	RISING	RISING	SAFE	35.33
140	BM	112	Non-Command	135.22	72.36	53.52	RISING	RISING	SAFE	57.45
141	BM	113	Command	292.04	190.65	96.09	FALLING	RISING	SEMI	40.21
142	BM	113	Non-Command	1664.83	1689.66					
143	BM	114	Command	132.51	124.31	88.77	RISING	RISING	SAFE	192.9
144	BM	114	Non-Command	2122.07	1877.13					
145	BM	115	Command	102.76	179.12	89.8	RISING	FALLING	SEMI	40.03
146	BM	115	Non-Command	561.09	417					
147	BM	116	Command	93.87	98.18	65.47	RISING	RISING	SAFE	325.1
148	BM	116	Non-Command	928.02	570.87					
149	BM	117	Non-Command	1242.48	864.8	69.6	RISING	RISING	SAFE	334.43
150	BM	118	Command	130.84	45.87	56.7	RISING	RISING	SAFE	1584.87

151	BM	118	Non-Command	3722.75	2139.11					
152	BM	119	Command	21.23	25.77	78.9	RISING	RISING	SAFE	264.21
153	BM	119	Non-Command	1418.06	1109.89					
154	BM	120	Non-Command	634.74	396.34	62.44	RISING	RISING	SAFE	228.72
155	BM	121	Command	324.43	887.16	64.09	RISING	RISING	SAFE	1293.13
156	BM	121	Non-Command	3475.76	1548.43					
157	BM	122	Non-Command	3357.18	2846.2	84.78	RISING	RISING	SAFE	438.9
158	BM	123	Command	82.05	45.46	59.92	RISING	RISING	SAFE	1459.05
159	BM	123	Non-Command	3800.89	2281.35					
160	BM	1	Non-Command	1555.19	1424.06	91.57	FALLING	RISING	SEMI	57.69
161	BM	2	Command	298.84	443.49	61.55	RISING	RISING	SAFE	512.92
162	BM	2	Non-Command	1205.43	482.41					
163	BM	3	Command	787.24	394.15	89.99	RISING	RISING	SAFE	155.63
164	BM	3	Non-Command	1515.06	1677.61					
165	BM	4	Command	329.08	410.41	101.68	FALLING	RISING	OVER	0
166	BM	4	Non-Command	2147.4	2107.57					
167	BM	5	Command	481.58	517.7	119.45	FALLING	RISING	OVER	0
168	BM	5	Non-Command	611.2	787.6					
169	BM	6	Command	1379.49	1628.54	85.47	RISING	RISING	SAFE	330.41
170	BM	6	Non-Command	1241.47	611.62					
171	BM	7	Command	1475.47	911.16	86.95	RISING	RISING	SAFE	331.86
172	BM	7	Non-Command	1617.41	1778.02					
173	BM	8	Command	645.5	644.64	84.2	RISING	RISING	SAFE	355.3
174	BM	8	Non-Command	2117.84	1682.03					
175	BM	9	Command	1211.03	886.51	83.52	FALLING	RISING	SEMI	426.78
176	BM	9	Non-Command	2149.48	1920.03					
177	BM	10	Non-Command	1153.75	266.53	23.1	RISING	RISING	SAFE	842.25
178	BM	11	Command	206.44	191.6	77.95	FALLING	RISING	SEMI	198.33
179	BM	11	Non-Command	1044.46	783.45					
180	BM	12	Command	1808.95	2053.48	96.24	FALLING	RISING	SEMI	0
181	BM	12	Non-Command	2349.86	1949.03					
182	BM	13	Non-Command	1324.02	1059.43	80.02	RISING	RISING	SAFE	231.15
183	BM	17	Non-Command	3735.1	2104.07	56.33	RISING	RISING	SAFE	1557.54
184	BM	18	Command	611.88	774.49	156.17	FALLING	RISING	OVER	0
185	BM	18	Non-Command	2260.67	3711.64					
186	BM	19	Command	1160.2	1330.16	88.09	RISING	RISING	SAFE	134.63
187	BM	19	Non-Command	1068.89	633.35					
188	BM	20	Command	1477.35	1432	84.16	FALLING	RISING	SEMI	308.58
189	BM	20	Non-Command	1374.2	967.84					
190	BM	21	Command	550.8	735.08	67.37	RISING	RISING	SAFE	719.07
191	BM	21	Non-Command	2382.12	1240.85					
192	BM	22	Non-Command	2540.37	1817.95	71.56	RISING	RISING	SAFE	524.07
193	BM	23	Non-Command	2602.98	2032.27	78.07	RISING	RISING	SAFE	383.15
194	BM	24	Non-Command	3143.97	469.62	14.94	RISING	RISING	SAFE	2637.53
195	BM	25	Non-Command	1770.62	1348.31	76.15	RISING	RISING	SAFE	323.41
196	BM	26	Command	1965.49	1224.43	87.43	RISING	RISING	SAFE	195.49
197	BM	26	Non-Command	1289	1620.85					
198	BM	27	Non-Command	2142.04	1750.15	81.7	RISING	RISING	SAFE	319.46
199	BM	34	Command	1810.71	1609.97	88.91	RISING	RISING	SAFE	184.25
200	BM	35	Command	1692.45	1800.25	74.18	RISING	RISING	SAFE	577.49
201	BM	35	Non-Command	1216.21	357.41					
202	BM	36	Non-Command	2074.8	1486.16	71.63	RISING	RISING	SAFE	546.18
203	BM	37	Non-Command	1434.35	451.33	31.47	RISING	RISING	SAFE	975.22

204	BM	38	Command	136.17	26.03	10.42	RISING	RISING	SAFE	889.45
205	BM	38	Non-Command	905.77	82.5					
206	BM	39	Non-Command	1494.22	414.82	27.76	RISING	RISING	SAFE	940.74
207	BM	40	Non-Command	1097.03	46.33	4.22	RISING	RISING	SAFE	1004.37
208	BM	41	Command	458.32	130	22.75	RISING	RISING	SAFE	1116.45
209	BM	41	Non-Command	1088.63	222					
210	BM	42	Non-Command	982.27	120.52	12.27	RISING	RISING	SAFE	840.63
211	BM	43	Command	537.52	158.64	17.32	RISING	RISING	SAFE	1567.52
212	BM	43	Non-Command	1495.14	193.44					
213	BM	44	Non-Command	1349.69	241.07	17.86	RISING	RISING	SAFE	1012.25
214	BM	45	Non-Command	2196.69	641.25	29.19	RISING	RISING	SAFE	1383.88
215	BM	46	Non-Command	3775.66	1985.77	52.59	RISING	RISING	SAFE	1753.26
216	BM	48	Command	2495.69	2233.15	72.28	RISING	RISING	SAFE	908.22
217	BM	48	Non-Command	940.99	250.84					
218	BM	48	Poor Quality	457.39	341.04					
219	BM	49	Command	1612.32	1710.01	95.64	FALLING	RISING	SEMI	0
220	BM	49	Non-Command	1269.16	1045.71					
221	BM	49	Poor Quality	246.12	137.86					
222	BM	50	Command	1624.76	1520.62	75.03	RISING	RISING	SAFE	720.6
223	BM	50	Non-Command	1579.45	883.52					
224	BM	50	Poor Quality	296.73	234.08					
225	BM	51	Command	1795.69	1986.42	84.54	FALLING	RISING	SEMI	309.34
226	BM	51	Non-Command	1445.63	753.72					
227	BM	52	Command	1012.41	798.79	73.89	RISING	RISING	SAFE	487.19
228	BM	52	Non-Command	1169.38	813.41					
229	BM	53	Non-Command	2092.94	154.51	7.38	RISING	RISING	SAFE	1881.83
230	BM	54	Non-Command	3490.26	35.42	1.01	RISING	RISING	SAFE	3426.42
231	BM	55	Command	445.93	44.32	37.87	RISING	RISING	SAFE	628.32
232	BM	55	Non-Command	862.31	451.12					
233	BM	56	Non-Command	2621.15	105.86	4.04	RISING	RISING	SAFE	2472.25
234	BM	57	Non-Command	1738.52	1503.91	86.51	RISING	RISING	SAFE	162.99
235	BM	58	Non-Command	3770.54	3623.06	96.09	FALLING	RISING	SEMI	36.88
236	BM	59	Non-Command	2981.64	3468.68	116.33	FALLING	RISING	OVER	0
237	BM	60	Non-Command	2209.96	1864.36	84.36	FALLING	RISING	SEMI	268.66
238	BM	61	Command	2433.51	1021.2	66	RISING	RISING	SAFE	1264.63
239	BM	61	Non-Command	1426.42	1526.29					
240	BM	66	Command	3701.59	1491.29	42.19	RISING	RISING	SAFE	2032.42
241	BM	66	Non-Command	143.66	131.12					
242	BM	67	Command	3285.81	1221.03	46.45	RISING	RISING	SAFE	2076.75
243	BM	67	Non-Command	1003.46	771.45					
244	BM	68	Command	1284.88	1281.99	85.45	RISING	RISING	SAFE	298.72
245	BM	68	Non-Command	959.86	636.19					
246	BM	69	Command	2130.39	3478.07	111.59	FALLING	RISING	OVER	0
247	BM	69	Non-Command	2290.53	1455.44					
248	BM	69	Poor Quality	142.14	100.83					
249	BM	70	Command	535.21	674.73	92.43	FALLING	RISING	SEMI	65.82
250	BM	70	Non-Command	1788.78	1473.35					
251	BM	71	Non-Command	933.16	159.44	17.09	RISING	RISING	SAFE	678.77
252	BM	72	Command	138.5	41.18	77.6	RISING	RISING	SAFE	416.91
253	BM	72	Non-Command	2104.42	1699.36					
254	BM	73	Command	1947.16	996.82	77.1	RISING	RISING	SAFE	960.79
255	BM	73	Non-Command	2425.54	2374.61					
256	BM	74	Command	718.7	452.74	97.07	FALLING	RISING	SEMI	0

257	BM	74	Non-Command	1223.03	1432.16					
258	BM	74	Poor Quality	44.05	86.8					
259	BM	75	Command	4236	4011.01	93.68	FALLING	RISING	SEMI	253.03
260	BM	75	Non-Command	1505.15	1367.48					
261	BM	75	Poor Quality	172.65	336.77					
262	BM	76	Command	6904.93	6883.14	115.16	FALLING	RISING	OVER	0
263	BM	76	Non-Command	1952.37	3316.91					
264	BM	76	Poor Quality	514.59	1020.76					
265	BM	77	Command	2873.13	2903.83	114.13	FALLING	FALLING	OVER	0
266	BM	77	Non-Command	1090.47	1619.95					
267	BM	77	Poor Quality	113.47	332.68					
268	BM	78	Command	2993.17	2337.34	66.07	RISING	RISING	SAFE	971.69
269	BM	78	Non-Command	605.84	40.41					
270	BM	81	Command	366.42	23.97	18.9	RISING	RISING	SAFE	1251
271	BM	81	Non-Command	1340.77	298.63					
272	SA	5 B	Command	583.71	156.17	42.58	RISING	RISING	SAFE	1281.12
273	SA	5 B	Non-Command	1857.51	883.33					
274	SA	9	Command	503.18	315.79	58.72	RISING	RISING	SAFE	783.2
275	SA	9	Non-Command	1740.09	1001.4					
276	SA	10	Command	453.93	142.14	49.52	RISING	RISING	SAFE	1067.44
277	SA	10	Non-Command	1838.94	993.22					
278	SA	11	Command	408.02	130.16	49.9	RISING	RISING	SAFE	670.28
279	SA	11	Non-Command	1045.29	595.06					
280	SA	12	Command	395.5	175.01	56.61	RISING	RISING	SAFE	1005.21
281	SA	12	Non-Command	2233.8	1313.4					
282	SA	13	Command	405.28	226.38	67.03	RISING	RISING	SAFE	590.03
283	SA	13	Non-Command	1756.11	1222.33					
284	SA	14	Command	356.99	182.59	58.68	RISING	RISING	SAFE	762.83
285	SA	14	Non-Command	1730.35	1042.17					
286	SA	15	Command	115.68	37.15	54.32	RISING	RISING	SAFE	980.63
287	SA	15	Non-Command	2117.3	1175.72					
288	BM	81	Non-Command	396.29	94.18	23.76	RISING	RISING	SAFE	286.4
289	BM	82	Command	250.21	23.02	46.08	RISING	RISING	SAFE	2269.01
290	BM	82	Non-Command	4142.41	2000.89					
291	BM	83	Command	1340.29	303.9	67.52	RISING	RISING	SAFE	990.93
292	BM	83	Non-Command	2063.75	1994.42					
293	BM	84	Command	1039.8	1048.37	89.73	RISING	RISING	SAFE	203.32
294	BM	84	Non-Command	2431.75	2066.53					
295	BM	85	Command	725.54	821.2	96.7	FALLING	RISING	SEMI	2.57
296	BM	85	Non-Command	2547.73	2344.2					
297	BM	86	Command	1935.89	1946.76	96.93	FALLING	RISING	SEMI	4.34
298	BM	86	Non-Command	2146.16	2009.85					
299	BM	87	Command	1080.38	1243.53	89.11	RISING	RISING	SAFE	195.2
300	BM	87	Non-Command	1238.9	823.26					
301	BM	88	Non-Command	116.13	39.17	33.73	RISING	RISING	SAFE	56.54
302	BM	89	Non-Command	183.76	34.85	18.97	RISING	RISING	SAFE	131.61
303	BM	100	Command	183.99	179.38	61.25	RISING	RISING	SAFE	1664.54
304	BM	100	Non-Command	4399.55	2628.26					
305	BM	101	Non-Command	5042.12	4806.34	95.32	FALLING	RISING	SEMI	37.95
306	BM	102	Non-Command	3440.37	1999.9	58.13	RISING	RISING	SAFE	1372.87
307	BM	103	Non-Command	2535.12	1745.95	68.87	RISING	RISING	SAFE	726.97
308	BM	104	Non-Command	1922.12	989.35	51.47	RISING	RISING	SAFE	820.06
Total				493573.45	362682.39	69.61				129626
Total (values in Mm^3)				4935.73	3626.82					1296.26

Annexure 7. 5 The Stage of development for the watersheds, Categories of the watersheds and the groundwater availability for the future development in Upper Bhima Sub Basin.

Sr. No.	Watershed No.		Type of Area	Net Annual GW Availability (Ham)	Gross Draft (Ham)	Stage of Devel. (%)	Category of Water--shed	Net GW avail. For Future Irri. Use (Ham)	Additional Feasible Wells @1.5 Ham/Well	Add.land to be Irrigated @2 Ha/Well
1	2		3	4	5	6	7	8	9	10
1	SA	21	Non-Command	1265.62	699.31	55.25	SAFE	539.3	360	719
2	SA	23	Command	620.36	288.11				381	762
3	SA	23	Non-Command	2426.86	2136.21	79.56	SAFE	571.18		
4	SA	24	Command	553.88	593.47				1211	2421
5	SA	24	Non-Command	3524.57	1614.32	54.13	SAFE	1816.04		
6	SA	25	Command	479.9	405.24				725	1449
7	SA	25	Non-Command	2579.25	1503	62.38	SAFE	1086.77	0	0
8	SA	27 A	Command	270.77	82.27				109	218
9	SA	27 A	Non-Command	1327.9	1318.95	87.65	SAFE	163.13	0	0
10	SA	28 A	Non-Command	2927.37	1418.72	48.46	SAFE	1468.62	979	1958
11	SA	29 A	Command	480.37	267.97				640	1281
12	SA	29 A	Non-Command	1292.53	523.87	44.66	SAFE	960.4	0	0
13	SA	33 B	Non-Command	435.56	267.4	61.39	SAFE	156.43	104	209
14	SA	37 A	Command	263.15	441.37				432	864
15	SA	37 A	Non-Command	2128.22	1271.6	71.63	SAFE	647.74	0	0
16	SA	38 A	Command	300.11	670.14				168	337
17	SA	38 A	Non-Command	1748.55	1095.66	86.19	SAFE	252.39	0	0
18	SA	39 A	Command	36.48	10.28				234	468
19	SA	39 A	Non-Command	1017.4	673.54	64.89	SAFE	351.07	0	0
20	SA	40 A	Non-Command	559.69	250.75	44.8	SAFE	304.93	203	407
21	SA	43 A	Command	349.14	783.17				916	1831
22	SA	43 A	Non-Command	3710.01	1842.49	64.68	SAFE	1373.5	0	0
23	BM	47	Non-Command	674.19	229.56	34.05	SAFE	429.66	286	573
24	BM	62	Non-Command	1982.94	1150.84	58.04	SAFE	787.57	525	1050
25	BM	63	Non-Command	2501.68	1535.84	61.39	SAFE	917.3	612	1223
26	BM	64	Non-Command	2376.19	944.04	39.73	SAFE	1387	925	1849
27	BM	65	Non-Command	2169.96	1092.98	50.37	SAFE	1024.68	683	1366
28	BM	79	Command	607.54	326.74				368	736
29	BM	79	Non-Command	3124.56	2789.09	83.49	SEMI	551.64	0	0
30	BM	80	Command	602.58	463.71				211	423
31	BM	80	Non-Command	3312.09	3028.23	89.2	SAFE	316.88	0	0
32	BM	87	Command	631.06	1288.63				0	0
33	BM	87	Non-Command	379.32	522.87	179.29	OVER	0	0	0
34	BM	88	Command	2890.38	1193.11	63.25	SAFE	1911.06	1274	2548

35	BM	88	Non-Command	2780.69	2393.87				0	0
36	BM	89	Command	2216	1354.49				0	0
37	BM	89	Non-Command	2762.51	4369.86	114.98	OVER	0	0	0
38	BM	90	Command	3158.85	3178.19				0	0
39	BM	90	Non-Command	3031.85	4974.07	131.69	OVER	0	0	0
40	BM	91	Command	1063.14	381.02				862	1725
41	BM	91	Non-Command	1477.01	787.33	46	SAFE	1293.44	0	0
42	BM	92	Command	1030.04	669.95				140	281
43	BM	92	Non-Command	1573.18	1682.22	90.36	SEMI	210.52	0	0
44	BM	93	Command	1246.11	4104.59				0	0
45	BM	93	Non-Command	3331.09	3345.11	162.76	OVER	0	0	0
46	BM	94	Command	1515.05	1025.72				591	1182
47	BM	94	Non-Command	1527.9	1080.09	69.2	SAFE	886.43	0	0
48	BM	95	Command	709.17	561.96				20	41
49	BM	95	Non-Command	1364.48	1382.86	93.79	SEMI	30.43	0	0
50	BM	96	Command	3874.16	2728.34	70.42	SAFE	1045.84	697	1394
51	BM	97	Command	1189.97	1115.94				1123	2247
52	BM	97	Non-Command	3550.52	1825.49	62.05	SAFE	1685.05	0	0
53	BM	98	Command	1028.94	567.66				386	772
54	BM	98	Non-Command	790.89	634.65	66.07	SAFE	579.03	0	0
55	BM	99	Command	1677.8	1055.11				434	868
56	BM	99	Non-Command	2184.54	2083.43	81.26	SAFE	650.95	0	0
57	BM	105	Non-Command	1809.57	1403.39	77.55	SAFE	369.46	246	493
58	BM	106	Non-Command	2230.17	1861.31	83.46	SAFE	287.09	191	383
59	BM	107	Command	1447.34	1303.31				303	606
60	BM	107	Non-Command	4152.06	3654.04	88.53	SAFE	454.75	0	0
61	BM	108	Command	1271.44	697.44				853	1706
62	BM	108	Non-Command	1879.25	1096.43	56.94	SAFE	1279.41	0	0
63	BM	109	Command	1047.25	803.93				400	799
64	BM	109	Non-Command	1403.94	984.58	72.96	SAFE	599.54	0	0
65	BM	110	Non-Command	2256.02	1511.35	66.99	SAFE	668.58	446	891
66	BM	111	Non-Command	1286.17	1260.46	98	SEMI	0	0	0
67	BM	112	Non-Command	1845.91	1628.97	88.25	SAFE	135.18	90	180
68	BM	115	Non-Command	1317.79	1067.39	81	SAFE	208.83	139	278
69	BM	116	Command	1401.12	952				661	1322
70	BM	116	Non-Command	2469.25	1696.79	68.44	SAFE	991.14	0	0
71	BM	117	Non-Command	1393.08	1242.26	89.17	SAFE	103.96	69	139
72	BM	119	Non-Command	2546.4	2209.42	86.77	SAFE	222.74	148	297
73	SA	15	Non-Command	663.57	539.89	81.36	SAFE	101.77	68	136
74	SA	16	Non-Command	986.92	1164.17	117.96	OVER	0	0	0
75	SA	20	Non-Command	1394.22	1183.74	84.9	SAFE	157.17	105	210
76	SA	21	Non-Command	416.53	361.82	86.87	SAFE	39.24	26	52

77	SA	22	Non-Command	1544.91	1465.25	94.84	SEMI	13.46	9	18
78	SA	26	Non-Command	1600.96	1420.74	88.74	SAFE	109.15	73	146
79	SA	27	Non-Command	2100.74	2073.1	98.68	SEMI	0	0	0
80	SA	28	Non-Command	5654.74	2521.35	44.59	SAFE	2973.28	1982	3964
81	SA	29	Non-Command	2577.29	3338.59	129.54	OVER	0	0	0
82	SA	30	Non-Command	1988.79	1215.63	61.12	SAFE	724.71	483	966
83	SA	31	Non-Command	1894.78	1657.46	87.47	SAFE	178.11	119	237
84	SA	32	Non-Command	2407.23	1599.2	66.43	SAFE	722.01	481	963
85	SA	33	Non-Command	1824.72	1612.22	88.35	SAFE	117.09	78	156
86	SA	34	Non-Command	1750.71	1152.5	65.83	SAFE	507.35	338	676
87	SA	35	Non-Command	1635.91	968.81	59.22	SAFE	630.4	420	841
88	SA	36	Command	664.45	292.53				456	912
89	SA	36	Non-Command	889.98	523.06	52.47	SAFE	684.11	0	0
90	SA	37	Command	752.58	496.53				293	586
91	SA	37	Non-Command	1603.54	1308.64	76.62	SAFE	439.61	0	0
92	SA	38	Command	1273.43	1288.46				1846	3692
93	SA	38	Non-Command	6162.44	3188.41	60.21	SAFE	2769.3	0	0
94	SA	39	Command	1433.02	1269.65				602	1204
95	SA	39	Non-Command	2256.66	1418.74	72.86	SAFE	903.01	0	0
96	SA	40	Non-Command	1409.96	678.63	48.13	SAFE	706.81	471	942
97	SA	41	Non-Command	3077.92	1609.47	52.29	SAFE	1385.5	924	1847
98	BM	1	Non-Command	336.65	111.84	33.22	SAFE	197.87	132	264
99	BM	5	Command	908.76	304.83				720	1440
100	BM	5	Non-Command	1012.3	506.9	42.25	SAFE	1079.76	0	0
101	BM	14	Command	2468.13	1062.45				861	1722
102	BM	14	Non-Command	1034.1	1108.7	61.99	SAFE	1291.84	0	0
103	BM	15	Non-Command	3815.11	2224.08	58.3	SAFE	1519.49	1013	2026
104	BM	16	Command	1969.57	1679.66				107	213
105	BM	16	Non-Command	626.34	717.31	92.34	SEMI	160.07	0	0
106	BM	28	Command	2091.28	907.3	43.38	SAFE	1158.39	772	1545
107	BM	29	Command	1146.52	2004.11				0	0
108	BM	29	Non-Command	1925.32	1129.06	102	OVER	0	0	0
109	BM	30	Command	397.44	526.23				355	710
110	BM	30	Non-Command	1396.9	702.87	68.5	SAFE	532.81	0	0
111	BM	31	Non-Command	2486.01	1863.04	74.94	SAFE	586.11	391	781
112	BM	32	Non-Command	3074.86	2608.52	84.83	SAFE	442.69	295	590
113	BM	33	Command	548.6	994.01				173	346
114	BM	33	Non-Command	2121.6	1373.17	88.65	SEMI	259.41	0	0
115	BM	33	Poor Quality	540.99	471.57				0	0
116	BM	47	Non-Command	3724.58	2508.72	67.36	SAFE	1180.46	787	1574
117	SA	1	Non-Command	1690.95	1445.8	85.5	SAFE	184.2	123	246
118	SA	1	Poor Quality	460.06	0				0	0

119	SA	2	Non-Command	3727.15	3038.6	81.53	SEMI	606.79	405	809
120	SA	3	Non-Command	1641.67	1380.55	84.09	SAFE	222.61	148	297
121	SA	4	Non-Command	2686.58	2170.91	80.81	SEMI	481.73	321	642
122	SA	5	Non-Command	1966.63	1893.54	96.28	SEMI	33.67	22	45
123	SA	6	Non-Command	1293.17	1043.39	80.68	SAFE	220.39	147	294
124	SA	7	Non-Command	463.72	189	40.76	SAFE	268.89	179	359
125	SA	8	Non-Command	1324.1	1182.52	89.31	SAFE	108.19	72	144
126	SA	10	Non-Command	716.85	230.7	32.18	SAFE	465.52	310	621
127	SA	11	Non-Command	1613.16	882.34	54.7	SAFE	710.18	473	947
128	SA	12	Non-Command	3186.53	1692.56	53.12	SAFE	1456.56	971	1942
129	SA	14	Non-Command	600.12	387.29	64.53	SAFE	199.7	133	266
130	SA	15	Non-Command	2279.62	818.32	35.9	SAFE	1429.36	953	1906
131	SA	16	Command	1003.36	218.36				748	1496
132	SA	16	Non-Command	1699.01	1323.04	57.04	SAFE	1121.91	0	0
133	SA	17	Non-Command	3027.35	1266.37	41.83	SAFE	1688.52	1126	2251
134	SA	18	Non-Command	1306.54	621.17	47.54	SAFE	672.96	449	897
135	SA	19	Non-Command	2578.35	1524.34	59.12	SAFE	981.19	654	1308
136	BM	103	Non-Command	776.42	448.51	57.77	SAFE	310.84	207	414
137	BM	104	Command	604.94	340.3				710	1419
138	BM	104	Non-Command	1760.84	928.5	53.63	SAFE	1064.6	0	0
139	BM	105	Non-Command	271.45	228.83	84.3	SAFE	35.33	24	47
140	BM	112	Non-Command	135.22	72.36	53.52	SAFE	57.45	38	77
141	BM	113	Command	292.04	190.65				27	54
142	BM	113	Non-Command	1664.83	1689.66	96.09	SEMI	40.21	0	0
143	BM	114	Command	132.51	124.31				129	257
144	BM	114	Non-Command	2122.07	1877.13	88.77	SAFE	192.9	0	0
145	BM	115	Command	102.76	179.12				27	53
146	BM	115	Non-Command	561.09	417	89.8	SEMI	40.03	0	0
147	BM	116	Command	93.87	98.18				217	433
148	BM	116	Non-Command	928.02	570.87	65.47	SAFE	325.1	0	0
149	BM	117	Non-Command	1242.48	864.8	69.6	SAFE	334.43	223	446
150	BM	118	Command	130.84	45.87				1057	2113
151	BM	118	Non-Command	3722.75	2139.11	56.7	SAFE	1584.87	0	0
152	BM	119	Command	21.23	25.77				176	352
153	BM	119	Non-Command	1418.06	1109.89	78.9	SAFE	264.21	0	0
154	BM	120	Non-Command	634.74	396.34	62.44	SAFE	228.72	152	305
155	BM	121	Command	324.43	887.16				862	1724
156	BM	121	Non-Command	3475.76	1548.43	64.09	SAFE	1293.13	0	0
157	BM	122	Non-Command	3357.18	2846.2	84.78	SAFE	438.9	293	585
158	BM	123	Command	82.05	45.46				973	1945
159	BM	123	Non-Command	3800.89	2281.35	59.92	SAFE	1459.05	0	0
160	BM	1	Non-Command	1555.19	1424.06	91.57	SEMI	57.69	38	77

161	BM	2	Command	298.84	443.49				342	684
162	BM	2	Non-Command	1205.43	482.41	61.55	SAFE	512.92	0	0
163	BM	3	Command	787.24	394.15				104	208
164	BM	3	Non-Command	1515.06	1677.61	89.99	SAFE	155.63	0	0
165	BM	4	Command	329.08	410.41				0	0
166	BM	4	Non-Command	2147.4	2107.57	101.68	OVER	0	0	0
167	BM	5	Command	481.58	517.7				0	0
168	BM	5	Non-Command	611.2	787.6	119.45	OVER	0	0	0
169	BM	6	Command	1379.49	1628.54				220	441
170	BM	6	Non-Command	1241.47	611.62	85.47	SAFE	330.41	0	0
171	BM	7	Command	1475.47	911.16				221	442
172	BM	7	Non-Command	1617.41	1778.02	86.95	SAFE	331.86	0	0
173	BM	8	Command	645.5	644.64				237	474
174	BM	8	Non-Command	2117.84	1682.03	84.2	SAFE	355.3	0	0
175	BM	9	Command	1211.03	886.51				285	569
176	BM	9	Non-Command	2149.48	1920.03	83.52	SEMI	426.78	0	0
177	BM	10	Non-Command	1153.75	266.53	23.1	SAFE	842.25	562	1123
178	BM	11	Command	206.44	191.6				132	264
179	BM	11	Non-Command	1044.46	783.45	77.95	SEMI	198.33	0	0
180	BM	12	Command	1808.95	2053.48				0	0
181	BM	12	Non-Command	2349.86	1949.03	96.24	SEMI	0	0	0
182	BM	13	Non-Command	1324.02	1059.43	80.02	SAFE	231.15	154	308
183	BM	17	Non-Command	3735.1	2104.07	56.33	SAFE	1557.54	1038	2077
184	BM	18	Command	611.88	774.49				0	0
185	BM	18	Non-Command	2260.67	3711.64	156.17	OVER	0	0	0
186	BM	19	Command	1160.2	1330.16				90	180
187	BM	19	Non-Command	1068.89	633.35	88.09	SAFE	134.63	0	0
188	BM	20	Command	1477.35	1432				206	411
189	BM	20	Non-Command	1374.2	967.84	84.16	SEMI	308.58	0	0
190	BM	21	Command	550.8	735.08				479	959
191	BM	21	Non-Command	2382.12	1240.85	67.37	SAFE	719.07	0	0
192	BM	22	Non-Command	2540.37	1817.95	71.56	SAFE	524.07	349	699
193	BM	23	Non-Command	2602.98	2032.27	78.07	SAFE	383.15	255	511
194	BM	24	Non-Command	3143.97	469.62	14.94	SAFE	2637.53	1758	3517
195	BM	25	Non-Command	1770.62	1348.31	76.15	SAFE	323.41	216	431
196	BM	26	Command	1965.49	1224.43				130	261
197	BM	26	Non-Command	1289	1620.85	87.43	SAFE	195.49	0	0
198	BM	27	Non-Command	2142.04	1750.15	81.7	SAFE	319.46	213	426
199	BM	34	Command	1810.71	1609.97	88.91	SAFE	184.25	123	246
200	BM	35	Command	1692.45	1800.25				385	770
201	BM	35	Non-Command	1216.21	357.41	74.18	SAFE	577.49	0	0
202	BM	36	Non-Command	2074.8	1486.16	71.63	SAFE	546.18	364	728

203	BM	37	Non-Command	1434.35	451.33	31.47	SAFE	975.22	650	1300
204	BM	38	Command	136.17	26.03				593	1186
205	BM	38	Non-Command	905.77	82.5	10.42	SAFE	889.45	0	0
206	BM	39	Non-Command	1494.22	414.82	27.76	SAFE	940.74	627	1254
207	BM	40	Non-Command	1097.03	46.33	4.22	SAFE	1004.37	670	1339
208	BM	41	Command	458.32	130				744	1489
209	BM	41	Non-Command	1088.63	222	22.75	SAFE	1116.45	0	0
210	BM	42	Non-Command	982.27	120.52	12.27	SAFE	840.63	560	1121
211	BM	43	Command	537.52	158.64				1045	2090
212	BM	43	Non-Command	1495.14	193.44	17.32	SAFE	1567.52	0	0
213	BM	44	Non-Command	1349.69	241.07	17.86	SAFE	1012.25	675	1350
214	BM	45	Non-Command	2196.69	641.25	29.19	SAFE	1383.88	923	1845
215	BM	46	Non-Command	3775.66	1985.77	52.59	SAFE	1753.26	1169	2338
216	BM	48	Command	2495.69	2233.15				605	1211
217	BM	48	Non-Command	940.99	250.84	72.28	SAFE	908.22	0	0
218	BM	48	Poor Quality	457.39	341.04				0	0
219	BM	49	Command	1612.32	1710.01				0	0
220	BM	49	Non-Command	1269.16	1045.71	95.64	SEMI	0	0	0
221	BM	49	Poor Quality	246.12	137.86				0	0
222	BM	50	Command	1624.76	1520.62				480	961
223	BM	50	Non-Command	1579.45	883.52	75.03	SAFE	720.6	0	0
224	BM	50	Poor Quality	296.73	234.08				0	0
225	BM	51	Command	1795.69	1986.42				206	412
226	BM	51	Non-Command	1445.63	753.72	84.54	SEMI	309.34	0	0
227	BM	52	Command	1012.41	798.79				325	650
228	BM	52	Non-Command	1169.38	813.41	73.89	SAFE	487.19	0	0
229	BM	53	Non-Command	2092.94	154.51	7.38	SAFE	1881.83	1255	2509
230	BM	54	Non-Command	3490.26	35.42	1.01	SAFE	3426.42	2284	4569
231	BM	55	Command	445.93	44.32				419	838
232	BM	55	Non-Command	862.31	451.12	37.87	SAFE	628.32	0	0
233	BM	56	Non-Command	2621.15	105.86	4.04	SAFE	2472.25	1648	3296
234	BM	57	Non-Command	1738.52	1503.91	86.51	SAFE	162.99	109	217
235	BM	58	Non-Command	3770.54	3623.06	96.09	SEMI	36.88	25	49
236	BM	59	Non-Command	2981.64	3468.68	116.33	OVER	0	0	0
237	BM	60	Non-Command	2209.96	1864.36	84.36	SEMI	268.66	179	358
238	BM	61	Command	2433.51	1021.2				843	1686
239	BM	61	Non-Command	1426.42	1526.29	66	SAFE	1264.63	0	0
240	BM	66	Command	3701.59	1491.29				1355	2710
241	BM	66	Non-Command	143.66	131.12	42.19	SAFE	2032.42	0	0
242	BM	67	Command	3285.81	1221.03				1385	2769
243	BM	67	Non-Command	1003.46	771.45	46.45	SAFE	2076.75	0	0
244	BM	68	Command	1284.88	1281.99	85.45	SAFE	298.72	199	398

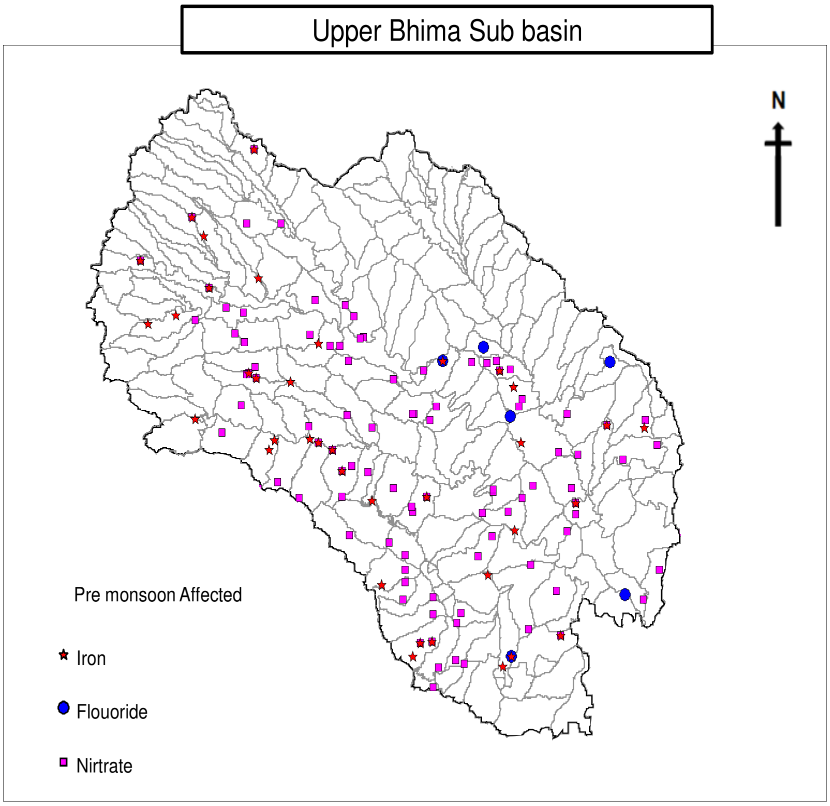
245	BM	68	Non-Command	959.86	636.19				0	0
246	BM	69	Command	2130.39	3478.07				0	0
247	BM	69	Non-Command	2290.53	1455.44	111.59	OVER	0	0	0
248	BM	69	Poor Quality	142.14	100.83				0	0
249	BM	70	Command	535.21	674.73				44	88
250	BM	70	Non-Command	1788.78	1473.35	92.43	SEMI	65.82	0	0
251	BM	71	Non-Command	933.16	159.44	17.09	SAFE	678.77	453	905
252	BM	72	Command	138.5	41.18				278	556
253	BM	72	Non-Command	2104.42	1699.36	77.6	SAFE	416.91	0	0
254	BM	73	Command	1947.16	996.82				641	1281
255	BM	73	Non-Command	2425.54	2374.61	77.1	SAFE	960.79	0	0
256	BM	74	Command	718.7	452.74				0	0
257	BM	74	Non-Command	1223.03	1432.16	97.07	SEMI	0	0	0
258	BM	74	Poor Quality	44.05	86.8				0	0
259	BM	75	Command	4236	4011.01				169	337
260	BM	75	Non-Command	1505.15	1367.48	93.68	SEMI	253.03	0	0
261	BM	75	Poor Quality	172.65	336.77				0	0
262	BM	76	Command	6904.93	6883.14				0	0
263	BM	76	Non-Command	1952.37	3316.91	115.16	OVER	0	0	0
264	BM	76	Poor Quality	514.59	1020.76				0	0
265	BM	77	Command	2873.13	2903.83				0	0
266	BM	77	Non-Command	1090.47	1619.95	114.13	OVER	0	0	0
267	BM	77	Poor Quality	113.47	332.68				0	0
268	BM	78	Command	2993.17	2337.34				648	1296
269	BM	78	Non-Command	605.84	40.41	66.07	SAFE	971.69	0	0
270	BM	81	Command	366.42	23.97				834	1668
271	BM	81	Non-Command	1340.77	298.63	18.9	SAFE	1251	0	0
272	SA	5 B	Command	583.71	156.17				854	1708
273	SA	5 B	Non-Command	1857.51	883.33	42.58	SAFE	1281.12	0	0
274	SA	9	Command	503.18	315.79				522	1044
275	SA	9	Non-Command	1740.09	1001.4	58.72	SAFE	783.2	0	0
276	SA	10	Command	453.93	142.14				712	1423
277	SA	10	Non-Command	1838.94	993.22	49.52	SAFE	1067.44	0	0
278	SA	11	Command	408.02	130.16				447	894
279	SA	11	Non-Command	1045.29	595.06	49.9	SAFE	670.28	0	0
280	SA	12	Command	395.5	175.01				670	1340
281	SA	12	Non-Command	2233.8	1313.4	56.61	SAFE	1005.21	0	0
282	SA	13	Command	405.28	226.38				393	787
283	SA	13	Non-Command	1756.11	1222.33	67.03	SAFE	590.03	0	0
284	SA	14	Command	356.99	182.59				509	1017
285	SA	14	Non-Command	1730.35	1042.17	58.68	SAFE	762.83	0	0
286	SA	15	Command	115.68	37.15	54.32	SAFE	980.63	654	1308

287	SA	15	Non-Command	2117.3	1175.72				0	0
288	BM	81	Non-Command	396.29	94.18	23.76	SAFE	286.4	191	382
289	BM	82	Command	250.21	23.02				1513	3025
290	BM	82	Non-Command	4142.41	2000.89	46.08	SAFE	2269.01	0	0
291	BM	83	Command	1340.29	303.9				661	1321
292	BM	83	Non-Command	2063.75	1994.42	67.52	SAFE	990.93	0	0
293	BM	84	Command	1039.8	1048.37				136	271
294	BM	84	Non-Command	2431.75	2066.53	89.73	SAFE	203.32	0	0
295	BM	85	Command	725.54	821.2				2	3
296	BM	85	Non-Command	2547.73	2344.2	96.7	SEMI	2.57	0	0
297	BM	86	Command	1935.89	1946.76				3	6
298	BM	86	Non-Command	2146.16	2009.85	96.93	SEMI	4.34	0	0
299	BM	87	Command	1080.38	1243.53				130	260
300	BM	87	Non-Command	1238.9	823.26	89.11	SAFE	195.2	0	0
301	BM	88	Non-Command	116.13	39.17	33.73	SAFE	56.54	38	75
302	BM	89	Non-Command	183.76	34.85	18.97	SAFE	131.61	88	175
303	BM	100	Command	183.99	179.38				1110	2219
304	BM	100	Non-Command	4399.55	2628.26	61.25	SAFE	1664.54	0	0
305	BM	101	Non-Command	5042.12	4806.34	95.32	SEMI	37.95	25	51
306	BM	102	Non-Command	3440.37	1999.9	58.13	SAFE	1372.87	915	1830
307	BM	103	Non-Command	2535.12	1745.95	68.87	SAFE	726.97	485	969
308	BM	104	Non-Command	1922.12	989.35	51.47	SAFE	820.06	547	1093
Total				493573.45	362682.39	69.61		129626	86417	172835

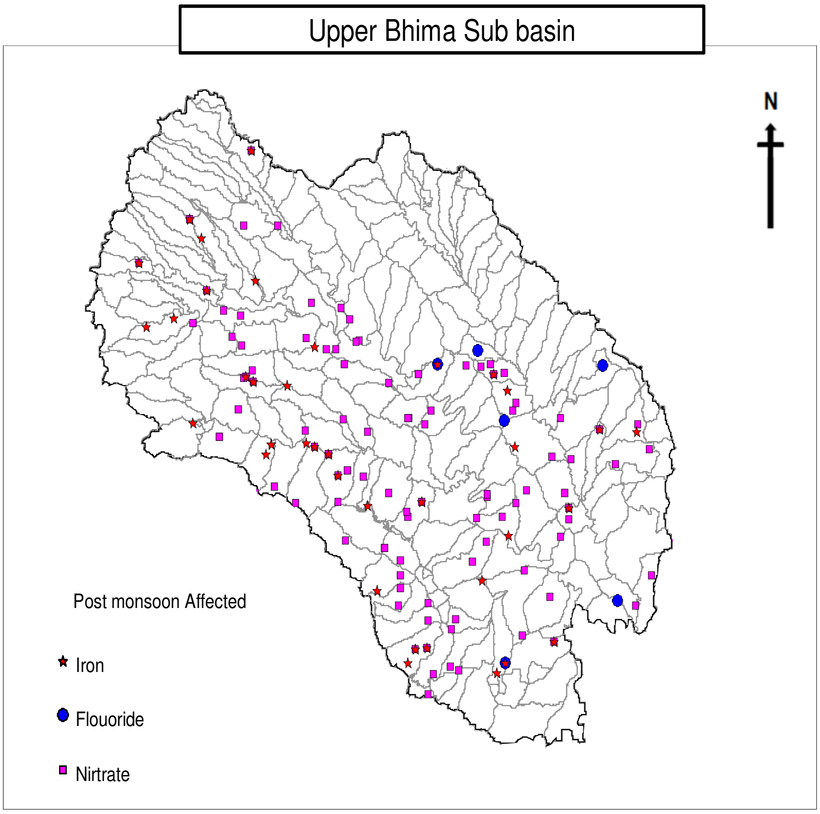
Annexure 7.6 District wise Groundwater Assessment

Sr. No.	District	No.of Watershed	Area (Hec)	Net Recharge (Ham)	Dom+Ind Draft (Ham)	Irrigation Draft (Ham)	Gross Draft (Ham)	Irrigation wells	Allocation for Dom.(Ham)	Available for Irrigation (Ham)
1	AHMEDNAGAR	29	618000	63888.94	1081.53	42560.08	43641.61	59354	2128.93	19261.27
2	BEED	8	156700	17541.70	808.96	8783.05	9592.00	10219	1617.91	7140.74
3	OSMANABAD	13	286900	28297.69	448.34	17709.50	18157.84	20791	896.69	9691.51
4	PUNE	65	1548300	171979.13	6975.74	119164.39	126140.13	154711	12674.69	44910.17
5	SANGLI	15	301287	27656.45	630.90	18724.89	19355.79	26227	1261.79	7669.77
6	SATARA	14	316837	39162.27	1256.65	27886.66	29143.30	33605	2513.29	8762.32
7	SOLAPUR	53	1305500	142059.15	4370.09	109219.15	113589.24	131995	7969.34	32190.23
	Total	**197**	**4533524**	**490585.34**	**15572.20**	**344047.72**	**359619.92**	**436902**	**29062.64**	**129626.01**
	Total in Mcum			**4906**	**156**	**3440**	**3596**		**291**	**1296**

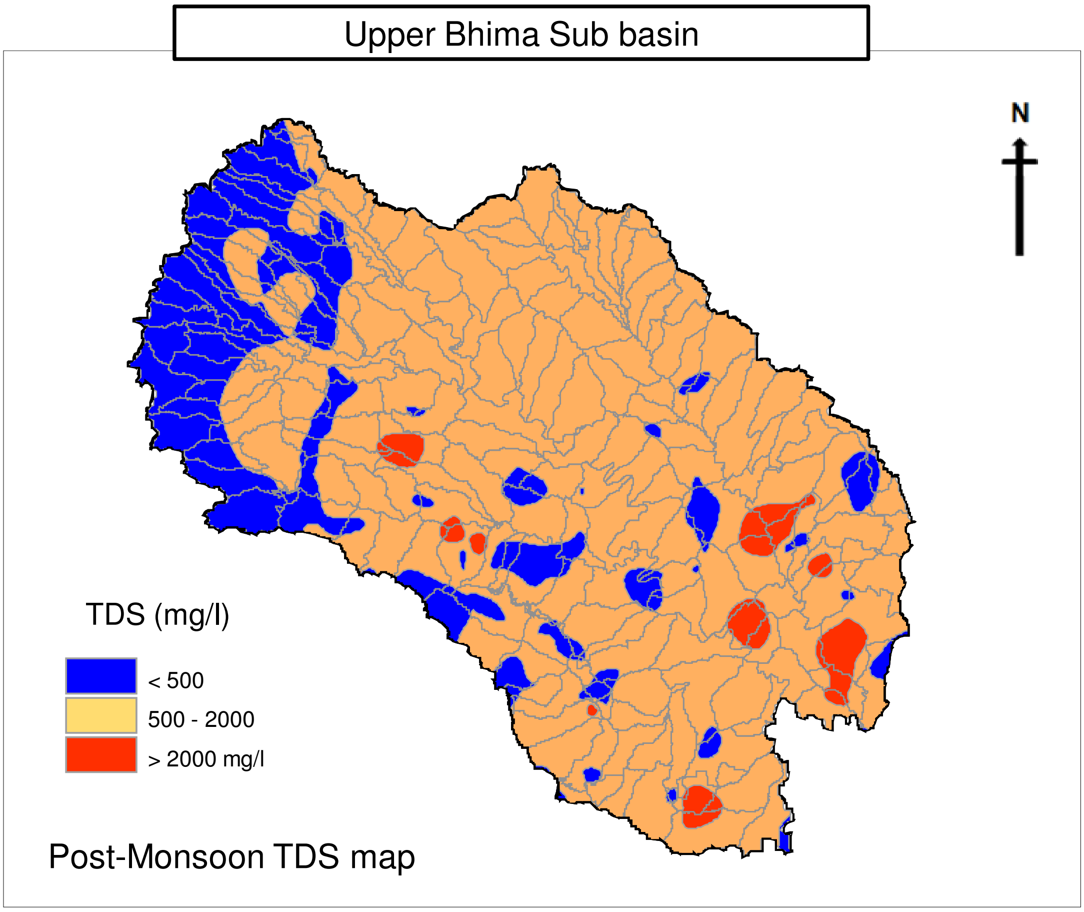
Map 7.1


Upper Bhima Sub basin
N
Pre monsoon Affected
Iron
Flouoride
Nirtrate

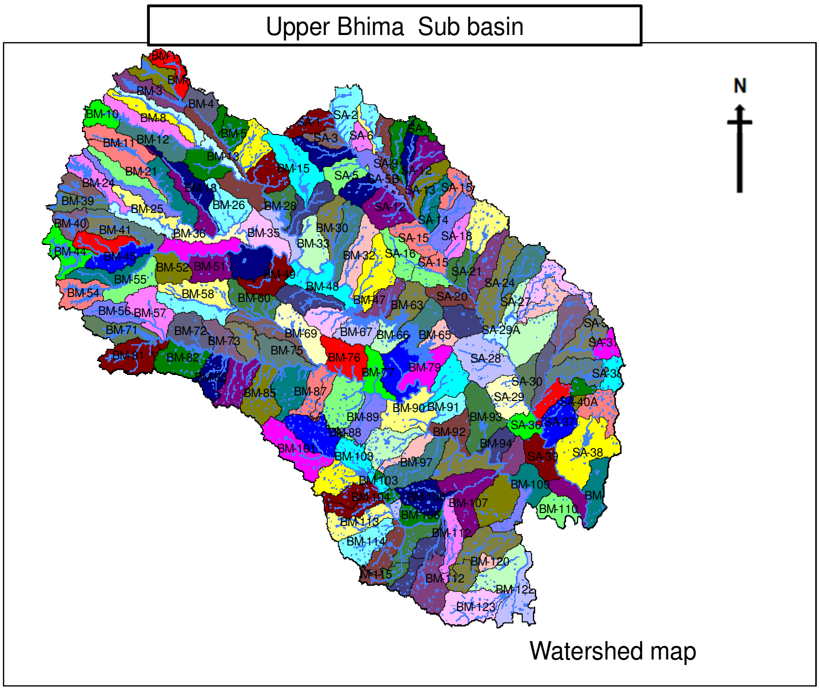
Map 7.2


Upper Bhima Sub basin
N
Post monsoon Affected
Iron
Flouoride
Nirtrate

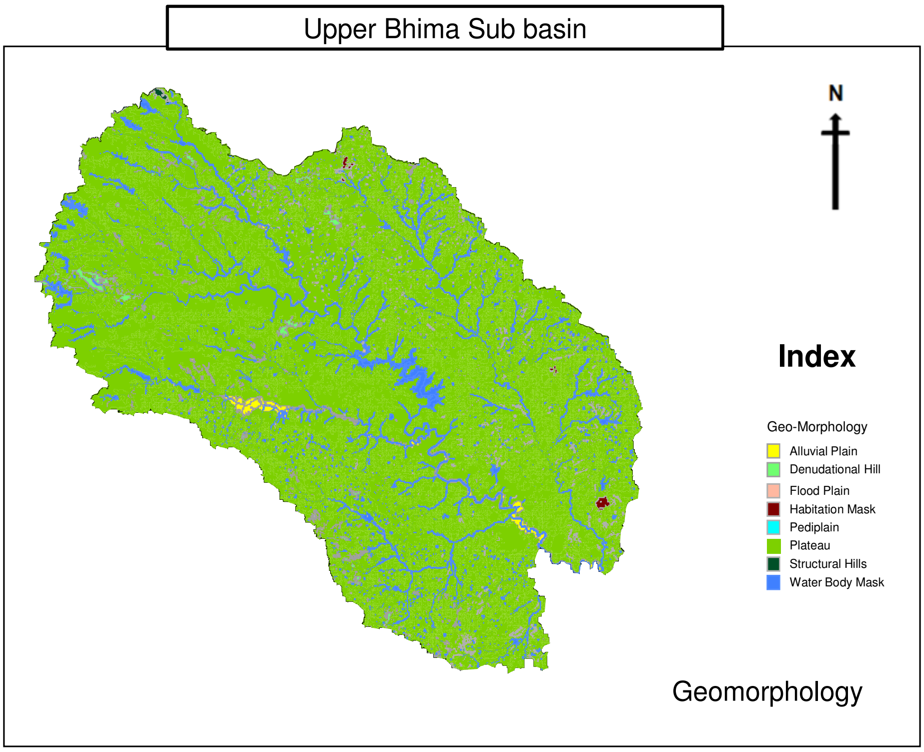
Map 7.3


Upper Bhima Sub basin
N
TDS (mg/l)
< 500
500 - 2000
> 2000 mg/l
Post-Monsoon TDS map

Map 7.4
Watershed map of Upper Bhima Sub-basin.

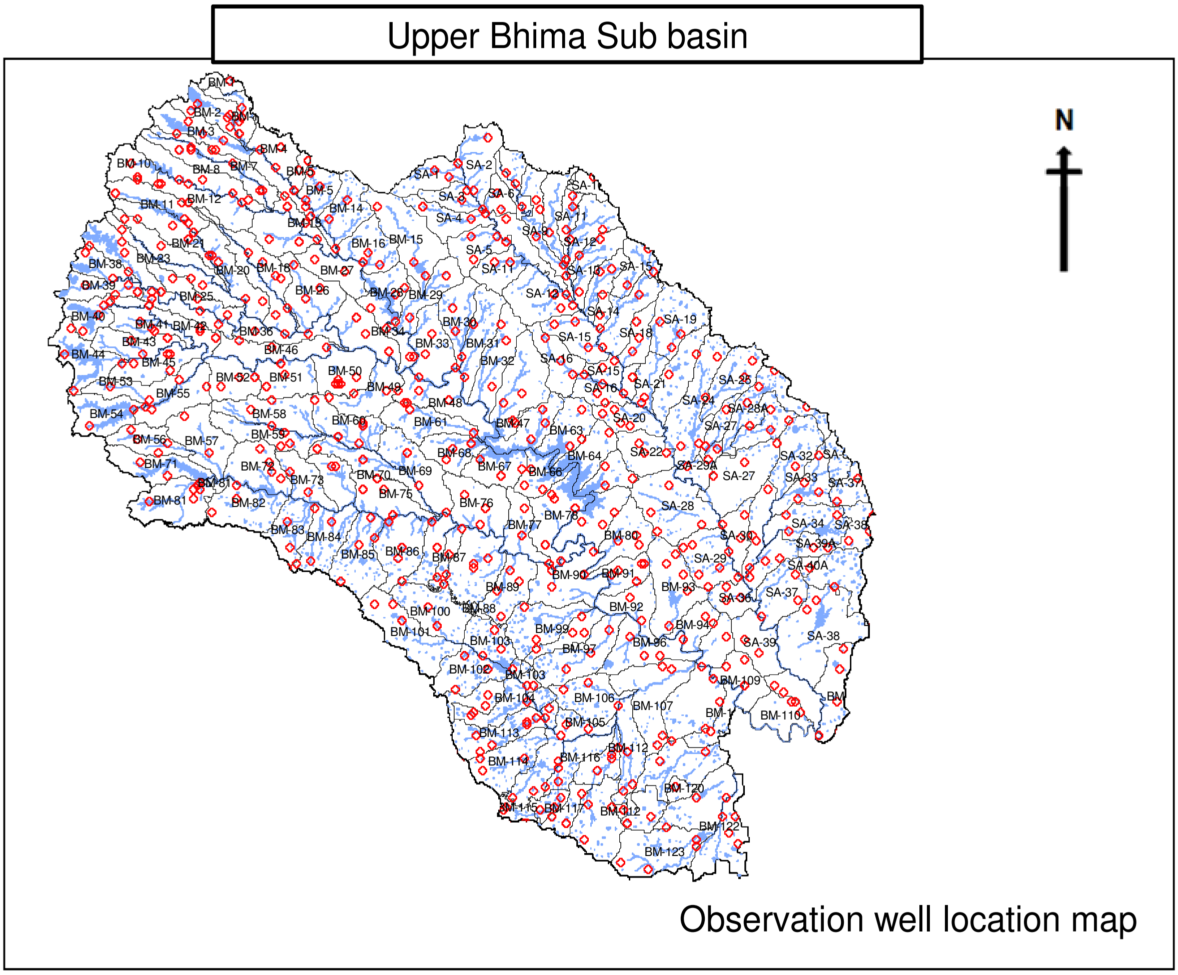


Map 7.5
Geomorphologic map of Upper Bhima Sub-basin.



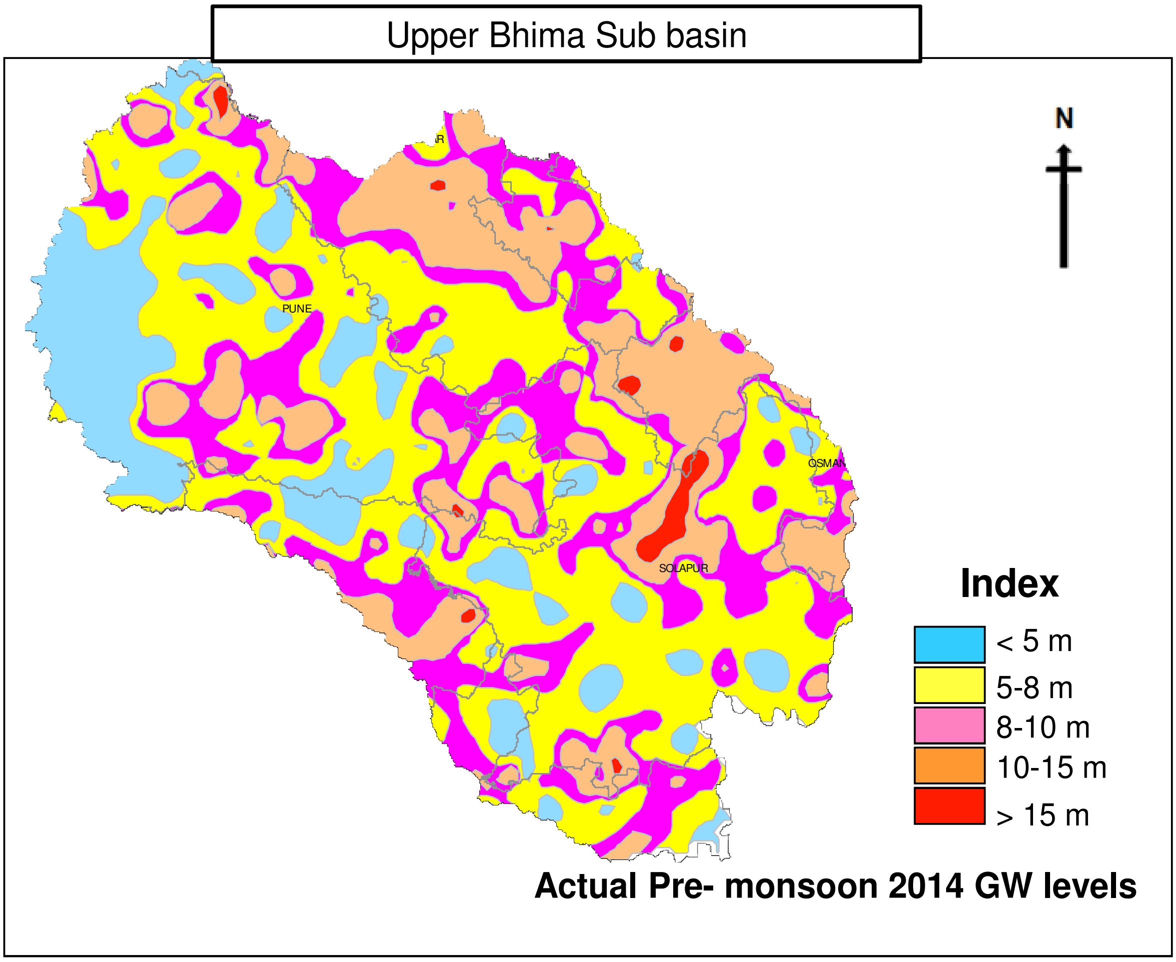
Map 7.6

Observation Wells Location in Upper Bhima Sub-basin.



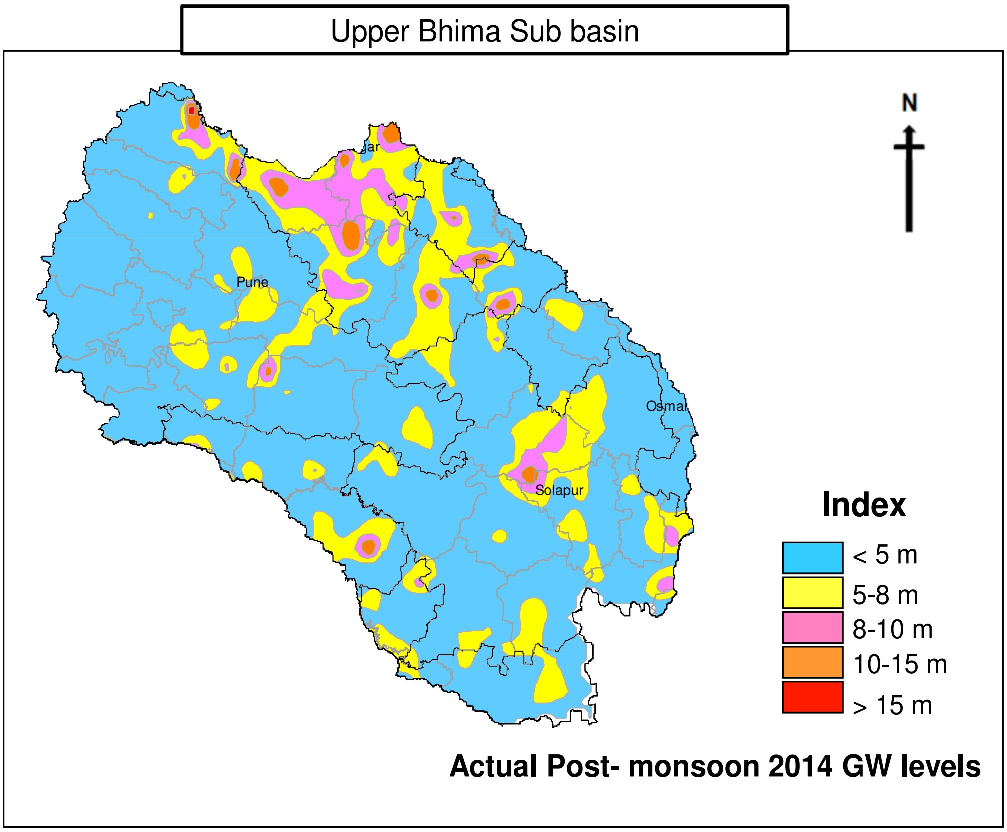
Map 7.7

The actual pre-monsoon 2014 groundwater level in Upper Bhima Sub-basin.



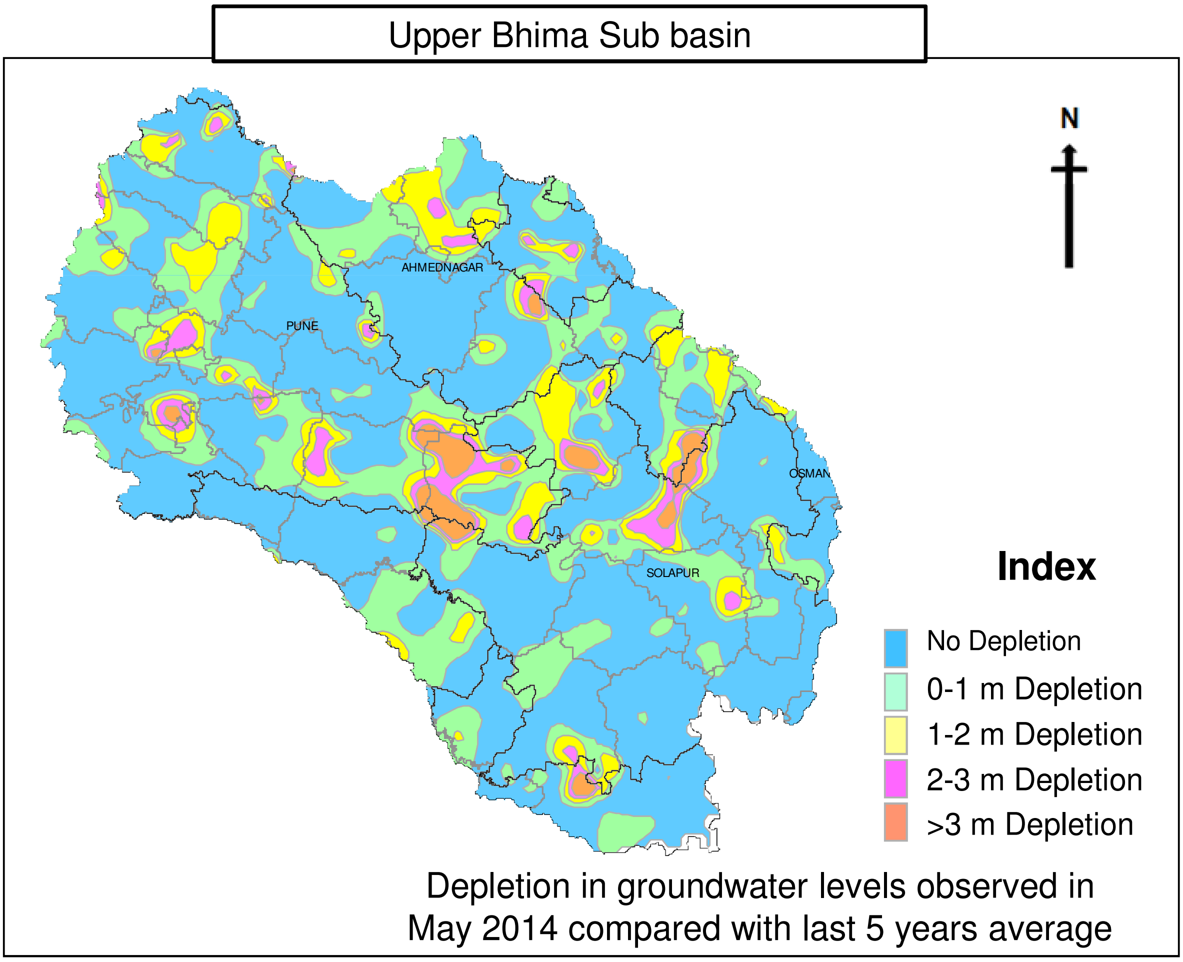
Map 7.8

The actual post-monsoon 2014 groundwater level in Upper Bhima Sub-basin.



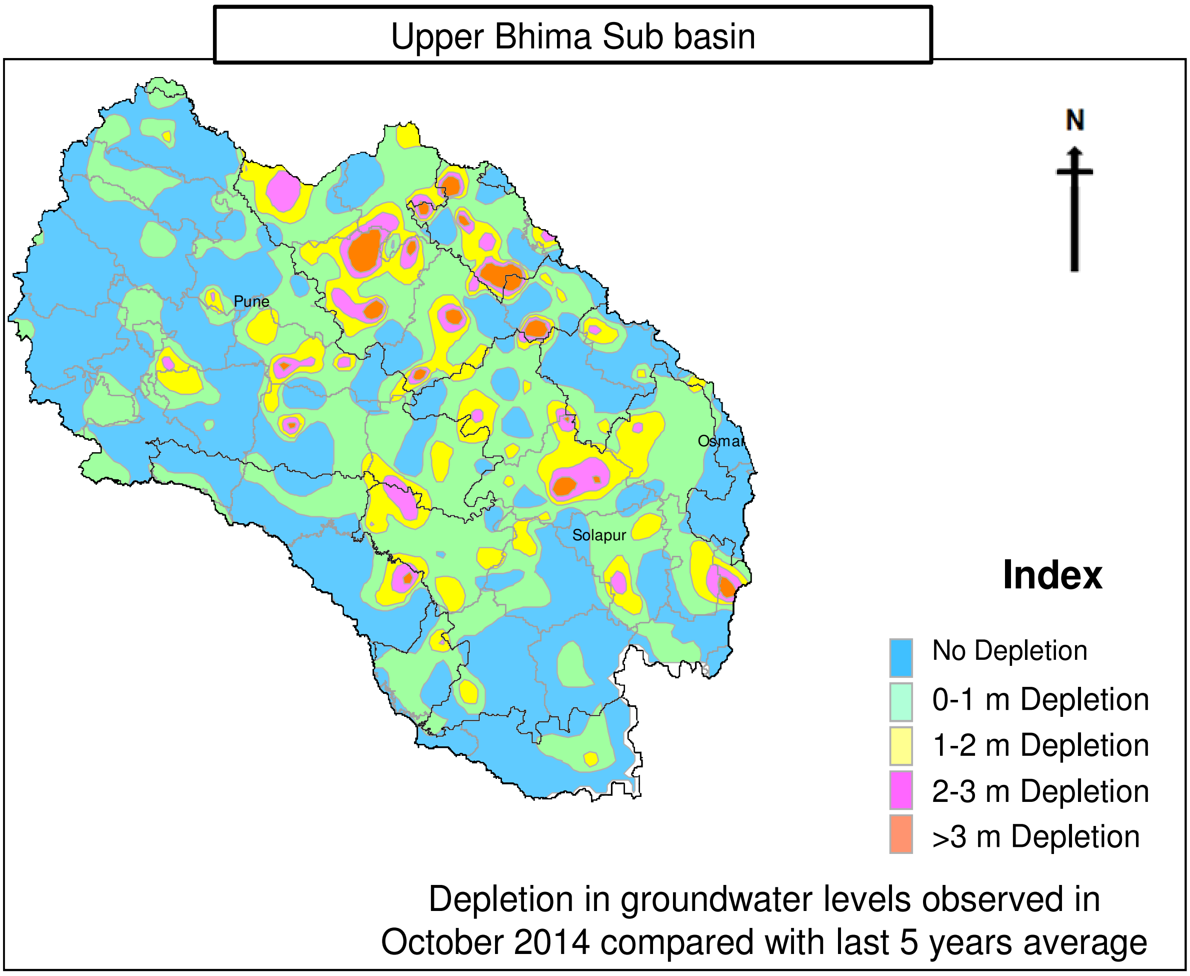
Map 7.9

Depletion in groundwater levels observed in May 2014 compared with last 5 years average in Upper Bhima Sub-basin.



Map 7.10

Depletion in groundwater levels observed in October 2014 compared with last 5 years average in Upper Bhima Sub-basin.



CHAPTER: 08 IRRIGATION

8.0 Introduction

This chapter deals with development of water resources in the sub basin through Flow Irrigation and Lift Irrigation Schemes. It also deals with use of water for various purposes such as irrigation, non-irrigation. Assessment of irrigation backlog in the sub basin is made.

The water resources development in this sub basin having catchment area 45335 Sqkm spread over seven districts namely Pune, Solapur, Ahmednagar, Satara, Sangli,Osmanabad & Beed is taking place through following ways –

i) Development through construction of State Sector irrigation Projects by Water Resources Department.

ii) Development through watershed based soil and water conservation measures in interdisciplinary manner by various Government Departments like Agriculture, Forest, Water Conservation Department, Groundwater Survey Development Agency (GSDA), etc.

iii) Development through private sector particularly use of Groundwater through wells by users. **8.1 Necessity of Water Resources Projects**

Upper Bhima sub basin (K-5) Rainfall ranges from **415 mm to 4240** mm but water is not available throughout the year. To fulfill the needs of agriculture, drinking water & industrial water requirement, activity of construction of irrigation projects wherever possible is necessary. Accordingly Government of Maharashtra has taken the activities of construction of the major, medium & minor irrigation projects in the sub basin.

The history of water resources development in the sub-basin dates back to 19th Century. The legendary Sir M.Vishweshwarayya introduced the very intricate Block system of irrigation in Pune region on Neera canal system, which is in use till to date. Upto pre independence period ***1 major, 5 medium,*** & ***12 minor*** irrigation projects were constructed by the then government to irrigate **126782 Ha.** area.

8.2 Irrigation

Table-8.2.1 – Details of completed, ongoing and future Projects

Sr. No.	Type of Project	Planned Utilization (Mm3)	Gross Storage (Mm3)	Designed Live storage (Mm3)	ICA Ha.
A	**Completed Projects**				
1	Major	4216	3658	3194	243839
2	Medium	731	761	638	96638
3	Minor	1443	1443	1443	302378
	Total	**6390**	**5862**	**5275**	**642855**
B	**Ongoing Projects**				
1	Major	4632	5548	3429	617127
2	Medium	67	83	77	13828
3	Minor	125	125	125	11776
	Total	**4824**	**5756**	**3631**	**642731**
C	**Future Projects (MI)**	0	0	0	
	GrandTotal (A,B,C)	**11214**	**11618**	**8906**	**1285586**
GrandTotal (A,B,C) in TMC		**395.940**	**410.240**	**314.477**	

Project wise details are given in annexure 8.2.1 a,b,c .

The planned utilization for irrigation, domestic and industry, designed live storage is tabulated as below .

Table-8.2.2 – Planned Utilization for Irrigation Projects

Sr. No.	Type of Project & Nos.	Planned Utilization (Mm3)				
		Irrigation	West ward Diversion (@ tataHEP)	Domestic	Industrial	Total
1	Major Projects (15 Nos)	6537	1274	918	119	**8848**
2	Medium Projects (37 Nos)	614	0	122	62	**798**
3	Minor Projects (631) Nos)	1422	0	96	50	**1568**
	Total (683)	**8573**	**1274**	**1136**	**231**	**11214**

Project wise details are given in annexure 8.2.1 a,b,c .

As specified by Krishna Water Dispute Tribunal clause VII is the consumptive use considering recycling for domestic & industrial use is 20% & 2.5% respectively. Hence the planned utilization as given below.

Irrigation : 8573 x 100% : 8573 Mm3
West Ward Diversion:1274 x 100% : 1274 Mm3
(Tata Hydro electric Project)
Domestic : 1136 x 20% : 227 Mm3
Industry : 231 x 2.5% : 6 Mm3

Total : 10080 Mm^3

8.3 FUTURE PROJECTS - There are no future projects in this sub basin.

Krishna Water Dispute Tribunal - II (KWDT-II) has allocated more water to the Maharashtra state in addition to that allocated by KWDT- I. Presently we cannot plan the use of that additional water since the award of KWDT-II is not yet notified by the Central Government. If that water is available, more projects can be taken for execution.

8.4 DIVERSION OF WATER FOR NON IRRIGATION-

As per planned utilisation water reserved for non irrigation & actual permissions given are tabulated below

Sr. No.	Type of Project	Planned use (Mm3)(As per DPR)			Actual Permission given (Mm3)		
		Domestic	Industrial	Total	Domestic	Industrial	Total
1	Major	918	119	1037	1022	238	1260
2	Medium	122	62	184	91	34	125
3	Minor	96	50	146	46	7	53
	Total	**1136**	**231**	**1367**	**1159**	**279**	**1438**

The details of permissions given in annexure 8.4 a & b.

8.5 Multi-purpose projects in the sub basin

There are in total 15 major, 37 medium and 629 minor projects in the sub basin coming under category of multi-purpose projects. All the projects are planned for irrigation as well as drinking and industrial use. Out of all the multi-purpose projects, only one major project named TATA project is planned for hydro electric generation by utilizing water through west ward diversion. Also the hydro power generation plants are installed on following projects for which no seperate water allocation has been made.

.

Sr.No.	Name of Project	Installed Capacity MW	Water Use (Mm3)
1	**Tata Hydro**	**1x72**	**1274**
2	Bhima (Ujjani)	1x12	**No separate provision made**
3	Dimbhe (Kukadi)	1x5	
4	Manikdoh (kukadi)	1x6	
5	Panshet (Khadakwasla)	1x8	
6	Varasgaon (Khadakwasla)	1x8	
7	Temghar	1x4	
8	Pawana	1x10	
	Total	**115 MW**	

(Ref – Mahahydro.org)

8.6 Inter-state Project in the sub basin

There are eight K.T.weirs constructed **(four by Maharashtra & four by Karnataka Govt.)** on Bhima river in Solapur district where river itself is boundary of Maharashtra & Karnataka states. Hence these K.T.weirs are inter-state projects. The total planned use of Maharashtra K.T.Weirs is 30.93 Mm3 in which Karnataka state is having share of 15.46 Mm3. The total planned use of Karnataka K.T.Weirs is 22.69 Mm3 in which Maharashtra state is having share of 11.34 Mm3. The Details of Inter State projects are given below.

Sr. No.	Name of Project	Planned Utilization (Mm3)	Gross Storage	Live storage	ICA (ha.)		
					Maharashtra	Karnataka	Total
A	**Constructed by Maharashtra State**						
1	Auj K.T.Weir	8.110	5.82	5.82	702	702	1404
2	Chinchpur K.T.Weir	8.100	5.88	5.88	689	689	1378
3	Khanapur K.T.Weir	7.100	4.99	4.99	612	612	1224
4	Hilli K.T.Weir	7.620	5.35	5.35	670	670	1340
	Total Maharashtra	**30.93**	**22.04**	**22.04**	**2673**	**2673**	**5346**
B	**Constructed by Karnataka State**						
1	Govindpur K.T.Weir	5.99	5.99	5.99	356	356	712
2	Umarani K.T.Weir	5.31	5.31	5.31	504	504	1008
3	Chanegaon K.T.Weir	3.12	3.12	3.12	460	460	920
4	Hingani K.T.Weir	8.27	8.27	8.27	493	493	986
	Total Karnataka	**22.69**	**22.69**	**22.69**	**1813**	**1813**	**3626**
	Grand Total	**53.62**	**44.73**	**44.73**	**4486**	**4486**	**8972**

8.7 Lift Irrigation Schemes

The large area between Nira sub basin, Bhima sub basins and Sina sub basin, cannot be irrigated by gravity system. Due to less rainfall there is no storage in M. I. & local tanks, resulting shortage of drinking water to people. This also reduces ground water table. The wells of sufficient water has to be reserved for drinking purpose & then starts the story of supply of water using tankers. There are certain areas where water is not available to tankers even within 50 km.The above story tells that there will be tremendous expenditure on cattle camp, tankers & such type of temporary remedies after about every three years. Other Social problems also arise due to shortage of water. e.g. , Migration, reduction in number of cattle, reduction in production of Eggs & Milk, it effecting health of the society. Due to all these effects farmer becomes labour & he has to migrate then towards urban areas. This creates social unrest against the government.

Hence Government of Maharashtra has taken various large Lift Irrigation Schemes in hand utilizing **1193.49** Mm^3 of water for irrigating **255529** ha (IP) area. Obviously the cost of LIS is more than any gravity scheme, but Government of Maharashtra is not having any alternative to meet the water demands, give social justice to large area and to avoid migrations in search of water, employment and food. The works of all LIS are under progress.

Presently no Lift irrigation scheme is completed so far in the sub basin. The details of ongoing Lift Irrigation schemes in the sub basin is given in Table-8.4

Table-8.7. – Lift Irrigation Schemes under construction in sub basin

Sr No	Name of LIS	District	Taluka	Cost (Rs. Crores)	Source of Water	Planned Use Mm3	ICA (Ha)	IP (Ha)
1	Tembhu	Satara	Karad	1416.59	Krishna River	145.13	23970	24330
2	Krishna Koyana (Mhaisal)	Sangali, Solapur	Kawathe mahankal, Jat, Sangola, Mangalwedha	82.43	Krishna River	280.44	37155	52645
3	Dahigaon	Solapur	Karmala	57.66	Ujjani	51.26	10500	13335
4	Ekrukh	Solapur	N.solapur	87.48	Ujjani	71.36	17310	24580
5	Shirapur	Solapur	Mohol	90.57	Ujjani	48.99	10000	14200
6	Ashti	Solapur	Mohol	49.60	Ujjani	43.89	9000	12780
7	Barshi	Solapur	Barshi	131.39	Ujjani	73.34	15000	21300
8	Sangola	Solapur	Sangola	73.59	Ujjani	56.60	6525	10701
9	Mangalwedha	Solapur	Mangalwedha	530.04	Ujjani	54.90	11820	11820
10	Sina Madha	Solapur	Madha	54.49	Ujjani	134.52	16151	24550
11	Janai Shirsai	Pune	Daund	56.92	Khadakwasla	101.94	14080	15488
12	Purandar	Pune	Haveli	178.93	Khadakwasla	113.28	25498	25753
13	Shirala	Osmanabad	Paranda	23.00	Ujjani	17.84	2850	4047
					Total	**1193.49**	**199859**	**255529**

Source – MKVDC Prapatra 1 showing all projects)

8.8 Wells in the Sub basin

After Irrigation there is vast diversion in well irrigation in the command of irrigation projects. Farmers are using water of canal & wells conjunctively.

As per information in **chapter -7 ground water** by GSDA; Information of No. of wells in command and uncommand is as below.

Table 8.8 – Wells in sub basin

Sr.No.	Type of Area	Existing Irrigation Wells	Area (ha.)
1	Command	124007	653358
2	Non-Command	312895	3423285
	Total	**436902**	**4076643**

8.9 Extent of area under Micro Irrigation

During the course of time, with intensive research in the field of irrigation, the irrigation techniques have been changed from traditional or conventional flow irrigation to modern techniques such as drip irrigation and sprinkler irrigation. Also to provide irrigation facilities to scarce and deficit rainfall areas and un command areas, various Lift Irrigation Schemes are taken up by the Government. The water lifted up is very costly considering the electricity charges and running maintenance charges of scheme. So to use this costly water, modern techniques of irrigation are used. The details of extent of the area under micro irrigation as per information in **chapter -5 Agriculture** by Agriculture Department is given as below.

Sr.No	Water Saving Micro -Irrigation Techniques	Area (Ha)
1	Area under Drip & Sprinkler Irrigation	191948
2	Projection -2030 (Drip and Sprinkler)	383897

8.10 Sedimentation Survey

The dams constructed long back are silted. Sedimentation Survey of reservoirs of 8 major, projects has been done. Information is as below.

Table 8.10 Sedimentation Survey

Sr. No.	Name of Project	Designed Gross Storage Mm3	Designed Live Storage Mm3	Current Gross Storage Mm3	Current Live Storage Mm3	Reduction in gross storage Mm3	Reduction in Live storage Mm3
1	Ghod	216.300	154.870	185.590	124.160	30.710	30.710
2	Bhatghar	672.650	665.570	564.060	564.060	108.590	101.510
3	Veer	279.000	266.000	239.650	226.650	39.350	39.350
4	Khadkwasla	86.000	56.000	87.870	63.960	-1.870	-7.960
5	Panshet	310.620	301.445	282.191	276.358	28.429	25.087
6	Warasgaon	375.361	363.189	373.239	361.232	2.122	1.957
7	Bhima (Ujjani)	3320.000	1517.200	2896.090	1408.810	423.910	108.390
8	Manikdoh	296.261	288.240	273.530	261.620	22.731	26.620
	TOTAL	**5556.192**	**3612.514**	**4902.220**	**3286.850**	**653.972**	**325.664**

Catchment area treatment works need to be taken in degraded and critically degraded catchments so as to reduce rate of siltation in the reservoirs. These works include soil conservation works, Nalla bunding, contour trenches, afforstation etc.

8.11 Irrigation Backlog

As per MWRRA Annual Report 2012-13(Annexure 5 (1) Page no. 77), the physical backlog in this sub basin is NIL.

8.12 Summary

The present water use and requirement for future by 2030 for various purposes are given below.

Sr. No.	Purpose	Present Planned Use (Mm^3)	Future Planned Use (Mm^3) (2030)
1)	Irrigation	8502	8388
2)	WWD (TATA Hydro Project)	1274	1274
3)	**Non Irrigation Use from irrigation projects–**		
a)	Domestic	1159	1245
b)	Industrial Use	279	307
	Total	**1438**	**1552**
	Grand Total	**11214**	**11214**

Abstract Of Projects under Upper Bhima Sub Basin (K-5)

Sr. No.	Name of project	Designed Storage (Mm3)		PLANNED WATER UTILISATION (Mm3)					Present WATER UTILISATION (Mm3) (Considering actual permissions for Non Irrigation)				
		Gross	Live	Irrigation	Drinking	Industrial	WWD	Total	Irrigation	Drinking	Industrial	WWD	Total
A	**Major**												
	Completed	3658.236	3194.213	2289.955	602.678	48.682	1274.400	4215.715	2121.043	755.493	64.779	1274.400	4215.715
	Ongoing	5548.398	3429.354	4246.782	315.513	69.950	0.000	4632.246	4192.506	266.330	173.410	0.000	4632.246
	Total Major	**9206.634**	**6623.567**	**6536.737**	**918.191**	**118.632**	**1274.400**	**8847.961**	**6313.549**	**1021.823**	**238.189**	**1274.400**	**8847.961**
B	**Medium**												
	Completed	761.056	638.384	546.859	122.257	62.021	0.000	731.137	606.535	90.683	33.919	0.000	731.137
	Ongoing	82.524	77.030	66.835	0.000	0.000	0.000	66.835	66.775	0.000	0.060	0.000	66.835
	Total Medium	**843.580**	**715.414**	**613.694**	**122.257**	**62.021**	**0.000**	**797.973**	**673.311**	**90.683**	**33.979**	**0.000**	**797.973**
C	**Minor**												
	Completed	1443.108	1443.108	1357.243	65.661	20.204	0.000	1443.108	1420.675	15.822	6.611	0.000	1443.108
	Ongoing	124.541	124.541	65.342	30.276	28.922	0.000	124.540	94.264	30.276	0.000	0.000	124.540
	Total Minor	**1567.649**	**1567.649**	**1422.585**	**95.937**	**49.125**	**0.000**	**1567.648**	**1514.939**	**46.098**	**6.611**	**0.000**	**1567.648**
	Grand Total	**11617.862**	**8906.629**	**8573.017**	**1136.385**	**229.779**	**1274.400**	**11213.581**	**8501.798**	**1158.604**	**278.779**	**1274.400**	**11213.581**

Upper Bhima Sub Basin (K-5)

Annexure - 8.2.1 (a) Details of Major Projects

Sr.No.	Name of project	District	Taluka	Designed Storage (TMC)		Designed Storage (Mm3)		PLANNED WATER UTILISATION (TMC)					ICA Ha.
				Gross	Live	Gross	Live	Irrigation	Drinking	Industrial	WWD	Total	
1	2	3	4	5	6	5A	6A	7	8	9	10	11	12
	Major Projects												
A	**Completed**												
1	TATA Hydro (5 Reservoirs) Including Mulashi Tunnel	Pune	Mulashi	49.91	40.760	1413.187	1154.107	0.000	0.000	0.000	45.000	45.000	5000
2	Pawana	Pune	Maval	10.780	8.510	305.232	240.958	1.701	8.000	0.489	0.000	10.190	5304
3	Khadakwasala (3 Reservoirs) with LIS	Pune	Haveli	27.260	25.140	771.859	711.832	22.820	11.000	0.150	0.000	33.970	101724
4	Ghod	Pune	Shirur	7.640	5.470	216.324	154.881	9.780	0.300	0.320	0.000	10.400	20500
5	Bhataghar/Veer(Neera canals)	Satara	Khandala	33.585	32.910	950.949	931.837	46.559	1.981	0.760	0.000	49.300	111311
	Total Completed			**129.175**	**112.790**	**3657.551**	**3193.615**	**80.860**	**21.281**	**1.719**	**45.000**	**148.860**	**243839**
B	**Ongoing**												
6	Bhima -(with lifts & tunnel)	Solapur	Madha	117.248	53.580	3320.463	1517.386	78.590	3.200	2.150	0.000	83.940	267169
7	Temghar	Pune	Mulashi	3.810	3.700	107.899	104.784	0.465	3.245	0.000	0.000	3.710	1000
8	Gunjavani	Pune	Velha	3.700	3.690	104.784	104.501	3.754	0.436	0.000	0.000	4.190	16500
9	Bhama Asakhed	Pune	Khed	8.140	7.647	230.525	216.563	6.652	0.020	0.140	0.000	6.812	23110
10	Nira Deodhar	Pune	Bhor	11.910	11.710	337.291	331.627	11.911	1.070	0.000	0.000	12.981	43050
11	Chasakman	Pune	Khed	8.530	7.535	241.570	213.391	9.650	0.350	0.000	0.000	10.000	44170
13	Kukadi (5 Reservoirs)	Pune	Junnar	37.260	30.540	1055.203	864.893	35.450	2.780	0.000	0.000	38.230	146053
15	Sina-Kolegaon	Osmanabad	Paranda	5.320	2.691	150.662	76.209	3.485	0.040	0.180	0.000	3.705	12100
	Other Lifts												**63975**
	Total ongoing			**195.918**	**121.093**	**5548.398**	**3429.354**	**149.957**	**11.141**	**2.470**	**0.000**	**163.568**	**617127**
	Total major			**325.093**	**233.883**	**9205.949**	**6622.969**	**230.817**	**32.422**	**4.189**	**45.000**	**312.428**	**860966**
							Mm3	**6536.74**	**918.19**	**118.63**	**1274.40**	**8847.96**	

Upper Bhima Sub Basin (K-5)

Annexure - 8.2.1 (b) Details of Medium Projects

Sr.No.	Name of project	District	Taluka	Designed Storage (TMC)		Designed Storage (Mm3)		PLANNED WATER UTILISATION (TMC)					ICA Ha.
				Gross	Live	Gross	Live	Irrigation	Drinking	Industrial	WWD	Total	
1	2	3	4	5	6	5A	6A	7	8	9	10	11	12
	Medium Projects												
A	**Completed**												
1	Andhali	Satara	Man	0.327	0.262	9.259	7.418	0.262	0.000	0.000	0.000	0.262	1498
2	Andra	Pune	Maval	2.940	2.920	83.245	82.679	0.850	0.350	1.800	0.000	3.000	5998
3	Ashti	Solapur	Mohol	0.8125	0.8125	23.006	23.006	0.337	0.213	0.000	0.000	0.550	4769
4	Banganga	Osmanabad	Bhoom	0.210	0.134	5.946	3.794	0.134	0.000	0.000	0.000	0.134	906
5	Budhihal	Solapur	Sangola	1.132	0.672	32.052	19.027	0.672	0.000	0.000	0.000	0.672	4251
6	Chandani	Osmanabad	Paranda	0.830	0.646	23.501	18.291	0.646	0.000	0.000	0.000	0.646	2024
7	Doddanalla	Sangli	Jath	0.270	0.195	7.645	5.521	0.210	0.000	0.000	0.000	0.210	1215
8	Ekrukh	Solapur	N.Solapur	2.160	2.160	61.160	61.160	0.206	1.575	0.019	0.000	1.800	2610
9	Hingani(P)	Solapur	Barshi	1.607	0.905	45.502	25.629	1.569	0.011	0.000	0.000	1.580	6140
10	Jawalgaon	Solapur	Barshi	1.233	0.826	34.915	23.401	1.181	0.039	0.000	0.000	1.220	4451
11	Kada	Beed	Ashti	0.350	0.302	9.910	8.551	0.302	0.000	0.000	0.000	0.302	1214
12	Kadi	Beed	Ashti	0.260	0.193	7.362	5.465	0.193	0.000	0.000	0.000	0.193	1084
13	Kambali	Beed	Ashti	0.130	0.110	3.681	3.115	0.110	0.000	0.000	0.000	0.110	972
14	Kasarsai	Pune	Mulashi	0.610	0.570	17.272	16.139	0.850	0.000	0.000	0.000	0.850	4119
15	Khairi	Ahmadnagar	Jamkhed	0.534	0.480	15.120	13.591	0.519	0.021	0.000	0.000	0.540	2318
16	Khandeshwar (Watefal)	Osmanabad	Paranda	0.381	0.311	10.788	8.806	0.390	0.010	0.000	0.000	0.400	1471
17	Khasapur	Osmanabad	Paranda	0.480	0.461	13.591	13.053	1.020	0.280	0.000	0.000	1.300	2146
18	Mangi	Solapur	Karamala	1.085	0.861	30.717	24.371	1.133	0.021	0.000	0.000	1.154	3116
19	Mehakari	Beed	Ashti	0.560	0.458	15.856	12.968	0.458	0.000	0.000	0.000	0.458	4048
20	Mhasawad	Satara	Man	1.692	1.574	47.908	44.567	1.029	0.600	0.000	0.000	1.629	4049
21	Nazare	Pune	Purandar	0.790	0.580	22.369	16.423	0.034	0.215	0.371	0.000	0.620	3195
22	Padavalkarwadi	Solapur	Mangalwedha	0.106	0.075	3.001	2.124	0.100	0.170	0.000	0.000	0.270	352

23	Ramganga	Osmanabad	Bhoom	0.217	0.189	6.144	5.351	0.217	0.013	0.000	0.000	0.230	963
24	Ranand	Satara	Man	0.251	0.220	7.107	6.229	0.226	0.000	0.000	0.000	0.226	1093
25	Rooti	Beed	Ashti	0.280	0.232	7.928	6.569	0.232	0.000	0.000	0.000	0.232	1862
26	Sakat	Osmanabad	Paranda	0.510	0.476	14.440	13.478	0.542	0.007	0.000	0.000	0.549	2355
27	Sankh	Sangli	Jath	0.700	0.525	19.820	14.865	0.418	0.064	0.000	0.000	0.482	3100
28	Shetphal	Pune	Indapur	0.600	0.600	16.989	16.989	0.600	0.000	0.000	0.000	0.600	1920
29	Sina	Ahmadnagar	Karjat	2.400	1.840	67.955	52.099	2.387	0.013	0.000	0.000	2.400	8445
30	Talwar	Beed	Ashti	0.130	0.114	3.681	3.228	0.114	0.000	0.000	0.000	0.114	668
32	Tisangi	Solapur	Pandharpur	0.924	0.864	26.163	24.464	0.864	0.000	0.000	0.000	0.864	4049
33	Visapur	Ahmadnagar	Shrigonda	0.922	0.904	26.106	25.596	0.922	0.000	0.000	0.000	0.922	5369
34	Wadivale	Pune	Maval	1.440	1.070	40.773	30.297	0.583	0.715	0.000	0.000	1.298	4868
	Total Completed			**26.873**	**22.542**	**760.913**	**638.264**	**19.310**	**4.317**	**2.190**	**0.000**	**25.817**	**96638**
B	**Ongoing**												
1	Pimpalgaon(Dhale)	Solapur	Barshi	0.440	0.340	12.461	9.629	0.520	0.000	0.000	0.000	0.520	2400
2	Chilhewadi	Pune	Junnar	0.960	0.870	27.187	24.638	0.970	0.000	0.000	0.000	0.970	6372
3	Kalmodi	Pune	Khed	1.514	1.510	42.876	42.763	0.870	0.000	0.000	0.000	0.870	5056
	Total Ongoing			**2.914**	**2.720**	**82.524**	**77.030**	**2.360**	**0.000**	**0.000**	**0.000**	**2.360**	**13828**
	Total Medium			**29.787**	**25.262**	**843.438**	**715.295**	**21.670**	**4.317**	**2.190**	**0.000**	**28.177**	**110466**
							Mm3	**613.69**	**122.26**	**62.02**	**0.00**	**797.97**	

Upper Bhima Sub Basin (K-5)
Annexure - 8.2.1- (C) Details of Minor Projects
(Including Tanks, K.T. Weirs, Bandharas etc.)

Sr. No.	Name of the Project	Taluka	District	Designed Storage (Mm3)		Planned Live Storage (Utilisation) (Mcum)				Projected ICA (Ha.)
				Gross	Live	irrigation	Drinking	Industries	Total	
1	**2**	**3**	**4**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Autewadi MI Tank	Shrigonda	Ahmadnagar	1.850	1.850	1.740	0.084	0.026	1.850	508
2	Bardari	Nagar	Ahmadnagar	1.530	1.530	1.439	0.070	0.021	1.530	296
3	Bhairobawdi	Karjat	Ahmadnagar	1.130	1.130	1.063	0.051	0.016	1.130	212
4	Bhandgaon MI Tank	Parner	Ahmadnagar	1.860	1.860	1.749	0.085	0.026	1.860	383
5	Bhatodi	Nagar	Ahmadnagar	0.560	0.560	0.527	0.025	0.008	0.560	121
6	Bhutwada Juna	Jamkhed	Ahmadnagar	2.492	2.492	2.344	0.113	0.035	2.492	650
7	Bhutwada MI Tank	Jamkhed	Ahmadnagar	1.614	1.614	1.518	0.073	0.023	1.614	255
8	Chinchodi Patil	Nagar	Ahmadnagar	2.180	2.180	2.050	0.099	0.031	2.180	449
9	Chinchodi Patil KT Weir	Nagar	Ahmednagar	0.899	0.899	0.846	0.041	0.013	0.899	278
10	Chondi	Jamkhed	Ahmadnagar	0.910	0.910	0.856	0.041	0.013	0.910	360
11	Dahigaon KT Weir	Nagar	Ahmednagar	0.730	0.730	0.687	0.033	0.010	0.730	189
12	Dashmigavhan	Nagar	Ahmednagar	0.000	0.000	0.000	0.000	0.000	0.000	141
13	Deulgaon Siddhi	Nagar	Ahmadnagar	1.700	1.700	1.599	0.077	0.024	1.700	365
14	Devibhoyare MI Tank	Parner	Ahmadnagar	2.760	2.760	2.596	0.126	0.039	2.760	1498
15	Dhangarwadi KT Weir	Shrigonda	Ahmadnagar	2.210	2.210	2.079	0.101	0.031	2.210	592
16	Dhondpargaon	Jamkhed	Ahmadnagar	2.170	2.170	2.041	0.099	0.030	2.170	460
17	Dhotri MI Tank	Jamkhed	Ahmednagar	1.440	1.440	1.354	0.066	0.020	1.440	281
18	Dighi	Karjat	Ahmadnagar	1.520	1.520	1.430	0.069	0.021	1.520	545
19	Durgaon MI Tank	Karjat	Ahmadnagar	1.130	1.130	1.063	0.051	0.016	1.130	347
20	Ghodegaon MI Tank	Shrigonda	Ahmadnagar	2.290	2.290	2.154	0.104	0.032	2.290	443
21	Girwali	Jamkhed	Ahmadnagar	0.650	0.650	0.611	0.030	0.009	0.650	260
22	Gunore KT Weir	Parner	Ahmadnagar	1.410	1.410	1.326	0.064	0.020	1.410	320
23	Gunwadi	Nagar	Ahmadnagar	5.690	5.690	5.351	0.259	0.080	5.690	712
24	Guravpimpri	Karjat	Ahmadnagar	3.140	3.140	2.953	0.143	0.044	3.140	526
25	Hanga	Parner	Ahmadnagar	1.340	1.340	1.260	0.061	0.019	1.340	283
26	Hatwalan KT Weir	Nagar	Ahmadnagar	0.832	0.832	0.782	0.038	0.012	0.832	297

27	Jadhavwadi	Parner	Ahmednagar	1.130	1.130	1.063	0.051	0.016	1.130	280
28	Jamkhed (Diversion Weir)	Jamkhed	Ahmadnagar	0.530	0.530	0.498	0.024	0.007	0.530	230
29	Jawala	Jamkhed	Ahmadnagar	1.220	1.220	1.147	0.056	0.017	1.220	315
30	Jawalake	Jamkhed	Ahmadnagar	0.900	0.900	0.846	0.041	0.013	0.900	208
31	Kamargaon	Nagar	Ahmadnagar	1.920	1.920	1.806	0.087	0.027	1.920	338
32	Kapsewasti MI Tank	Shrigonda	Ahmadnagar	1.390	1.390	1.307	0.063	0.019	1.390	410
33	Karmanwadi KT Weir	Karjat	Ahmadnagar	0.600	0.600	0.564	0.027	0.008	0.600	437
34	Kaudgaon	Nagar	Ahmadnagar	2.100	2.100	1.975	0.096	0.029	2.100	340
35	Kavadgaon	Jamkhed	Ahmadnagar	1.470	1.470	1.383	0.067	0.021	1.470	305
36	Kohkadi	Parner	Ahmadnagar	0.830	0.830	0.781	0.038	0.012	0.830	258
37	Kolgaon (Moharwadi) MI Tank	Shrigonda	Ahmadnagar	1.250	1.250	1.176	0.057	0.018	1.250	390
38	Limjewadi MI Tank	Shrigonda	Ahmadnagar	0.790	0.790	0.743	0.036	0.011	0.790	240
39	Lonimawala	Parner	Ahmadnagar	0.870	0.870	0.818	0.040	0.012	0.870	168
40	Mathapimpri	Nagar	Ahmadnagar	0.560	0.560	0.527	0.025	0.008	0.560	297
41	Mathapimpri KTW	Nagar	Ahmadnagar	0.833	0.833	0.783	0.038	0.012	0.833	270
42	Mhase Khurd KT Weir	Parner	Ahmadnagar	1.340	1.340	1.260	0.061	0.019	1.340	235
43	Mohri	Jamkhed	Ahmadnagar	1.520	1.520	1.430	0.069	0.021	1.520	230
44	Naigaon	Jamkhed	Ahmadnagar	1.890	1.890	1.778	0.086	0.026	1.890	440
45	Narayandoh MI Tank	Nagar	Ahmadnagar	1.580	1.580	1.486	0.072	0.022	1.580	310
46	Narayandoh MI Tank	Nagar	Ahmednagar	1.590	1.590	1.495	0.072	0.022	1.590	310
47	Nighoj KT Weir	Parner	Ahmednagar	0.850	0.850	0.799	0.039	0.012	0.850	268
48	Nimgaon Daku	Karjat	Ahmadnagar	1.270	1.270	1.194	0.058	0.018	1.270	657
49	Nimgaon Gangarda	Karjat	Ahmadnagar	0.970	0.970	0.912	0.044	0.014	0.970	307
50	Pargaon MI Tank	Shrigonda	Ahmadnagar	0.880	0.880	0.828	0.040	0.012	0.880	360
51	Pimpalgaon Alwa	Jamkhed	Ahmadnagar	2.410	2.410	2.267	0.110	0.034	2.410	535
52	Pimparkhed KT Weir	Jamkhed	Ahmednagar	0.740	0.740	0.696	0.034	0.010	0.740	205
53	Rakshaswadi Bk. MI Tank	Karjat	Ahmadnagar	1.130	1.130	1.063	0.051	0.016	1.130	237
54	Rakshaswadi Kh. MI Tank	Karjat	Ahmadnagar	1.600	1.600	1.505	0.073	0.022	1.600	358
55	Rashin KT Weir	Karjat	Ahmadnagar	0.790	0.790	0.743	0.036	0.011	0.790	170
56	Ratnapur MI Tank	Jamkhed	Ahmednagar	1.660	1.660	1.561	0.076	0.023	1.660	430
57	Renwadi KT Weir	Parner	Ahmadnagar	1.690	1.690	1.589	0.077	0.024	1.690	361
58	Ruichhatrapati	Parner	Ahmadnagar	1.069	1.069	1.005	0.049	0.015	1.069	168
59	Sakat	Nagar	Ahmadnagar	0.960	0.960	0.903	0.044	0.013	0.960	246
60	Sangvi	Jamkhed	Ahmadnagar	0.850	0.850	0.799	0.039	0.012	0.850	272

61	Shivdoh MI Tank	Parner	Ahmadnagar	1.100	1.100	1.035	0.050	0.015	1.100	635
62	Takli Khandeshwari	Karjat	Ahmadnagar	0.960	0.960	0.903	0.044	0.013	0.960	233
63	Telangashi	Jamkhed	Ahmadnagar	0.960	0.960	0.903	0.044	0.013	0.960	156
64	Thergaon	Karjat	Ahmadnagar	0.940	0.940	0.884	0.043	0.013	0.940	150
65	Therwadi MI Tank	Karjat	Ahmadnagar	2.490	2.490	2.342	0.113	0.035	2.490	432
66	Thorat Wasti KT Weir	Karjat	Ahmadnagar	0.790	0.790	0.743	0.036	0.011	0.790	258
67	Vadgaon Tandali	Nagar	Ahmadnagar	1.450	1.450	1.364	0.066	0.020	1.450	247
68	Vadjhire MI Tank	Parner	Ahmadnagar	1.710	1.710	1.608	0.078	0.024	1.710	982
69	Vadner KT Weir	Parner	Ahmadnagar	1.253	1.253	1.178	0.057	0.018	1.253	505
70	Valki KT Weir	Nagar	Ahmednagar	1.210	1.210	1.138	0.055	0.017	1.210	450
71	Valunj No. 1 KT Weir	Nagar	Ahmednagar	0.850	0.850	0.799	0.039	0.012	0.850	312
72	Valunj No. 2	Nagar	Ahmadnagar	0.590	0.590	0.555	0.027	0.008	0.590	257
73	Vatephal	Nagar	Ahmadnagar	0.620	0.620	0.583	0.028	0.009	0.620	126
74	Walki	Nagar	Ahmadnagar	1.860	1.860	1.749	0.085	0.026	1.860	440
75	Yeswadi MI Tank	Karjat	Ahmadnagar	0.710	0.710	0.668	0.032	0.010	0.710	178
76	yesarthav	Akole	Ahmadnagar	5.520	5.520	5.192	0.251	0.077	5.520	1088
77	Ashti (Ni. Cho.) Major MI Tank	Ashti	Beed	6.540	6.540	6.151	0.298	0.092	6.540	1400
78	Balewadi Storage Tank	Ashti	Beed	1.870	1.870	1.759	0.085	0.026	1.870	420
79	Bhurewadi Storage Tank	Patoda	Beed	1.810	1.810	1.702	0.082	0.025	1.810	405
80	Dhamangaon Storage Tank	Ashti	Beed	1.080	1.080	1.016	0.049	0.015	1.080	256
81	Dhirdi KT Weir	Ashti	Beed	2.090	2.090	1.966	0.095	0.029	2.090	445
82	Hingani KT Weir	Ashti	Beed	1.220	1.220	1.147	0.056	0.017	1.220	264
83	Jalgaon Storage Tank	Ashti	Beed	1.450	1.450	1.364	0.066	0.020	1.450	332
84	Kada KT Weir	Ashti	Beed	1.690	1.690	1.589	0.077	0.024	1.690	348
85	Khadkat KT Weir 2	Ashti	Beed	2.150	2.150	2.022	0.098	0.030	2.150	480
86	Koyal Storage Tank	Ashti	Beed	1.170	1.170	1.100	0.053	0.016	1.170	262
87	Kuntephal Storage Tank	Ashti	Beed	1.130	1.130	1.063	0.051	0.016	1.130	298
88	Labarwadi Storage Tank	Patoda	Beed	1.730	1.730	1.627	0.079	0.024	1.730	308
89	Pandhari storage tank	Ashti	Beed	1.350	1.350	1.270	0.061	0.019	1.350	278
90	Paragaon (Jo)	Ashti	Beed	1.460	1.460	1.373	0.066	0.020	1.460	320
91	Pimpalsuti KT Weir	Ashti	Beed	1.480	1.480	1.392	0.067	0.021	1.480	287
92	Pimpri Ghumri KT Weir	Ashti	Beed	1.500	1.500	1.411	0.068	0.021	1.500	276
93	Pimpri Ghumri storage tank	Ashti	Beed	1.080	1.080	1.016	0.049	0.015	1.080	268
94	Rameshwar Sautada St Tank	Patoda	Beed	2.840	2.840	2.671	0.129	0.040	2.840	772

95	Sagvi (S) KT Weir	Ashti	Beed	2.670	2.670	2.511	0.121	0.037	2.670	594
96	Suleman Devala Storage Tank	Ashti	Beed	1.700	1.700	1.599	0.077	0.024	1.700	500
97	Takalsingh KT Weir	Ashti	Beed	1.500	1.500	1.411	0.068	0.021	1.500	344
98	Vasantwadi Storage Tank	Patoda	Beed	1.390	1.390	1.307	0.063	0.019	1.390	306
99	Adle	Mawal	Pune	0.960	0.960	0.903	0.044	0.013	0.960	199
100	Adwadi	Purandar	Pune	0.660	0.660	0.621	0.030	0.009	0.660	40
101	Alegaon Paga	Shirur	Pune	1.950	1.950	1.834	0.089	0.027	1.950	300
102	Alegoan Paga	Shirur	Pune	4.480	4.480	4.213	0.204	0.063	4.480	1642
103	Ambadwet	Mulshi	Pune	1.350	1.350	1.270	0.061	0.019	1.350	768
104	Ambegaon	Haveli	Pune	1.730	1.730	1.627	0.079	0.024	1.730	284
105	Ambeghar	Bhor	Pune	0.958	0.958	0.901	0.044	0.013	0.958	226
106	Amboli	Khed	Pune	0.260	0.260	0.245	0.012	0.004	0.260	125
107	Amdabad KT Weir	Shirur	Pune	1.520	1.520	1.430	0.069	0.021	1.520	134
108	Amondi KT Weir	Ambegaon	Pune	1.320	1.320	1.241	0.060	0.018	1.320	317
109	Andgaon	Mulshi	Pune	0.560	0.560	0.527	0.025	0.008	0.560	274
110	Ane Pemdara MI Tank	Junnar	Pune	1.480	1.480	1.392	0.067	0.021	1.480	293
111	Anjangaon	Baramati	Pune	0.908	0.908	0.854	0.041	0.013	0.908	368
112	Annapur KT Weir	Shirur	Pune	1.130	1.130	1.063	0.051	0.016	1.130	448
113	Apti	Bhor	Pune	0.690	0.690	0.649	0.031	0.010	0.690	259
114	Arvi KT Weir	Junnar	Pune	0.170	0.170	0.160	0.008	0.002	0.170	40
115	Askwadi	Velhe	Pune	0.268	0.268	0.252	0.012	0.004	0.268	133
116	Avasari KT Weir	Ambegaon	Pune	0.720	0.720	0.677	0.033	0.010	0.720	197
117	Babarmala KT Weir	Shirur	Pune	1.010	1.010	0.950	0.046	0.014	1.010	225
118	Baburdi (Dho.Mala)	Baramati	Pune	0.399	0.399	0.375	0.018	0.006	0.399	162
119	Baburdi (Sa.Di.)	Baramati	Pune	0.760	0.760	0.715	0.035	0.011	0.760	267
120	Bahuli	Haveli	Pune	0.290	0.290	0.273	0.013	0.004	0.290	154
121	Balapudi	Indapur	Pune	0.590	0.590	0.555	0.027	0.008	0.590	103
122	Ballalwadi	Junnar	Pune	1.951	1.951	1.835	0.089	0.027	1.951	288
123	Barhanpur	Baramati	Pune	0.605	0.605	0.569	0.028	0.008	0.605	231
124	Bebedohal	Mawal	Pune	0.820	0.820	0.771	0.037	0.011	0.820	976
125	Belsar KT Weir	Junnar	Pune	1.050	1.050	0.988	0.048	0.015	1.050	422
126	Bhadalwadi	Indapur	Pune	4.530	4.530	4.260	0.206	0.063	4.530	640
127	Bhakarewadi KT Weir	Shirur	Pune	1.272	1.272	1.196	0.058	0.018	1.272	508
128	Bhat-Nimgaon	Indapur	Pune	6.090	6.090	5.728	0.277	0.085	6.090	1212

129	Bhivegaon	Khed	Pune	0.570	0.570	0.536	0.026	0.008	0.570	120
130	Bhivri KT Weir	Haveli	Pune	4.540	4.540	4.270	0.207	0.064	4.540	1242
131	Bhoire	Mawal	Pune	0.590	0.590	0.555	0.027	0.008	0.590	279
132	Bhomale	Khed	Pune	0.570	0.570	0.536	0.026	0.008	0.570	295
133	Bhor Orlabs	Bhor	Pune	0.440	0.440	0.414	0.020	0.006	0.440	177
134	Bhose	Khed	Pune	0.880	0.880	0.828	0.040	0.012	0.880	773
135	Bhoyachi Malai (Anvade)	Bhor	Pune	0.023	0.023	0.022	0.001	0.000	0.023	38
136	Bhugaon	Mawal	Pune	0.580	0.580	0.545	0.026	0.008	0.580	125
137	Bhugaon	Mulshi	Pune	1.800	1.800	1.693	0.082	0.025	1.800	516
138	Boratwadi	Indapur	Pune	2.370	2.370	2.229	0.108	0.033	2.370	526
139	Bordara	Khed	Pune	0.465	0.465	0.437	0.021	0.007	0.465	180
140	Bori KT Weir	Junnar	Pune	1.564	1.564	1.471	0.071	0.022	1.564	580
141	Borkarwadi	Baramati	Pune	0.880	0.880	0.828	0.040	0.012	0.880	158
142	Budhwadi	Mawal	Pune	0.180	0.180	0.169	0.008	0.003	0.180	82
143	Burkegaon	Haveli	Pune	2.070	2.070	1.947	0.094	0.029	2.070	727
144	Chande	Mulshi	Pune	1.600	1.600	1.505	0.073	0.022	1.600	295
145	Chandoh KT Weir	Shirur	Pune	1.710	1.710	1.608	0.078	0.024	1.710	725
146	Chandoli KT Weir	Ambegaon	Pune	1.490	1.490	1.401	0.068	0.021	1.490	366
147	Charholi	Khed	Pune	0.490	0.490	0.461	0.022	0.007	0.490	255
148	Chasnarodi KT Weir	Ambegaon	Pune	0.930	0.930	0.875	0.042	0.013	0.930	384
149	Chikhali	Indapur	Pune	2.350	2.350	2.210	0.107	0.033	2.350	493
150	Chimbali	Khed	Pune	1.500	1.500	1.411	0.068	0.021	1.500	830
151	Chinchwad	Mulshi	Pune	1.460	1.460	1.373	0.066	0.020	1.460	204
152	Dahitane	Daund	Pune	6.210	6.210	5.841	0.283	0.087	6.210	1134
153	Dahiwadi	Shirur	Pune	1.030	1.030	0.969	0.047	0.014	1.030	125
154	Dakhali	Mulshi	Pune	0.930	0.930	0.875	0.042	0.013	0.930	420
155	Dapode	Velhe	Pune	0.250	0.250	0.235	0.011	0.004	0.250	102
156	Davje	Mulshi	Pune	0.770	0.770	0.724	0.035	0.011	0.770	376
157	Dehu	Haveli	Pune	1.980	1.980	1.862	0.090	0.028	1.980	425
158	Deulgaon Raje	Daund	Pune	3.640	3.640	3.423	0.166	0.051	3.640	562
159	Devgaon KT Weir	Ambegaon	Pune	1.735	1.735	1.632	0.079	0.024	1.735	686
160	Dhamari	Shirur	Pune	0.900	0.900	0.846	0.041	0.013	0.900	153
161	Dhanore	Khed	Pune	0.790	0.790	0.743	0.036	0.011	0.790	357
162	Didghar	Bhor	Pune	0.900	0.900	0.846	0.041	0.013	0.900	363

163	Divale	Bhor	Pune	2.000	2.000	1.881	0.091	0.028	2.000	445
164	Donde	Khed	Pune	1.840	1.840	1.731	0.084	0.026	1.840	848
165	Dongargaon	Mulshi	Pune	0.970	0.970	0.912	0.044	0.014	0.970	320
166	Gadadawane (Shindewadi) MI	Mulshi	Pune	2.120	2.120	1.994	0.096	0.030	2.120	311
167	Gadilgaon KT Weir	Shirur	Pune	1.586	1.586	1.492	0.072	0.022	1.586	300
168	Gangapur KT Weir	Ambegaon	Pune	1.340	1.340	1.260	0.061	0.019	1.340	316
169	Garade	Purandar	Pune	1.560	1.560	1.467	0.071	0.022	1.560	372
170	Ghadgewadi	Baramati	Pune	2.590	2.590	2.436	0.118	0.036	2.590	606
171	Ghagargaon	Indapur	Pune	1.110	1.110	1.044	0.051	0.016	1.110	174
172	Ghangaldara MI Tank	Junnar	Pune	2.244	2.244	2.110	0.102	0.031	2.244	450
173	Ghorvadi	Purandar	Pune	1.570	1.570	1.477	0.071	0.022	1.570	0
174	Godumbre	Mawal	Pune	0.450	0.450	0.423	0.020	0.006	0.450	96
175	Gohe MI Tank	Ambegaon	Pune	1.100	1.100	1.035	0.050	0.015	1.100	175
176	Gonwadi KT Weir	Ambegaon	Pune	1.232	1.232	1.159	0.056	0.017	1.232	621
177	Gunvadi	Baramati	Pune	1.190	1.190	1.119	0.054	0.017	1.190	429
178	Hadshi	Mulshi	Pune	2.980	2.980	2.803	0.136	0.042	2.980	508
179	Hadshi-2 MI Tank	Mulshi	Pune	1.410	1.410	1.326	0.064	0.020	1.410	292
180	Hinjwadi	Mulshi	Pune	1.510	1.510	1.420	0.069	0.021	1.510	713
181	Hivre No. 1 KT Weir	Junnar	Pune	0.283	0.283	0.266	0.013	0.004	0.283	73
182	Hivre No. 2 KT Weir	Junnar	Pune	0.790	0.790	0.743	0.036	0.011	0.790	189
183	Hol	Baramati	Pune	2.800	2.800	2.633	0.127	0.039	2.800	402
184	Honewadi KT Weir	Shirur	Pune	1.189	1.189	1.118	0.054	0.017	1.189	487
185	Inamgaon (Nalge mala) KT Weir	Shirur	Pune	2.290	2.290	2.154	0.104	0.032	2.290	530
186	Inamgaon KT Weir	Shirur	Pune	4.160	4.160	3.912	0.189	0.058	4.160	1032
187	Jadhavwadi KT Weir	Junnar	Pune	1.254	1.254	1.179	0.057	0.018	1.254	812
188	Jadhavwadi MI Tank	Mawal	Pune	12.030	12.030	11.314	0.547	0.168	12.030	1660
189	Jalgaon K.P.	Baramati	Pune	0.870	0.870	0.818	0.040	0.012	0.870	302
190	Jalgaon Supe	Baramati	Pune	0.460	0.460	0.433	0.021	0.006	0.460	141
191	Jalgaon Supe	Baramati	Pune	0.548	0.548	0.516	0.025	0.008	0.548	225
192	Jamb	Indapur	Pune	2.610	2.610	2.455	0.119	0.037	2.610	835
193	Jambhali	Bhor	Pune	0.780	0.780	0.734	0.035	0.011	0.780	391
194	Jambut KT Weir	Shirur	Pune	2.420	2.420	2.276	0.110	0.034	2.420	524
195	Jedhecha Doh KT Weir	Junnar	Pune	0.782	0.782	0.735	0.036	0.011	0.782	45
196	Jeur	Purandar	Pune	3.497	3.497	3.289	0.159	0.049	3.497	680

197	Jiregaon	Daund	Pune	0.890	0.890	0.837	0.040	0.012	0.890	178
198	Kadadhe	Mawal	Pune	0.500	0.500	0.470	0.023	0.007	0.500	108
199	Kadus	Khed	Pune	2.250	2.250	2.116	0.102	0.032	2.250	522
200	Kalamb KT Weir	Ambegaon	Pune	1.860	1.860	1.749	0.085	0.026	1.860	666
201	Kalus	Khed	Pune	1.930	1.930	1.815	0.088	0.027	1.930	720
202	Kambaleshwar	Baramati	Pune	2.000	2.000	1.881	0.091	0.028	2.000	450
203	Kangaon KT Weir	Daund	Pune	1.510	1.510	1.420	0.069	0.021	1.510	991
204	Kanhesar	Khed	Pune	0.524	0.524	0.493	0.024	0.007	0.524	184
205	Karanjawane Sonde	Velhe	Pune	0.520	0.520	0.489	0.024	0.007	0.520	240
206	Karhathi	Baramati	Pune	1.310	1.310	1.232	0.060	0.018	1.310	405
207	Karhati KT Weir	Baramati	Pune	0.490	0.490	0.461	0.022	0.007	0.490	269
208	Karhavagaj	Baramati	Pune	0.776	0.776	0.730	0.035	0.011	0.776	274
209	Kasarsai	Mulshi	Pune	0.300	0.300	0.282	0.014	0.004	0.300	129
210	Kasunjai Karnavad	Bhor	Pune	0.020	0.020	0.019	0.001	0.000	0.020	42
211	Kathapur KT Weir	Ambegaon	Pune	3.880	3.880	3.649	0.177	0.054	3.880	1420
212	Kavdi KT Weir	Haveli	Pune	4.510	4.510	4.242	0.205	0.063	4.510	1323
213	Kavthe Phakte KT Weir	Shirur	Pune	2.577	2.577	2.424	0.117	0.036	2.577	1048
214	Khambavadi	Velhe	Pune	0.250	0.250	0.235	0.011	0.004	0.250	126
215	Khamboli MI Tank	Mulshi	Pune	2.040	2.040	1.919	0.093	0.029	2.040	362
216	Khamgaon	Daund	Pune	2.350	2.350	2.210	0.107	0.033	2.350	586
217	Khariv	Velhe	Pune	0.850	0.850	0.799	0.039	0.012	0.850	429
218	Kharochi	Indapur	Pune	1.870	1.870	1.759	0.085	0.026	1.870	384
219	Kharpudi	Khed	Pune	1.420	1.420	1.336	0.065	0.020	1.420	525
220	Khodad 1 KT Weir	Junnar	Pune	0.113	0.113	0.106	0.005	0.002	0.113	25
221	Khodad 2 KT Weir	Junnar	Pune	0.113	0.113	0.106	0.005	0.002	0.113	25
222	Khodad 3 KT Weir	Junnar	Pune	0.169	0.169	0.159	0.008	0.002	0.169	40
223	Khorwadi	Daund	Pune	5.660	5.660	5.323	0.258	0.079	5.660	716
224	Kodhwal MI Tank	Ambegaon	Pune	1.590	1.590	1.495	0.072	0.022	1.590	256
225	Kohkadi KT Weir	Shirur	Pune	0.890	0.890	0.837	0.040	0.012	0.890	258
226	Kolgaon Dolas KT Weir	Shirur	Pune	0.860	0.860	0.809	0.039	0.012	0.860	134
227	Kolwade	Mulshi	Pune	0.290	0.290	0.273	0.013	0.004	0.290	210
228	Kolwan	Mulshi	Pune	0.240	0.240	0.226	0.011	0.003	0.240	113
229	Kondhivali	Velhe	Pune	0.679	0.679	0.639	0.031	0.010	0.679	337
230	Kondiwade	Mawal	Pune	0.660	0.660	0.621	0.030	0.009	0.660	219

231	Koregaon	Khed	Pune	0.260	0.260	0.245	0.012	0.004	0.260	125
232	Korhale	Baramati	Pune	3.390	3.390	3.188	0.154	0.047	3.390	737
233	Koyali	Khed	Pune	1.640	1.640	1.542	0.075	0.023	1.640	656
234	Lakhangaon KT Weir	Ambegaon	Pune	0.590	0.590	0.555	0.027	0.008	0.590	157
235	Late	Baramati	Pune	2.120	2.120	1.994	0.096	0.030	2.120	436
236	Lavle	Mulshi	Pune	2.090	2.090	1.966	0.095	0.029	2.090	402
237	Madanwadi	Indapur	Pune	4.680	4.680	4.402	0.213	0.066	4.680	682
238	Mahakoshi MI Tank	Bhor	Pune	2.280	2.280	2.144	0.104	0.032	2.280	477
239	Mahur	Purandar	Pune	1.830	1.830	1.721	0.083	0.026	1.830	432
240	Malad	Daund	Pune	1.230	1.230	1.157	0.056	0.017	1.230	236
241	Malegaon (Nasrapur)	Bhor	Pune	0.280	0.280	0.263	0.013	0.004	0.280	148
242	Malwadi	Baramati	Pune	0.830	0.830	0.781	0.038	0.012	0.830	290
243	Malwandi MI Tank	Mawal	Pune	3.690	3.690	3.470	0.168	0.052	3.690	437
244	Mandki	Purandar	Pune	1.430	1.430	1.345	0.065	0.020	1.430	710
245	Mangrul Pargaon KT Weir	Junnar	Pune	1.670	1.670	1.571	0.076	0.023	1.670	383
246	Manjarwadi KT Weir	Junnar	Pune	0.113	0.113	0.106	0.005	0.002	0.113	25
247	Margasani	Velhe	Pune	0.644	0.644	0.606	0.029	0.009	0.644	298
248	Marnewadi MI Tank	Mulshi	Pune	0.854	0.854	0.803	0.039	0.012	0.854	158
249	Matoba	Daund	Pune	4.520	4.520	4.251	0.206	0.063	4.520	1090
250	Medad	Baramati	Pune	0.448	0.448	0.421	0.020	0.006	0.448	173
251	Mhase Bk. KT Weir	Shirur	Pune	1.240	1.240	1.166	0.056	0.017	1.240	282
252	Mohri	Bhor	Pune	0.510	0.510	0.480	0.023	0.007	0.510	255
253	Morgaon	Baramati	Pune	1.112	1.112	1.046	0.051	0.016	1.112	410
254	Motewadi	Bhor	Pune	0.780	0.780	0.734	0.035	0.011	0.780	132
255	Murum	Baramati	Pune	3.171	3.171	2.982	0.144	0.044	3.171	677
256	Mutha	Mulshi	Pune	0.220	0.220	0.207	0.010	0.003	0.220	158
257	Naigaon Degaon	Bhor	Pune	1.070	1.070	1.006	0.049	0.015	1.070	163
258	Nande	Mulshi	Pune	1.870	1.870	1.759	0.085	0.026	1.870	295
259	Nandgaon	Bhor	Pune	0.575	0.575	0.541	0.026	0.008	0.575	273
260	Nane, Nanoli	Mawal	Pune	0.270	0.270	0.254	0.012	0.004	0.270	130
261	Narsinhpur (Shevre)	Indapur	Pune	5.870	5.870	5.521	0.267	0.082	5.870	1150
262	Nepatvalan	Baramati	Pune	0.810	0.810	0.762	0.037	0.011	0.810	284
263	Nigde	Bhor	Pune	0.990	0.990	0.931	0.045	0.014	0.990	422
264	Nighoje	Khed	Pune	1.320	1.320	1.241	0.060	0.018	1.320	613

265	Nighutghar	Bhor	Pune	0.083	0.083	0.078	0.004	0.001	0.083	710
266	Nimbut	Baramati	Pune	1.850	1.850	1.740	0.084	0.026	1.850	275
267	Nimdari KT Weir	Junnar	Pune	1.780	1.780	1.674	0.081	0.025	1.780	38
268	Nimgaon Bhogi	Shirur	Pune	0.450	0.450	0.423	0.020	0.006	0.450	161
269	Nimgaon Dude (Kund) KT Weir	Shirur	Pune	1.328	1.328	1.249	0.060	0.019	1.328	410
270	Nimgaon Dude (Tamkarwadi) KTW	Shirur	Pune	0.870	0.870	0.818	0.040	0.012	0.870	295
271	Nimgaon Dude KT Weir	Shirur	Pune	1.770	1.770	1.665	0.081	0.025	1.770	683
272	Nimgaon Mhalungi	Shirur	Pune	3.000	3.000	2.822	0.137	0.042	3.000	520
273	Nimgaon Tambevasti	Khed	Pune	1.300	1.300	1.223	0.059	0.018	1.300	439
274	Nira	Purandar	Pune	2.169	2.169	2.040	0.099	0.030	2.169	517
275	Nira Vagaj	Baramati	Pune	2.980	2.980	2.803	0.136	0.042	2.980	679
276	Nira-Narsinhpur	Indapur	Pune	5.720	5.720	5.380	0.260	0.080	5.720	687
277	Nirgudsar KT Weir	Ambegaon	Pune	1.150	1.150	1.082	0.052	0.016	1.150	389
278	Nirwangi Khalal	Indapur	Pune	1.100	1.100	1.035	0.050	0.015	1.100	380
279	Nirwangi Nimsakhar	Indapur	Pune	2.640	2.640	2.483	0.120	0.037	2.640	595
280	Otur KT Weir	Junnar	Pune	0.540	0.540	0.508	0.025	0.008	0.540	260
281	Otur Wagdara MI Tank	Junnar	Pune	0.950	0.950	0.893	0.043	0.013	0.950	140
282	Palasdev	Indapur	Pune	2.530	2.530	2.379	0.115	0.035	2.530	557
283	Panhval	Bhor	Pune	0.043	0.043	0.040	0.002	0.001	0.043	43
284	Pargaon KT Weir	Ambegaon	Pune	2.350	2.350	2.210	0.107	0.033	2.350	836
285	Pargoan	Daund	Pune	7.080	7.080	6.659	0.322	0.099	7.080	1075
286	Parunde MI Tank	Junnar	Pune	0.870	0.870	0.818	0.040	0.012	0.870	172
287	Patethan	Daund	Pune	2.440	2.440	2.295	0.111	0.034	2.440	896
288	Pedgaon KT Weir	Daund	Pune	4.140	4.140	3.894	0.188	0.058	4.140	928
289	Perne	Haveli	Pune	2.620	2.620	2.464	0.119	0.037	2.620	1158
290	Peshwekalin KT Weir	Junnar	Pune	0.390	0.390	0.367	0.018	0.005	0.390	147
291	Phondwada Gaothan	Baramati	Pune	0.930	0.930	0.875	0.042	0.013	0.930	323
292	Phondwada J. Wasti	Baramati	Pune	0.770	0.770	0.724	0.035	0.011	0.770	262
293	Pilanwadi	Purandar	Pune	1.810	1.810	1.702	0.082	0.025	1.810	399
294	Pimpalgaon (Satikon) KT Weir	Junnar	Pune	0.810	0.810	0.762	0.037	0.011	0.810	260
295	Pimpalgaon Kh. KT Weir	Ambegaon	Pune	1.690	1.690	1.589	0.077	0.024	1.690	416
296	Pimpalgaon KT Weir	Junnar	Pune	0.880	0.880	0.828	0.040	0.012	0.880	35
297	Pimpalwadi Vaishakhkhede KTW	Junnar	Pune	1.660	1.660	1.561	0.076	0.023	1.660	401

298	Pimpoli	Mawal	Pune	0.150	0.150	0.141	0.007	0.002	0.150	40
299	Pimpoli	Mulshi	Pune	1.410	1.410	1.326	0.064	0.020	1.410	259
300	Pimpra KT Weir	Purandar	Pune	2.570	2.570	2.417	0.117	0.036	2.570	482
301	Pimpri	Khed	Pune	0.470	0.470	0.442	0.021	0.007	0.470	279
302	Pingori	Purandar	Pune	0.560	0.560	0.527	0.025	0.008	0.560	40
303	Pisarve	Purandar	Pune	1.650	1.650	1.552	0.075	0.023	1.650	243
304	Pithewadi	Indapur	Pune	1.770	1.770	1.665	0.081	0.025	1.770	4170
305	Pondewadi	Indapur	Pune	1.500	1.500	1.411	0.068	0.021	1.500	249
306	Pur	Khed	Pune	0.530	0.530	0.498	0.024	0.007	0.530	184
307	Rahu	Daund	Pune	9.790	9.790	9.207	0.445	0.137	9.790	1887
308	Rajapuri	Mawal	Pune	33.000	33.000	31.037	1.502	0.462	33.000	421
309	Rajgurunagar	Khed	Pune	1.340	1.340	1.260	0.061	0.019	1.340	372
310	Ramjewadi MI Tank	Junnar	Pune	1.500	1.500	1.411	0.068	0.021	1.500	304
311	Ranjni 1 KT Weir	Ambegaon	Pune	0.198	0.198	0.186	0.009	0.003	0.198	48
312	Ranjni 2 KT Weir	Ambegaon	Pune	0.085	0.085	0.080	0.004	0.001	0.085	20
313	Rawade	Mulshi	Pune	1.890	1.890	1.778	0.086	0.026	1.890	737
314	Rihe	Mulshi	Pune	1.270	1.270	1.194	0.058	0.018	1.270	210
315	Sablewadi KT Weir	Shirur	Pune	0.508	0.508	0.478	0.023	0.007	0.508	205
316	Sadalgaon	Shirur	Pune	3.670	3.670	3.452	0.167	0.051	3.670	894
317	Sakori KT Weir	Junnar	Pune	1.589	1.589	1.494	0.072	0.022	1.589	358
318	Saltar MI Tank	Mulshi	Pune	1.360	1.360	1.279	0.062	0.019	1.360	255
319	Sangise	Mawal	Pune	0.280	0.280	0.263	0.013	0.004	0.280	82
320	Sangvi Bhide	Bhor	Pune	0.089	0.089	0.084	0.004	0.001	0.089	43
321	Sangvi Sandas	Haveli	Pune	2.620	2.620	2.464	0.119	0.037	2.620	1215
322	Saradwadi KT Weir	Shirur	Pune	1.140	1.140	1.072	0.052	0.016	1.140	456
323	Savargaon	Mulshi	Pune	0.410	0.410	0.386	0.019	0.006	0.410	101
324	Savargaon KT Weir	Junnar	Pune	0.873	0.873	0.821	0.040	0.012	0.873	53
325	Shel Pimpalgaon	Khed	Pune	1.030	1.030	0.969	0.047	0.014	1.030	419
326	Shelgaon	Khed	Pune	0.280	0.280	0.263	0.013	0.004	0.280	240
327	Shere	Mulshi	Pune	0.660	0.660	0.621	0.030	0.009	0.660	129
328	Shere MI Tank	Mulshi	Pune	1.760	1.760	1.655	0.080	0.025	1.760	425
329	Shind	Bhor	Pune	1.258	1.258	1.183	0.057	0.018	1.258	349
330	Shindevasti	Haveli	Pune	1.079	1.079	1.015	0.049	0.015	1.079	428
331	Shingwe KT Weir	Ambegaon	Pune	0.141	0.141	0.133	0.006	0.002	0.141	35

332	Shirsuphal	Baramati	Pune	9.520	9.520	8.954	0.433	0.133	9.520	448
333	Shirur KT Weir	Shirur	Pune	0.557	0.557	0.524	0.025	0.008	0.557	0
334	Shirvali	Baramati	Pune	2.390	2.390	2.248	0.109	0.033	2.390	493
335	Shivtakrar Mhalungi	Daund	Pune	4.120	4.120	3.875	0.187	0.058	4.120	1528
336	Siddhegavhan	Khed	Pune	0.850	0.850	0.799	0.039	0.012	0.850	335
337	Sirasgaon Kata KT Weir	Shirur	Pune	2.090	2.090	1.966	0.095	0.029	2.090	455
338	Songaon Gitewasti	Baramati	Pune	1.680	1.680	1.580	0.076	0.024	1.680	510
339	Songaon Sangam	Baramati	Pune	1.710	1.710	1.608	0.078	0.024	1.710	451
340	Sonwadi	Daund	Pune	19.480	19.480	18.321	0.886	0.273	19.480	1967
341	Sultanpur KT Weir	Ambegaon	Pune	0.850	0.850	0.799	0.039	0.012	0.850	232
342	Takwe	Mawal	Pune	0.180	0.180	0.169	0.008	0.003	0.180	200
343	Tambad Kokwadi	Bhor	Pune	0.810	0.810	0.762	0.037	0.011	0.810	317
344	Tandali Khorevasti KT Weir	Shirur	Pune	2.140	2.140	2.013	0.097	0.030	2.140	542
345	Tandali Sangam KT Weir	Shirur	Pune	1.860	1.860	1.749	0.085	0.026	1.860	700
346	Tannu-Takli	Indapur	Pune	6.310	6.310	5.935	0.287	0.088	6.310	1255
347	Tarangwadi	Indapur	Pune	1.540	1.540	1.448	0.070	0.022	1.540	161
348	Tardoli	Baramati	Pune	1.060	1.060	0.997	0.048	0.015	1.060	143
349	Thikekarwadi KT Weir	Junnar	Pune	1.290	1.290	1.213	0.059	0.018	1.290	386
350	Thitewadi MI Tank	Shirur	Pune	9.860	9.860	9.273	0.449	0.138	9.860	1078
351	Tulapur	Khed	Pune	1.980	1.980	1.862	0.090	0.028	1.980	526
352	Ucchil MI Tank	Junnar	Pune	3.060	3.060	2.878	0.139	0.043	3.060	699
353	Udapur KT Weir	Junnar	Pune	0.659	0.659	0.620	0.030	0.009	0.659	253
354	Umbre	Bhor	Pune	0.450	0.450	0.423	0.020	0.006	0.450	183
355	Urwade	Mulshi	Pune	1.890	1.890	1.778	0.086	0.026	1.890	258
356	Vadaj KT Weir	Junnar	Pune	0.899	0.899	0.846	0.041	0.013	0.899	100
357	Vadgaon	Bhor	Pune	0.584	0.584	0.549	0.027	0.008	0.584	226
358	Vadgaon Bande	Daund	Pune	1.180	1.180	1.110	0.054	0.017	1.180	255
359	Vadgaon Kandli MT Weir	Junnar	Pune	1.076	1.076	1.012	0.049	0.015	1.076	478
360	Vadgaon Kashimbe KT Weir	Ambegaon	Pune	1.493	1.493	1.404	0.068	0.021	1.493	606
361	Vadgaon Shinde	Haveli	Pune	1.660	1.660	1.561	0.076	0.023	1.660	656
362	Vadhu	Haveli	Pune	4.560	4.560	4.289	0.207	0.064	4.560	1783
363	Vakad	Mulshi	Pune	0.380	0.380	0.357	0.017	0.005	0.380	80
364	Valhe Kondavale	Velhe	Pune	0.220	0.220	0.207	0.010	0.003	0.220	109
365	Valti 1 KT Weir	Ambegaon	Pune	0.141	0.141	0.133	0.006	0.002	0.141	35

366	Valti 2 KT Weir	Ambegaon	Pune	1.050	1.050	0.988	0.048	0.015	1.050	406
367	Vaphgaon	Khed	Pune	2.670	2.670	2.511	0.121	0.037	2.670	312
368	Varangali	Indapur	Pune	0.560	0.560	0.527	0.025	0.008	0.560	109
369	Varkute	Indapur	Pune	1.270	1.270	1.194	0.058	0.018	1.270	172
370	Varude	Khed	Pune	0.460	0.460	0.433	0.021	0.006	0.460	204
371	Varvand	Daund	Pune	5.240	5.240	4.928	0.238	0.073	5.240	1309
372	Vatekarvasti	Khed	Pune	1.060	1.060	0.997	0.048	0.015	1.060	260
373	Venvadi	Bhor	Pune	0.620	0.620	0.583	0.028	0.009	0.620	134
374	Virnala	Purandar	Pune	2.050	2.050	1.928	0.093	0.029	2.050	344
375	Wagajwadi MI Tank	Bhor	Pune	1.670	1.670	1.571	0.076	0.023	1.670	263
376	Waki	Baramati	Pune	2.300	2.300	2.163	0.105	0.032	2.300	329
377	Waki	Khed	Pune	1.280	1.280	1.204	0.058	0.018	1.280	603
378	Walanwadi KT Weir	Junnar	Pune	0.469	0.469	0.441	0.021	0.007	0.469	181
379	Walchandnagar	Indapur	Pune	1.640	1.640	1.542	0.075	0.023	1.640	563
380	Walen	Mulshi	Pune	5.110	5.110	4.806	0.233	0.072	5.110	918
381	Walha	Purandar	Pune	0.071	0.071	0.067	0.003	0.001	0.071	40
382	Warulwadi KT Weir	Junnar	Pune	0.270	0.270	0.254	0.012	0.004	0.270	0
383	Yenere MT Tank	Junnar	Pune	1.780	1.780	1.674	0.081	0.025	1.780	378
384	Atpadi	Atpadi	Sangli	7.960	7.960	7.486	0.362	0.111	7.960	1120
385	Arjunwadi	Atpadi	Sangli	1.700	1.700	1.599	0.077	0.024	1.700	281
386	Banpuri	Atpadi	Sangli	1.290	1.290	1.213	0.059	0.018	1.290	216
387	Bhivargi	Jat	Sangli	8.627	8.627	8.114	0.393	0.121	8.627	1995
388	Birnal	Jat	Sangli	2.140	2.140	2.013	0.097	0.030	2.140	256
389	Daribdachi	Jat	Sangli	1.588	1.588	1.494	0.072	0.022	1.588	309
390	Dighanchi (Yadavmala) KTW	Atpadi	Sangli	3.330	3.330	3.132	0.152	0.047	3.330	664
391	Dighanchi (Yadavmala) KTW	Atpadi	Sangli	0.599	0.599	0.563	0.027	0.008	0.599	275
392	Dudhebhavi	Kawathemahankal	Sangli	3.460	3.460	3.254	0.157	0.048	3.460	697
393	Ghanand	Atpadi	Sangli	1.133	1.133	1.065	0.052	0.016	1.133	166
394	Goradwadi	Atpadi	Sangli	0.950	0.950	0.893	0.043	0.013	0.950	113
395	Jalihal	Jat	Sangli	1.920	1.920	1.806	0.087	0.027	1.920	265
396	Jambhulni	Atpadi	Sangli	2.640	2.640	2.483	0.120	0.037	2.640	408
397	Kachrevasti	Atpadi	Sangli	2.480	2.480	2.332	0.113	0.035	2.480	528
398	Kauthuli KT Weir	Atpadi	Sangli	0.849	0.849	0.799	0.039	0.012	0.849	196
399	Kosari	Jat	Sangli	1.390	1.390	1.307	0.063	0.019	1.390	186

400	Malevasti	Atpadi	Sangli	1.410	1.410	1.326	0.064	0.020	1.410	270
401	Mirwad	Jat	Sangli	1.416	1.416	1.332	0.064	0.020	1.416	322
402	Nimbvade	Atpadi	Sangli	5.670	5.670	5.333	0.258	0.079	5.670	600
403	Pandozari	Jat	Sangli	2.480	2.480	2.332	0.113	0.035	2.480	576
404	Pratapur	Jat	Sangli	1.430	1.430	1.345	0.065	0.020	1.430	212
405	Revnal	Jat	Sangli	2.190	2.190	2.060	0.100	0.031	2.190	252
406	Sanamdi	Jat	Sangli	1.780	1.780	1.674	0.081	0.025	1.780	385
407	Shegaon	Jat	Sangli	5.820	5.820	5.474	0.265	0.081	5.820	840
408	Shegaon No. 2	Jat	Sangli	1.008	1.008	0.948	0.046	0.014	1.008	261
409	Shetphale	Atpadi	Sangli	1.140	1.140	1.072	0.052	0.016	1.140	165
410	Siddhanath	Jat	Sangli	4.900	4.900	4.608	0.223	0.069	4.900	846
411	Singanhalli	Jat	Sangli	1.053	1.053	0.990	0.048	0.015	1.053	256
412	Sordi	Jat	Sangli	3.750	3.750	3.527	0.171	0.053	3.750	780
413	Tikondi No. 1	Jat	Sangli	2.810	2.810	2.643	0.128	0.039	2.810	307
414	Tikondi No. 2	Jat	Sangli	2.200	2.200	2.069	0.100	0.031	2.200	309
415	Tippehalli	Jat	Sangli	1.416	1.416	1.332	0.064	0.020	1.416	324
416	Valekhindi	Jat	Sangli	3.100	3.100	2.916	0.141	0.043	3.100	496
417	Vibhutwadi	Atpadi	Sangli	1.156	1.156	1.087	0.053	0.016	1.156	169
418	Yelvi	Jat	Sangli	2.240	2.240	2.107	0.102	0.031	2.240	320
419	Banganga	Phaltan	Satara	6.490	6.490	6.104	0.295	0.091	6.490	1036
420	Barad	Phaltan	Satara	0.640	0.640	0.602	0.029	0.009	0.640	102
421	Dambwadi	Khatav	Satara	0.660	0.660	0.621	0.030	0.009	0.660	139
422	Dhakni	Man	Satara	2.680	2.680	2.521	0.122	0.038	2.680	495
423	Dhaval	Phaltan	Satara	0.960	0.960	0.903	0.044	0.013	0.960	157
424	Dhumalwadi	Phaltan	Satara	0.720	0.720	0.677	0.033	0.010	0.720	192
425	Gangoti	Man	Satara	1.360	1.360	1.279	0.062	0.019	1.360	247
426	Hingangaon	Phaltan	Satara	1.240	1.240	1.166	0.056	0.017	1.240	208
427	Jambhulni	Man	Satara	2.230	2.230	2.097	0.101	0.031	2.230	416
428	Jhashi MI Tank	Man	Satara	3.540	3.540	3.329	0.161	0.050	3.540	306
429	Kankatrewadi	Khatav	Satara	1.040	1.040	0.978	0.047	0.015	1.040	152
430	Kurvli Bk.	Phaltan	Satara	1.010	1.010	0.950	0.046	0.014	1.010	133
431	Kurvli Kh.	Phaltan	Satara	0.790	0.790	0.743	0.036	0.011	0.790	147
432	Lodhawade	Man	Satara	0.700	0.700	0.658	0.032	0.010	0.700	120
433	Mahabaleshwarwadi	Man	Satara	1.500	1.500	1.411	0.068	0.021	1.500	197

434	Masalwadi	Man	Satara	2.010	2.010	1.890	0.091	0.028	2.010	204
435	Mulikwadi	Phaltan	Satara	1.350	1.350	1.270	0.061	0.019	1.350	219
436	Pingali	Man	Satara	2.360	2.360	2.220	0.107	0.033	2.360	456
437	Tambve	Phaltan	Satara	4.850	4.850	4.561	0.221	0.068	4.850	708
438	Vinchurni	Phaltan	Satara	1.050	1.050	0.988	0.048	0.015	1.050	170
439	Achakdani	Sangola	Solapur	1.350	1.350	1.270	0.061	0.019	1.350	186
440	Akluj KT Weir	Malshiras	Solapur	4.510	4.510	4.242	0.205	0.063	4.510	945
441	Akole M KT Weir	South Solapur	Solapur	2.700	2.700	2.539	0.123	0.038	2.700	652
442	Alegaon (Korda)	Sangola	Solapur	1.650	1.650	1.552	0.075	0.023	1.650	252
443	Anakdhala (Hakemala) KTW	Sangola	Solapur	5.381	5.381	5.061	0.245	0.075	5.381	837
444	Arali KT Weir	Mangalwedha	Solapur	5.670	5.670	5.333	0.258	0.079	5.670	1315
445	Arjunsond KT Weir	Mohol	Solapur	1.900	1.900	1.787	0.086	0.027	1.900	445
446	Auj KT Weir	South Solapur	Solapur	5.820	5.820	5.474	0.265	0.081	5.820	1404
447	Bablad KT Weir	Madha	Solapur	0.820	0.820	0.771	0.037	0.011	0.820	441
448	Balwadi	Sangola	Solapur	1.660	1.660	1.561	0.076	0.023	1.660	509
449	Bamni KT Weir	Sangola	Solapur	2.800	2.800	2.633	0.127	0.039	2.800	654
450	Bandalgi KT Weir	South Solapur	Solapur	2.610	2.610	2.455	0.119	0.037	2.610	760
451	Bangard KT Weir	Malshiras	Solapur	1.640	1.640	1.542	0.075	0.023	1.640	310
452	Bathan	Mangalwedha	Solapur	4.608	4.608	4.334	0.210	0.065	4.608	2690
453	Bhalewadi KT Weir	Karmala	Solapur	2.379	2.379	2.237	0.108	0.033	2.379	579
454	Bhambewadi KT Weir	Mohol	Solapur	0.880	0.880	0.828	0.040	0.012	0.880	262
455	Bhandishegaon	Pandharpur	Solapur	1.860	1.860	1.749	0.085	0.026	1.860	338
456	Bhose	Mangalwedha	Solapur	1.730	1.730	1.627	0.079	0.024	1.730	266
457	Bhoyre	Mohol	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	1209
458	Bopale	Mohol	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	2086
459	Chare	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	298
460	Chincholi	Sangola	Solapur	2.700	2.700	2.539	0.123	0.038	2.700	728
461	Chinchpoor KT Weir	South Solapur	Solapur	5.890	5.890	5.540	0.268	0.082	5.890	1378
462	Chinke (A) KT Weir	Sangola	Solapur	1.390	1.390	1.307	0.063	0.019	1.390	332
463	Darphal (Si)	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	257
464	Darphal (U)	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	322
465	Darphal Bibi	North Solapur	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	447
466	Degaon	Mohol	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	2262

467	Dharamgaon KT Weir	Mangalwedha	Solapur	3.310	3.310	3.113	0.151	0.046	3.310	564
468	Dharniki KT Weir	Mangalwedha	Solapur	3.540	3.540	3.329	0.161	0.050	3.540	576
469	Dikral Narkhed KT Weir	Mohol	Solapur	3.540	3.540	3.329	0.161	0.050	3.540	817
470	Dongargaon	Mangalwedha	Solapur	1.190	1.190	1.119	0.054	0.017	1.190	207
471	Ganeshgaon	Malshiras	Solapur	7.400	7.400	6.960	0.337	0.104	7.400	1473
472	Ghanegaon	Barshi	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	261
473	Gherdi	Sangola	Solapur	2.820	2.820	2.652	0.128	0.039	2.820	417
474	Girjhani	Malshiras	Solapur	1.460	1.460	1.373	0.066	0.020	1.460	231
475	Girzani MI Tank (Ht raising)	Malshiras	Solapur	0.520	0.520	0.489	0.024	0.007	0.520	80
476	Gormale	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	283
477	Gunjegaon KT Weir	Mangalwedha	Solapur	1.670	1.670	1.571	0.076	0.023	1.670	796
478	Gursale KT Weir	Pandharpur	Solapur	5.130	5.130	4.825	0.233	0.072	5.130	1295
479	Hangirge	Sangola	Solapur	1.330	1.330	1.251	0.061	0.019	1.330	223
480	Hilli KT Weir	Akkalkot	Solapur	5.350	5.350	5.032	0.243	0.075	5.350	1340
481	Hingani (K)	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	401
482	Hotgi	South Solapur	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	320
483	Huljanti	Mangalwedha	Solapur	1.010	1.010	0.950	0.046	0.014	1.010	184
484	Huljanti KT Weir	Mangalwedha	Solapur	0.990	0.990	0.931	0.045	0.014	0.990	184
485	Irle KT Weir	Barshi	Solapur	1.950	1.950	1.834	0.089	0.027	1.950	352
486	Jambud KT Weir	Malshiras	Solapur	6.967	6.967	6.552	0.317	0.098	6.967	1465
487	Jawala	Sangola	Solapur	1.320	1.320	1.241	0.060	0.018	1.320	214
488	Junoni	Sangola	Solapur	0.720	0.720	0.677	0.033	0.010	0.720	116
489	Kadlas	Sangola	Solapur	3.090	3.090	2.906	0.141	0.043	3.090	500
490	Kalambwadi	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	486
491	Kalamwadi	Malshiras	Solapur	0.590	0.590	0.555	0.027	0.008	0.590	130
492	Kamlapur	Sangola	Solapur	3.180	3.180	2.991	0.145	0.045	3.180	1943
493	Kari	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	254
494	Karunde KT Weir	Malshiras	Solapur	1.970	1.970	1.853	0.090	0.028	1.970	373
495	Kategaon	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	212
496	Kavhe	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	653
497	Khairav	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	1050
498	Khanapur KT Weir	Akkalkot	Solapur	4.990	4.990	4.693	0.227	0.070	4.990	1225
499	Khawaspur	Sangola	Solapur	2.790	2.790	2.624	0.127	0.039	2.790	398
500	Kole Diversion Weir	Sangola	Solapur	0.000	0.000	0.000	0.000	0.000	0.000	151

501	Kolegaon KT Weir	Mohol	Solapur	2.240	2.240	2.107	0.102	0.031	2.240	2118
502	Kolegaon MI Tank	Malshiras	Solapur	3.540	3.540	3.329	0.161	0.050	3.540	540
503	Kondhej	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	292
504	Koregaon	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	283
505	Korsegaon KT Weir	Akkalkot	Solapur	3.350	3.350	3.151	0.152	0.047	3.350	1022
506	Kudal KT Weir	South Solapur	Solapur	1.470	1.470	1.383	0.067	0.021	1.470	333
507	Kumbhej	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	212
508	Lawangi	Mangalwedha	Solapur	0.880	0.880	0.828	0.040	0.012	0.880	127
509	Lotewadi	Sangola	Solapur	1.880	1.880	1.768	0.086	0.026	1.880	344
510	Machnoor KT Weir	Mangalwedha	Solapur	2.180	2.180	2.050	0.099	0.031	2.180	545
511	Madha	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	422
512	Mahisgaon	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	1648
513	Malikpeth	Mohol	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	1951
514	Malinagar KT Weir	Malshiras	Solapur	1.920	1.920	1.806	0.087	0.027	1.920	1071
515	Mallewadi KT Weir	Mangalwedha	Solapur	3.740	3.740	3.517	0.170	0.052	3.740	668
516	Mamdapur	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	326
517	Mandwe MI Tank	Malshiras	Solapur	1.700	1.700	1.599	0.077	0.024	1.700	332
518	Manjari	Sangola	Solapur	1.910	1.910	1.796	0.087	0.027	1.910	1164
519	Marapur	Mangalwedha	Solapur	4.550	4.550	4.279	0.207	0.064	4.550	600
520	Marapur KT Weir	Mangalwedha	Solapur	3.000	3.000	2.822	0.137	0.042	3.000	600
521	Maroli	Mangalwedha	Solapur	1.530	1.530	1.439	0.070	0.021	1.530	243
522	Medshingi	Sangola	Solapur	1.900	1.900	1.787	0.086	0.027	1.900	388
523	Methawade	Sangola	Solapur	4.020	4.020	3.781	0.183	0.056	4.020	638
524	Mhasewadi	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	203
525	Mire KT Weir	Malshiras	Solapur	7.110	7.110	6.687	0.324	0.100	7.110	1473
526	Mundhewadi KT Weir	Pandharpur	Solapur	6.030	6.030	5.671	0.274	0.084	6.030	897
527	Mundwi KT Weir	Mangalwedha	Solapur	2.920	2.920	2.746	0.133	0.041	2.920	614
528	Nandur KT Weir	North Solapur	Solapur	4.190	4.190	3.941	0.191	0.059	4.190	2444
529	Nazare	Sangola	Solapur	1.900	1.900	1.787	0.086	0.027	1.900	302
530	Nerle	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	320
531	Nimgaon	Malshiras	Solapur	4.400	4.400	4.138	0.200	0.062	4.400	592
532	Nimgaon	Madha	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	296
533	Nimgaon KT Weir	Madha	Solapur	0.570	0.570	0.536	0.026	0.008	0.570	260
534	Nimgaon MI Tank (Ht raising)	Malshiras	Solapur	1.897	1.897	1.784	0.086	0.027	1.897	250

535	Ozare-Tambve KT Weir	Malshiras	Solapur	1.410	1.410	1.326	0.064	0.020	1.410	571
536	Pakni KT Weir	North Solapur	Solapur	3.160	3.160	2.972	0.144	0.044	3.160	2167
537	Parewadi	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	629
538	Parite	Madha	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	132
539	Pathari	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	647
540	Phondshiras	Malshiras	Solapur	2.400	2.400	2.257	0.109	0.034	2.400	448
541	Phondshiras MI Tank (Ht raising)	Malshiras	Solapur	0.530	0.530	0.498	0.024	0.007	0.530	180
542	Pirachi Kuroli KT Weir	Pandharpur	Solapur	4.300	4.300	4.044	0.196	0.060	4.300	1169
543	Pokharapur	Mohol	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	338
544	Potegaon	Karmala	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	815
545	Puluj	Pandharpur	Solapur	13.920	13.920	13.092	0.633	0.195	13.920	3552
546	Rajuri	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	417
547	Ridhore	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	577
548	Ridhore KT Weir	Madha	Solapur	2.890	2.890	2.718	0.131	0.040	2.890	577
549	Sangoba KT Weir	Karmala	Solapur	2.580	2.580	2.426	0.117	0.036	2.580	817
550	Sangola (Aa) KT Weir	Sangola	Solapur	2.350	2.350	2.210	0.107	0.033	2.350	373
551	Sangvi	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	439
552	Sapatane	Madha	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	728
553	Sarati KT Weir	Malshiras	Solapur	0.760	0.760	0.715	0.035	0.011	0.760	250
554	Sarkoli	Mangalwedha	Solapur	1.791	1.791	1.684	0.081	0.025	1.791	522
555	Save KT Weir	Sangola	Solapur	1.980	1.980	1.862	0.090	0.028	1.980	510
556	Shelgaon (R)	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	485
557	Shetphal KT Weir	Pandharpur	Solapur	2.610	2.610	2.455	0.119	0.037	2.610	1592
558	Shingoli KT Weir	North Solapur	Solapur	2.180	2.180	2.050	0.099	0.031	2.180	357
559	Shirapur KT Weir	Mohol	Solapur	2.790	2.790	2.624	0.127	0.039	2.790	1678
560	Sindkhed KT Weir	South Solapur	Solapur	2.040	2.040	1.919	0.093	0.029	2.040	942
561	Soregaon MI Tank	North Solapur	Solapur	1.590	1.590	1.495	0.072	0.022	1.590	252
562	Tadwale	Barshi	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	401
563	Talsangi	Mangalwedha	Solapur	2.420	2.420	2.276	0.110	0.034	2.420	242
564	Taratgaon KT Weir	Karmala	Solapur	1.470	1.470	1.383	0.067	0.021	1.470	408
565	Tawadi	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	214
566	Tirvandi KT Weir	Malshiras	Solapur	4.820	4.820	4.533	0.219	0.067	4.820	1240
567	Ughadowadi	Malshiras	Solapur	1.080	1.080	1.016	0.049	0.015	1.080	220
568	Undargaon	Madha	Solapur	1.488	1.488	1.400	0.068	0.021	1.488	2754

569	Vairag	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	360
570	Vasud (A)	Sangola	Solapur	2.090	2.090	1.966	0.095	0.029	2.090	7274
571	Vatambare KT Weir	Sangola	Solapur	1.500	1.500	1.411	0.068	0.021	1.500	363
572	Veet	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	302
573	Velapur-2 KT Weir	Malshiras	Solapur	1.260	1.260	1.185	0.057	0.018	1.260	608
574	Velapur-3 KT Weir	Malshiras	Solapur	0.360	0.360	0.339	0.016	0.005	0.360	175
575	Wadakbal KT Weir	South Solapur	Solapur	0.800	0.800	0.752	0.036	0.011	0.800	239
576	Wadapur KT Weir	South Solapur	Solapur	4.700	4.700	4.420	0.214	0.066	4.700	1989
577	Wadhegaon	Sangola	Solapur	4.350	4.350	4.091	0.198	0.061	4.350	1327
578	Wadshivane	Karmala	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	713
579	Wafegaon KT Weir	Malshiras	Solapur	9.340	9.340	8.784	0.425	0.131	9.340	1822
580	Walwad	Barshi	Solapur	5.279	5.279	4.965	0.240	0.074	5.279	202
581	Ambehol Storage tank	Osmanabad	Osmanabad	0.850	0.850	0.799	0.039	0.012	0.850	258
582	Ambejawalga Storage Tank	Osmanabad	Osmanabad	0.990	0.990	0.931	0.045	0.014	0.990	300
583	Apsinga storage tank	Tuljapur	Osmanabad	1.160	1.160	1.091	0.053	0.016	1.160	478
584	Arsoli MI	Bhoom	Osmanabad	6.400	6.400	6.019	0.291	0.090	6.400	966
585	Awarpipri KT Weir	Paranda	Osmanabad	1.160	1.160	1.091	0.053	0.016	1.160	383
586	Bedkinalla Major MI	Osmanabad	Osmanabad	3.580	3.580	3.367	0.163	0.050	3.580	601
587	Bhotra KT Weir	Paranda	Osmanabad	2.940	2.940	2.765	0.134	0.041	2.940	683
588	Chorakhali Storage Tank	Kalamb	Osmanabad	3.140	3.140	2.953	0.143	0.044	3.140	712
589	Dhekari Storage Tank	Tuljapur	Osmanabad	1.720	1.720	1.618	0.078	0.024	1.720	372
590	Dukkarwadi Storage Tank	Bhoom	Osmanabad	1.200	1.200	1.129	0.055	0.017	1.200	252
591	Gavsud MI	Osmanabad	Osmanabad	1.610	1.610	1.514	0.073	0.023	1.610	252
592	Ghulewadi Storage Tank	Bhoom	Osmanabad	1.280	1.280	1.204	0.058	0.018	1.280	330
593	Giralgaon Storage Tank	Bhoom	Osmanabad	1.220	1.220	1.147	0.056	0.017	1.220	286
594	Hiwarda MI	Bhoom	Osmanabad	3.150	3.150	2.963	0.143	0.044	3.150	477
595	Jamb MI Tank	Bhoom	Osmanabad	1.860	1.860	1.749	0.085	0.026	1.860	273
596	Jamb storage tank	Bhoom	Osmanabad	0.940	0.940	0.884	0.043	0.013	0.940	255
597	Kadaknathwadi Storage Tank	Vashi	Osmanabad	0.820	0.820	0.771	0.037	0.011	0.820	309
598	Kaudgaon Storage Tank	Osmanabad	Osmanabad	0.980	0.980	0.922	0.045	0.014	0.980	262
599	Kemwadi Storage Tank	Tuljapur	Osmanabad	2.650	2.650	2.492	0.121	0.037	2.650	560
600	Lower Khairi Large MI	Paranda	Osmanabad	8.440	8.440	7.938	0.384	0.118	8.440	1149
601	Nandgaon Storage Tank	Bhoom	Osmanabad	1.610	1.610	1.514	0.073	0.023	1.610	320
602	Pathrud MI	Bhoom	Osmanabad	2.040	2.040	1.919	0.093	0.029	2.040	310

603	Salgara (Di) storage tank	Tuljapur	Osmanabad	1.550	1.550	1.458	0.071	0.022	1.550	254
604	Savargaon Storage Tank	Tuljapur	Osmanabad	3.010	3.010	2.831	0.137	0.042	3.010	686
605	Shelgaon Storage Tank	Paranda	Osmanabad	1.220	1.220	1.147	0.056	0.017	1.220	312
606	Sonegaon MI	Osmanabad	Osmanabad	1.720	1.720	1.618	0.078	0.024	1.720	262
607	Tambewadi MI	Bhoom	Osmanabad	4.070	4.070	3.828	0.185	0.057	4.070	528
608	Umachiwadi storage tank	Bhoom	Osmanabad	1.300	1.300	1.223	0.059	0.018	1.300	282
609	Vadji Stroage Tank	Vashi	Osmanabad	1.590	1.590	1.495	0.072	0.022	1.590	485
610	Valgud storage tank	Osmanabad	Osmanabad	1.180	1.180	1.110	0.054	0.017	1.180	433
611	Vataphal Storage Tank	Paranda	Osmanabad	3.920	3.920	3.687	0.178	0.055	3.920	861
612	Wangijawala storage tank	Paranda	Osmanabad	3.785	3.785	3.560	0.172	0.053	3.785	813
613	Yedeshwari Storage Tank	Kalamb	Osmanabad	1.090	1.090	1.025	0.050	0.015	1.090	274
614	Yermala Storage Tank	Kalamb	Osmanabad	1.280	1.280	1.204	0.058	0.018	1.280	383
			Total in Mcum	**1311.743**	**1311.743**	**1233.694**	**59.684**	**18.364**	**1311.743**	**302378**
			Total in TMC	**46.324**	**46.324**	**43.568**	**2.108**	**0.649**	**46.324**	
	Projects not in list		**mm3**	131.2066	131.2066	123.400	5.970	1.837	131.207	
			Tmc	**4.633**	**4.633**	**4.357**	**0.211**	**0.065**	**4.633**	
	Total completed		**mm3**	**1442.949**	**1442.949**	**1357.094**	**65.654**	**20.201**	**1443**	**302378**
			Tmc	**50.957**	**50.957**	**47.925**	**2.319**	**0.713**	**50.957**	

	Ongoing									
1	Amrutling MI Tank	Jamkhed	Ahmadnagar	1.246	1.246	1.172	0.057	0.017	1.246	260
2	Palsude MI Tank	Akole	Ahmadnagar	2.436	2.436	2.291	0.111	0.034	2.436	500
3	Karhewadi storage tank	Ashti	Beed	1.640	1.640	1.542	0.075	0.023	1.640	442
4	Bhongwali MI Tank	Bhor	Pune	3.220	3.220	3.028	0.147	0.045	3.220	504
5	Bopgaon MI Tank	Purandar	Pune	1.284	1.284	1.208	0.058	0.018	1.284	265
6	Otur (Wak vasti) KT Weir	Junnar	Pune	0.930	0.930	0.875	0.042	0.013	0.930	320
7	Ankalagi	Jat	Sangli	4.076	4.076	3.833	0.185	0.057	4.076	705
8	Mahadikwadi	Atpadi	Sangli	1.850	1.850	1.740	0.084	0.026	1.850	416
9	Babhulgaon MI Tank	Barshi	Solapur	5.610	5.610	5.276	0.255	0.079	5.610	1280
10	Chikhalgi MI Tank	Mangalwedha	Solapur	5.950	5.950	5.596	0.271	0.083	5.950	1100
11	Ekatpur(S)	Sangola	Solapur	2.266	2.266	2.131	0.103	0.032	2.266	256
12	Hatid No.1	Sangola	Solapur	0.493	0.493	0.463	0.022	0.007	0.493	283
13	Pout	Mangalwedha	Solapur	5.664	5.664	5.327	0.258	0.079	5.664	1509
14	Suste-Tarapur	Pandharpur	Solapur	4.814	4.814	4.528	0.219	0.067	4.814	2804

15	Hingani	Shrigonda	Ahmadnagar	1.501	1.501	1.412	0.068	0.021	1.501	1132
16	Gunjavani (Chirmodi)			56.640	56.640	0.000	28.320	28.320	56.640	
17	waroti			24.921	24.921	24.920	0.000	0.000	24.920	
			mm3	**124.541**	**124.541**	**65.342**	**30.276**	**28.922**	**124.540**	**11776**
			Tmc	**4.398**	**4.398**	**2.307**	**1.069**	**1.021**	**4.398**	
		Grand Total M.I. in TMC		**55.355**	**55.355**	**50.233**	**3.388**	**1.735**	**55.355**	
		Grand Total M.I. in Mm3		**1567.490**	**1567.490**	**1422.436**	**95.930**	**49.123**	**1567.489**	**314154**

Upper Bhima Sub Basin (K-5)
Annexure 8.4 (a) Details of Dometic sanctions K-5 Sub basin

Sr.No.	Name of Project	District	Domestic Water Reservation (Mcum)
1	Ghod	Pune	3.8850
2	Bhama Askhed Irrigation Project	Pune	141.4860
3	bhatghar (Nira left bank canal)	Pune	15.3262
4	bhatghar (Nira left bank canal)	Pune	0.2333
5	Khadakwasla (3 water body)	Pune	7.7709
6	Khadakwasla (3 water body)	Pune	24.9458
7	Khadakwasla (3 water body)	Pune	379.7014
8	Khadakwasla (3 water body)	Pune	0.0004
9	Khadakwasla (3 water body)	Pune	0.0637
10	Khadakwasla (3 water body)	Pune	0.0000
11	Kukadi Project	Pune	0.2810
12	Kukadi Project	Pune	1.5730
13	Kukadi Project	Pune	0.8800
14	Kukadi Project	Pune	2.8330
15	Nira Deoghar	Pune	0.4320
16	Pawana	Pune	0.5240
17	Pawana	Pune	1.0480
18	Pawana	Pune	0.1116
19	Pawana	Pune	289.8953
20	Pawana	Pune	0.3680
21	Chaskaman	Pune	7.8951
22	Bhima (Ujjani)	Solapur	110.4308
23	Neera Right Bank Canal (Veer Dam)	Satara	32.13911
	Total Major		**1021.823**
1	Kasarsai Medium Project	Pune	3.8768
2	Kasarsai Medium Project	Pune	0.0000
3	Mulshi Medium Project Tunnel	Pune	19.0663
4	Nazare Medium Project	Pune	3.2800
5	Wadivale Medium Project	Pune	0.2500
6	Wadivale Medium Project	Pune	0.8704
7	Wadivale Medium Project	Pune	2.6800
8	Andra Project	Pune	37.0250
9	EKRUKH MEDIUM PROJECT	Solapur	5.0450
10	Hingani (P) Medium Project	Solapur	1.1300
11	Jawalgaon Medium Project	Solapur	0.2140
12	Ashti Medium Project	Solapur	2.9253
13	Mangi Medium Project	Solapur	0.1830
14	Tisangi Medium	Solapur	2.1360
15	DODDANALA MEDIUM PROJECT	Sangli	0.5935
16	SANKH MEDIUM PROJECT	Sangli	1.9427

17	sina medium project	Ahmednagar	1.596
18	Visapur Medium project	Ahmednagar	3.360
19	Banganga Medium Project	Osmanabad	0.5700
20	Chandni Medium Project	Osmanabad	1.7970
21	Khandeshwer M .P	Osmanabad	0.0000
22	Khasapur medium project	Osmanabad	0.5620
23	Sakat medium project	Osmanabad	0.3816
24	Kada Medium Project	Beed	0.222
25	Mehkari Medium Project	Beed	0.003
26	Ruty Medium Project	Beed	0.970
27	Talwar Medium Project	Beed	0.003
	Total Medium		**90.683**
1	Aadale M.I.Tank	Pune	0.0000
2	Bhatnimgaon K. T. Weir	Pune	0.0052
3	Bhugaon M.I.Project	Pune	1.0448
4	Garade M.I.TANK	Pune	0.3000
5	Kadus M. I. Tank	Pune	0.0000
6	Mahakoshi M.I.Tank	Pune	0.0620
7	Narsinhapur (Shevare)K.T.W.	Pune	0.0037
8	Perne K.T.Weir	Pune	0.2376
9	Pilanwadi M.I. Tank	Pune	0.2000
10	Pimpra K.T.Weir	Pune	0.0089
11	Shirur K.T.Weir	Pune	1.2200
12	Shivtakrar Mhalungi K.T.Weir	Pune	0.1600
13	Tanu-Takali K.T.W.	Pune	0.0000
14	Urawade M.I.Tank	Pune	0.2454
15	Vadhu K.T.WEIR	Pune	0.3850
16	Wafgaon M.I.Tank	Pune	0.0498
17	Arali K.T. W.	Solapur	0.7380
18	Bathan K.T. W.	Solapur	3.4800
19	Bhoyare KT Weir	Solapur	0.0700
20	Chare Minor Irrigation Project	Solapur	0.1630
21	Chincholi M. I . Project	Solapur	0.0360
22	Diksal KT Weir	Solapur	0.1800
23	Gormale Minor Irrigation Project	Solapur	0.0670
24	Gursale K.T.W.	Solapur	17.8486
25	HOTGI MINOR PROJECT	Solapur	0.1400
26	K. T. Weir Bopale	Solapur	0.1366
27	K T WEIR KHANAPUR	Solapur	0.0330
28	K. T. Weir Kolegaon	Solapur	0.5256
29	K. T. Weir Malikpeth	Solapur	0.0350
30	K. T. Weir Mhaisgao	Solapur	0.0438
31	Kalambwadi Minor irrigation Project	Solapur	0.1280
32	Kari Minor Irrigation Project	Solapur	0.0721
33	Koregaon Minor Irrigation Project	Solapur	0.0178
34	KT Weir Chinchpur	Solapur	0.3190

35	KT Weir Pakani	Solapur	0.0180
36	KT Weir Shingoli	Solapur	0.0430
37	K.T.Weir at Waphegaon T	Solapur	0.2300
38	K.T.Weir HILLI	Solapur	3.6116
39	Mamdapur Minor Irrigation Project	Solapur	0.0980
40	Mire K.T.W.	Solapur	0.3070
41	Mundhewadi K.T.W.	Solapur	2.2660
42	Pathari Minor Irrigation Project	Solapur	1.2290
43	Pirachikuroli K.T.W.	Solapur	0.6290
44	Puluj K.T. W.	Solapur	0.0360
45	Vadapur K.T. W.	Solapur	0.0400
46	Tambave	Satara	0.07667
47	ARJUNWADI M.I. TANK	Sangli	0.0300
48	ATPADI MINOR PROJECT	Sangli	2.8678
49	BHIVARGI M.I. TANK	Sangli	0.3331
50	BIRNAL M.I.TANK	Sangli	0.4250
51	DIGHANCHI MINOR PROJECT	Sangli	0.1040
52	DUDHEBHAVI M.I. TANK	Sangli	0.6944
53	GHANAND MINOR PROJECT	Sangli	0.7662
54	GORADWADI MINOR PROJECT	Sangli	0.0219
55	JALIHAL MINOR PROJECT	Sangli	0.1489
56	JAMBHULANI MINOR PROJECT	Sangli	0.2108
57	KACHAREVASTI MINOR PROJECT	Sangli	0.8545
58	PANDOZARI M.I. TANK	Sangli	0.2182
59	PRATAPUR MINOR PROJECT	Sangli	0.3062
60	SHALGAON MINOR PROJECT	Sangli	0.3230
61	SHEGAON NO-01 MINOR PROJECT	Sangli	0.0000
62	SHETPHALE MINOR PROJECT	Sangli	0.0980
63	TIKONDI NO-02 M.I. TANK	Sangli	0.2710
64	WALEKHINDI MINOR PROJECT	Sangli	0.1208
65	Chichondi Patil M.I. Tank, Nagar	Ahmednagar	0.239
66	Durgaon M.I.Tank	Ahmednagar	0.450
67	Sangavi M.I.Project	Ahmednagar	0.072
68	Arsoli M.I.	Osmanabad	0.6130
69	DEV KURALI S.T.	Osmanabad	0.0000
70	Kunthalgiri M.I.	Osmanabad	0.0600
71	Belgaon Minor Tank	Beed	0.180
72	Bramhagaon Minor Tank	Beed	0.140
73	Chobanimgaon Minor Tank	Beed	0.004
74	Pandhari Minor Tank	Beed	0.003
75	Wadgaon Minor Tank	Beed	0.003
	Total Minor		**46.098**

Upper Bhima Sub Basin (K-5)

Annexure 8.4 (b) Details of Industrial sanctions K-5 Sub basin

Sr.No.	Name of Project	District	Industrial Water Reservation (Mcum)
1	bhatghar (Nira left bank canal)	Pune	4.528
2	bhatghar (Nira left bank canal)	Pune	1.650
3	Ghod	Pune	10.116
4	Khadakwasla (3 water body)	Pune	6.369
5	Khadakwasla (3 water body)	Pune	0.080
6	Khadakwasla (3 water body)	Pune	5.363
7	Khadakwasla (3 water body)	Pune	0.000
8	Khadakwasla (3 water body)	Pune	0.000
9	Kukadi Project	Pune	2.500
10	Kukadi Project	Pune	0.324
11	Pawana	Pune	6.240
12	Bhima (Ujjani) Project, Tal. Madha, Dist. Solapur	Solapur	170.398
13	Neera Right Bank Canal (Veer Dam)	Satara	30.433
14	sina kolegaon project	Osmanabad	0.188
	Total Major		**238.189**
1	Kasarsai Medium Project	Pune	0.038
2	Wadivale Medium Project	Pune	0.233
3	Andra Project	Pune	25.156
4	Kathapur K T Weir	Pune	0.288
5	Mulshi Medium Project Tunnel	Pune	1.319
6	Nazare Medium Project	Pune	3.970
7	Ashti Medium Project	Solapur	0.059
8	Hingani (P) Medium Project	Solapur	0.680
9	Jawalgaon Medium Project	Solapur	0.127
10	Mangi Medium Project	Solapur	0.051
11	Pimpalgaon (Dhale) medium Project Tal. Barshi Dist. Solapur	Solapur	0.060
12	Tisangi Medium	Solapur	1.398
13	Visapur Medium project	Ahmednagar	0.120
14	Ruty Medium Project	Beed	0.480
	Total medium		**33.979**
1	Bhugaon M.I.Project	Pune	0.002
2	Burkegaon K.T.Weir	Pune	0.160
3	Diwale M.i.tank	Pune	0.194
4	Pilanwadi M.I. Tank	Pune	0.050
5	Pimpra K.T.Weir	Pune	0.021
6	Tanu-Takali K.T.W.	Pune	0.442
7	Watekarwadi K.T. Weir	Pune	0.351
8	Arali K.T. W.	Solapur	1.150
9	Bathan K.T. W.	Solapur	0.600
10	Chincholi M. I . Project	Solapur	0.262
11	HOTGI MINOR PROJECT	Solapur	0.405

12	K. T. Weir Kavhe	Solapur	0.180
13	K. T. Weir Ridhore	Solapur	0.334
14	K. T. Weir Shirapur	Solapur	0.140
15	KT Weir Shingoli	Solapur	0.275
16	Pirachikuroli K.T.W.	Solapur	0.430
17	Puluj K.T. W.	Solapur	0.200
18	Vadapur K.T. W.	Solapur	0.400
19	Deulgaon siddhi M.I. Tank, Tal. Nagar	Ahmednagar	0.044
20	Ghodegaon M.I. Tank, Tal. Shrigonda.	Ahmednagar	0.281
21	Kolgaon (Mohorwadi) M.I. Tank, Tal. Shrigonda	Ahmednagar	0.079
22	Wadgaon Tandali M.I. Tank, Tal. Nagar.	Ahmednagar	0.044
23	Walki M.I. Tank, Tal. Nagar.	Ahmednagar	0.044
24	SHEGAON NO-01 MINOR PROJECT	Sangli	0.524
	Total Minor		**6.611**

Chapter -9 WATER CONSERVATION (Agri.)

The water conservation activities are carried out by two departments, Agriculture as well as Local sector of Water Resources Department.

9.1. Agriculture Department

9.1.1 Soil Conservation Works in Upper Bhima Sub Basin (K-5)

The Upper Bhima Sub-basin **(K-5)** comes under Pune, Satara, Solapur, Ahmendnagar, Osmanabad, Beed districts.It covers total area of **4533500 ha.** Out of which **4293922 ha.** area is available for watershed development work in this sub-basin, and area treated up to March, 2013 is of **2624764 ha** (61.12%). The balance area for watershed activities in this basin is **1610413 ha.** District and Taluka wise proposed area, Treated area and Balance area is as given in table No.1

Table-9.1 Soil Conservation Works Upper Bhima Sub Basin (K-5)

Districts	Taluka	Watershed Nos.	Total Area (ha)	Area Proposes to be treated with soil & Water Conservation Measures (ha.)	Area treated up to 2013	Balance area to be treated (ha.)
Pune	Junner	BM 1 to 9, GV 114	124734	44952	25173	19779
	Vadgoan Maval	BM 37 to BM 42, WF 41	113135	30100	16856	13244
	Mulshi	BM 43 to 45, WF 45,47	103931	46186	25864	20322
	Velha	BM 54 to 57	49955	8792	4924	3868
	Bhor	BM 71,72,81 WF 51	89234	54935	30763	24171
	Khed (Rajguruna gar)	BM 11 &BM18 to 25	137354	97380	54533	42847
	Purandar (Sasvad)	BM 58 to 60 & BM 74	110313	63501	35560	27940
	Daund	BM 36,46,48,49 to 53 & BM61	128986	50175	28098	22077
	Indapur	BM 66 to 70 & BM 76 to 78	146791	64684	36223	28461
	Shirur	BM 13,17,26,27,34,35	155727	110000	61600	48400
	Baramati	BM 73,75	138248	62285	34879	27405

Districts	Taluka	Watershed Nos.	Total Area (ha)	Area Proposes to be treated with soil & Water Conservation Measures (ha.)	Area treated up to 2013	Balance area to be treated (ha.)
	Ambegoan (Ghodegaon)	89	104275	21710	12157	9552
	Haveli	109	145617	27727	15527	12200
Total Pune			**1548300**	**654700**	**382157**	**300266**
SATARA	Man	119	144000	137749	108582	29167
	Khandala	74	53808	53857	11995	41862
	Phaltan	170	119029	91241	71982	19259
Total Satara			**316837**	**282847**	**192559**	**90288**
Solapur	Malshiras	BM 87-I,II,BM-88-I to BM 88IV,BM89-I to III ,BM 90 -I to V, BM 99 -I to BM-IV	160801	160106	103655	56451
	Managal vedha	99	114159	113494	68156	36700
	Sangola	143	159443	158749	93599	50379
	Pandhapur	115	129437	128727	75838	40836
	Madha	135	152600	151935	95134	49029
	North Solapur	64	68303	65739	37325	24884
	South Solapur	100	77235	118853	62154	50854
	Barshi	128	152250	151538	88165	54037
	Mohal	90	131689	131059	69415	48137
	Karmala		159580			
Total Solapur			**1305497**	**1278705**	**821500**	**413971**
Ahmad-nagar	Parner	107	120553	63226.39	34774.51	28451.87
	Karjat	129	149152	111867.76	61527.26	50340.49
	Shrigonda	143	160481	120333.73	66183.55	54150.19
	Jamkhed	105	87524	65643.48	36103.92	29539.56

Districts	Taluka	Watershed Nos.	Total Area (ha)	Area Proposes to be treated with soil & Water Conservation Measures (ha.)	Area treated up to 2013	Balance area to be treated (ha.)
	Nagar	157	75309	90787.83	49933.29	40854.53
	Pathrdi	12	8271	6525	3588.75	2936.25
	Akole	14	16710	5985.05	3291.77	2693.27
Total Ahmadnagar		**667**	**618000**	**464369.24**	**255403.05**	**208966.16**
Osmana-bad	Tuljapur (30%)	11	95564	40288	22740	17548
	Umaraga	**5**	**92525**	**92525**	**40838**	**51687**
	Osmanabad		**20150**			
	Kalamb		**6250**			
	Washim		**13025**			
	Bhum		**57840**			
	Paranda,	**5**	**94050**	**79583**	**54817**	**24766**
Total Osmanabad		**21**	**216605**	**212396**	**118395**	**94001**
Beed	Ashti	12	142605	116000	31900	84100
	Patoda	13	14095	6200	1350	4850
Total Beed		25	**156700**	**122200.00**	**33250.00**	**88950.00**
Total K-5			**4533500**	**4293922.24**	**2624764.05**	**1610413.16**

9.1.2 .Watershed wise Status of Soil & Water Conservation Works n Upper Bhima Sub Basin (K5)

Soil & Water Conservation works include **d**ifferent area treatments & drainage line treatments are implemented by Soil & Water Conservation Department. Under area treatment, on upper ridges the treatments like continuous contour trenches (CCT), deep CCT, loose bolder structure, earthen structure, etc. are taken. It checks the soil erosion and stores water. Stored water is percolated in soil, which increases the water level of nearby wells in lower-side areas.On landsides, Compartment bunding (0-4% slope) & Terracing (0 - 6 %) are taken. It stores the rain water & checks the soil erosion.

On Lower ridges, drainage line treatments like Mati nala bund, Cement nala bund, Diversion bunds are taken. The water is stored & percolated in soil, which recharge the ground water. Water becomes available for crops during dry spell & critical growth stages of crops. It increases the productivity and production.

9.1.2 Watershedwise Status of Soil & Water Conservation Works are given in the following Tables

Sub Basin	Districts	Watershed No.	Water Conservation work				Total	Soil Conservation Work - area ha/no.of structure						Total
			Earthen Structure	Cement Nala Bund	Farm pond	Diversion Bund		Majgi (ha)	Compartment Bunding (ha)	CCT (ha)	Losse Bolder (no)	Gabian Structures	Padkai (ha)	
K-5	Pune		13151	844	1775	102	**15872**	25981	35103	0	0	0	934	**62018**
	Junner	BM 1 to 9, GV 114												
	Vadegoan Maval	BM 37 to BM 42, WF 41												
	Mulshi	BM 43 to 45, WF 45,47												
	Velha	BM 54 to 57												
	Bhor	BM 71,72,81 WF 51												
	Khed	BM 11 &BM18 to 25												
	Purandar	BM 58 to 60 & BM 74												
	Daund	BM 36,46,48,49 to 53 & BM61												
	Indapur	BM 66 to 70 & BM 76 to 78												
	Shirur	BM 13,17,26, 27,34,35												
	Baramati	BM 73,75												
	Ambegoan	89												
	Haveli	109												
	Satara		3164	973	1321	0	**5458**	18271	6932	1605	307	0	0	**27115**
	Man,	119												
	Khandala	74												
	Phaltan	170												
	Solapur		18606	1283	5052	0	**24941**	0	276746	0	0	0	0	**276746**
	Malshiras	BM 87-I,II,BM-88-I to BM 88IV,BM89-I to III ,BM 90 - I to V, BM 99 -I to BM-IV												
	Solapur	164												
	Mangalvedha	99												
	Sangola	143												
	Pandharpur	115												
	Madha	135												
	Barshi	128												
	Mohal	90												
	Partly Kalamb & Usmanabad)													
	Ahmednagar		0	355	1163	0	**1518**	62	24519	0	0	0	0	**24581**
	Parner	107												
	Shrigonda	143												
	Jamkhed	105												
	Karjat	129												
	Nagar	157												
	Pathradi	12												
	Akole	14												

9.1.3. **Water Conservation Works in Upper Bhima Sub Basin (K5)**

The various types of Completed Water conservation schemes, there are mainly four types of water conservation works carried out by Agriculture Department i.e. Earther structures ,cement Nala Bund, Farm Pond & Diversion Bunds. These structures created approxly **255.87 Mm^3** storage potential. Hence 98163 ha. area indirectly created irrigation potential in the sub-basin, which helps to increases ground water level appr.1 to 3 mtrs. The details are given below.

Table -9.1.3 Abstract of Water Conservation Schemes in Upper Bhima Sub Basin (K5)

Sr.No	Type Of Schemes	No of Schemes				Potential	
		Completed	Ongoing	Future	Total	Ha.	Mm^3
2.	Mati Nala Bund	36177	0	0	36177	72354	217.06
3.	Cement Nala Bund	3455	0	0	3455	13820	27.64
4.	Farn Pond	9311	0	0	9311	11173.20	11.173
5.	Diversion Bund	102	0	0	102	816	0
	Total	**49045**	**0**	**0**	**49045**	**98163.2**	**255.873**

Note- For Storage potential factors used for no. of Erthen Structure ×6 =TCM, no.of C.N.B. ×8=TCM, no.of Farm Pond×1.20 =TCM

For area potential factors used for Erthen Structure × 2=ha, C.N.B. ×4=ha, Farm Pond×1.20=ha, No. of Diversion Bund×8=ha

9.2. Local Sector Department

The soil water conservation works are helpful for distribution of water and increasing the agricultural productivity. These works conserve the water at local level and provides flexibility for water management by the farmers. The integrated approach for watershed development helps for protecting the environment. It also useful for controlling the siltation of irrigation reservoirs.

Table-9.2.1 - **Abstract of Local Sector Schemes 101 to 250 ha [for details see Appendix-I]**

Sr.No.	Type of Schemes	No of Schemes				Potential	
		Completed	ongoing	Future	Total	Ha.	Mm3
a	Irrigation Tank	112	14	0	126	22410	168.69
b	Storage Tank	17	40	11	68	11127	152.17
c	K.T.Weir	120	21	81	222	32311	156.03
	Total	**249**	**75**	**92**	**416**	**65848**	**476.89**

Table-9.2.3- **Abstract of Local Sector Schemes 0 to 100 ha**

Sr.No.	Type of Schemes	No of Schemes				Potential	
		Completed	ongoing	Future	Total	Ha.	Mm3
a	Irrigation Tank	60	0	0	60	3826	16.46
b	Storage Tank	1506	5	4	1515	30268	153.29
c	K.T.Weir	1877	232	67	2176	56853	446.60
	Total	**3443**	**237**	**71**	**3751**	**90947**	**616.35**

9.2.4 Review of Impact

A] The report o Groundwater Resource Estimation Committee June 1997 [GOI] indicated about impact of watershed development as given below-

I] Recharge form storage tanks and pounds is 1.4 mm/day for the period in which the tanks has water [Based on average area of water spread]

2] Recharge form percolation tanks-50% of grose storage considering number of fillings

3] Recharge due to check dams and nalla bunds provided annual desilting is done 50% of grose storage provided annual desilting is done.

4] Case studies

5)As per information furnished by GSDA

Table 9.2.4.1- Increase in Recharge

Type of Structure	Village	Recharge to Groundwater as percentage of Gross Storage
Percolation Tank	Rajapur	50%
Percolation Tank	Waghajaiwadi	50%

9.2.5 A Status of water conservation Works [area upto 100 ha]

The details of percolation tank, village tank at local sector level, location, storage capacity, irrigation potential etc. The abstract of which is as given below

Table-9.2.5.1.- Status of water conservation Works

Taluka	Water shed No	Percolation Tank				Village Tank			
		Completed		Ongoing		Completed		Ongoing	
		No	Capacity Mcft	No	Capacity Mcft	No	Capacity Mcft	No	Capacity Mcft
Jamkhed	SA-19	90	270.00	7	1.9.2	25	13.42	0	0
Parner	VM-15	354	1000.6	5	13.14	56	60.02	0	0
Pathardi	SA-19	115	230	4	18.30	24	21.10	0	0
Shrigonda	GV-129	190	475	12	48.55	39	19.90	1	1.82
Ambegaon	SA-11	74	239.75	5	21.00	22	38.84	1	2.47
Baramati	BM-9	306	950.79	0	0	14	19.42	1	2.47
Bhour	BM-75	13	28.60	3	8.47	1	1.06	0	0
Daund	BM-57	65	203.38	1	3.53	4	7.42	0	0
Indapur	BM-49	72	231.28	0	0	0	0	0	0
Junnar	BM-76	51	190.31	2	8.47	29	32.83	0	0
Khed	BM-114	94	385.23	8	29.47	8	10.59	3	10.94

Mawal	BM-21	3	11.65	1	2.47	0	0	0	0
Mulishi	BM-24	12	59.32	1	1.02	0	0	0	0
Purander	BM-44	114	448.79	8	3.80	72	62.15	1	1.06
Shriur	BM-27	150	497.16	3	11.30	11	10.94	6	8.17
Walhe	BM-54	0	0	3	9.18	0	0	0	0
Khandla	BM-82	74	348.86	1	1.77	43	41.31	12	18.35
Man	BM-101	400	1300.82	5	3.60	106	98.51	5	7.35
Faltan	BM-87	147	691.49	8	10.22	96	99.93	3	2.35
Atpadi	BM-104,114	265	1007.74	26	94.98	58	97.81	0	0
Jat	KR-52,38 BM-123,118,119	291	1171.57	12	37.43	48	46.60	1	1.77
Barshi	SA-27	257	1111.20	2	7.06	6	13.06	0	0
Karmala	SA-15	147	673.71	0	0	52	113.70	0	0
Madha	SA-93	233	582.50	1	3.88	38	57.55	0	0
Malshiras	SA-19	173	432.50	3	13.41	15	16.59	0	0
Mangalvedha	BM-5	180	494.82	5	12.71	12	18.71	0	0
Mohol	BM-2	346	1130	70	236.57	77	120.40	0	0
North Solapur	SAD-15	70	371.10	20	62.14	10	7.00	0	0
Pandharpur	SAD-2	43	127.30	7	21.89	6	10.94	0	0
Sangola	BM-03	216	134.87	1	21.18	50	78.74	0	0
Asthi	SA-19	98	293.00	3	10.59	191	576.72	45	61.07
Patoda		118	413.00	12	46.55	96	306.84	29	48.38
Kalamb	MR-7,MR-16	141	304.37	29	125.98	9	13.77	7	11.18
Osmanabad	MR-22	218	663.50	24	104.52	11	16.24	1	1.91
Paranda	SA-23,24	89	222.50	45	174.21	3	3.53	1	1.80
Washim	MR-10	132	330.50	30	131.31	10	4.23	3	5.36
	SA-19	**5341**	**17027.21**	**367**	**1298.70**	**1242**	**2039.87**	**120**	**186.22**

Type of measure	Total capacity (Mm⊡)	Recharge Potential (%)	Recharge Quantity (Mm⊡)
Storage Schemes (0 to 100 ha.)	16.75	50%	8.37
Storage Schemes (101 to 250 ha.)	67.73	50%	33.86
Total	**84.48**		**42.23**
Add Recharge due to Soil Conservation	0	0	0
Grand Total	**84.48**		**42.23**

The details about storage tanks [L.S] and k.t.weirs [L.S] of 101 to 250 Acres 0 to 100 ha., The details of district wise, watershed wise number of various structures such as Nalla Bandharas, Percolation Tank, Cement Plugs, Underground Bandharas, Forest Tanks, Village Tanks, Farn Ponds, etc Completed and Balance and area treated and Balance are given in Table.

9.2.6 Effect of Water Conservation works – A basin specific Case Study

Case study-1 -In Completed schemes Kanthi Storage tank is one of the storage tank having following Salient features

Sr.No.	Description	
1	Name of Project	Kanthi Storage Tank, Village- Kanthi,Taluka-Jath, District- Sangli
2	Water available from	SubNalla of Korda River
3	Lattitude	36 0’ 0” (N)
	Longitude	75 5’ 0” (E)
4	Total Catchment Area	22.58 Sq.Km
5	Type of Dam	Earthen
6	Length of Dam	645 Mtr
7	Maximum Height of Dam	16.40 Mtr
8	Waste weir	88 Mtr(On right Bank)
9	Total Storage (Dead storage- 411.49 TCM & Live- 962.03 TCM)	1373.52 TCM
10	Irrigable Area	156 Hactor
11	Sbmergence Area	35 Hactor

12	Cost of Project	1089.18 Lakh
13	Total expenditure	1040.50 lakh
14	Work started	2008
15	Work Completed	2011

Yearwise Water Storage In Kanthi Storage Tank in TCM

Sr.No.	Year	Avg.Storage (TCM)	Irrigation (Ha)	Remark
1	2011	567.81	0	Collector declared Scarcity due to which water is kept reserve for drinking purpose only upto 2013
2	2012	73.06	0	
3	2013	1373.52	100	
4	2014	1373.52	100	

Total Rainfall in this area is very low but from the upstream of this tank Mhaisal lift Irrigation Scheme's canal is passing , from this canal one feeder canal is provided , since 2013 water is stored in this tank during scarcity for the purpose of drinking water in that area.

So it is always posssible to feed it from Mhaisal Canal.

Water User Association

Name of WUA	Nagnath Water user Association
Area	156 Ha
Members	72 Nos.

As this is storage tank so their is no any provision of Canal . Farmers area lifting water from upstream. But due to scarcity one Head regulator is provided for supplying drinking water in scarcity through nalla.Main purpose of this tank is irrigation but due to scarcity from last three years water is used for drinking purpose. Due to Mhaisal lift irrigation scheme dam is feeded two times in a year which has incresaed irrigation area two times.

Also due to continue water storage in Dam tanker feeding has been stopped permanantly in that area. Due to this Project proposed area has come under irrigation , farmers are taking all types of crops. And this helps to increase economical growth of farmers.

In future after completion of this types of tanks & other Water Conservation work's, will bring drastic change in Jath Taluka.

Case study-2

K.T.Weir at Huljanthi, Tal.Mangalwedha, Dist: Solapur

To understand the ground reality and utility of the project, Executive Engineer, Shri.N.R.Karimungi and Deputy Engineer, Shri.A.C.Kadam, Small Scale irrigation (Water Conservation) Division, Solapur visited K.T.Weir at Huljanti on 14.3.2015. Salient features of the scheme are attached separately. This K.T.Weir is constructed across Dodda Nalla which is tributary of Bhima river. The population of village Huljanti is about 4000 souls. The scheme is 4 km away from Huljanti and 24 km away from Mangalwedha.

Shri.Birappa Ramanna Ingale a farmer from village Huljanti who is having land holding about 5 acres on bank of Nalla was present at the time of visit. He is Chairman of Shri.Mahalingraya Water use Society of the scheme. About 400 farmers from village Huljanti having land on left and right bank adjacent to the scheme have formed water use society. They are operating gate and maintaining the scheme very well. About 80 wells and 10 tube wells are recharged due to this K.T.Weir.

Farmers informed that, prior to the completion of scheme, they were cultivating Rabi Jawar, Maize etc. fully depending on rainfall only. After recession of rainy season no water was available in that area. After completion of scheme, they are growing sugarcane, pomegranate vegetables etc. There appears comparatively better rise of water table in that area. The farmers expressed view that minor repairs those are required is to be carried out. Also silt should be removed from basin, it will help in increasing capacity.

9.2.7 Construction & Maintenance.

As per present Government Rules, Schemes upto 100 ha are being executed by Zilla Parishad, Schemes from 100 to 250 ha are to be Local Sector Dept and Schemes above 250 ha irrigation potential are being executed by Water Resources Dept.As per present government Rules, some of the Schemes like K.T.weirs etc after completion are, are to be handed over to Water User Associations/Societies for maintenance and management However it is seen that for last 30 years or so no such Scheme has been taken over by Farmers Association for one reason of the other. Hence it is recommended that all the schemes after construction shall be looked after by respective Dept for maintenance and management who have constructed the Scheme.

9.3 Jalyukt Shivar Abhiyan – This is an ambitious program with an aim to halt and percolate water on the farms, where it rains and make the farm self sustainable for annual water requirement.

K : 5 Upper Bhima Sub basin (Jalyukt Shivar Abhiyaan)								
Sr. No	Taluka	No of villages	Agency	Jalyukt Shivar		Estimated cost	Structure Proposed	
				No.of Villages	No.of work			
1	Ambegaon	10	GSDA	2	30	7.80	Recharge Shaft	Recharge Structure
2	Baramati	15		15	225	58.50	Recharge Shaft	Recharge Structure
3	Bhor	12		12	180	46.80	Recharge Shaft	Recharge Structure
4	Daund	15		14	210	54.60	Recharge Shaft	Recharge Structure
5	Indapur	15		15	225	58.50	Recharge Shaft	Recharge Structure
6	Junnar	14		6	90	23.40	Recharge Shaft	Recharge Structure
7	Haveli	15		10	150	39.00	Recharge Shaft	Recharge Structure
8	Khed	15		0	0	0.00	Recharge Shaft	Recharge Structure
9	Mawal	15		0	0	0.00	Recharge Shaft	Recharge Structure
10	Mulshi	13		3	45	11.70	Recharge Shaft	Recharge Structure
11	Purandar	18		8	120	31.20	Recharge Shaft	Recharge Structure
12	Shirur	16		6	90	23.40	Recharge Shaft	Recharge Structure
13	Welha	11		0	0	0	Recharge Shaft	Recharge Structure
	Total	184		**91**	**1365**	**354.90**	Recharge Shaft	Recharge Structure

Sr. No.	Taluka	Village	Agency	Scheme No. of Work	Estimated cost	Structure Proposed
1	Jat	Hivare	GSDA	3	2.97	Aquifer Recharge Shaft
2	Jat	Karajangi	GSDA	3	2.97	Aquifer Recharge Shaft
3	Aatpadi	Kauthuli	GSDA	3	2.97	Aquifer Recharge Shaft
4	Aatpadi	Gharniki	GSDA	3	2.97	Aquifer Recharge Shaft
5	Aatpadi	Banpuri	GSDA	3	2.97	Aquifer Recharge Shaft
6	Aatpadi	Vibhutwadi	GSDA	3	2.97	Aquifer Recharge Shaft
7	Aatpadi	Baalewadi	GSDA	3	2.97	Aquifer Recharge Shaft

Sr. No.	Taluka	Villages selected under Jalyukt Shivar Abhiyan	No. of Villages in Progress under Jalyukt Shiva Abhiyan	Type of Work	No.	Available amount (Rs. Lakh)	No.of work	Available fund in Lakkh
1	Mohod	15	2	Recharge shaft	4	1		
				Recharge trench			18	18
				Borewell recharge				
				Dugwell recharge				
				Total	4	1	18	18
2	Madha	43	2	Recharge shaft	4	1		
				Recharge trench	6	4.2	20	20
				Borewell recharge				
				Dugwell recharge				
				Total	10	5.2	20	20
3	Barshi	33	5	Recharge shaft	10	2.5		
				Recharge trench	3	2.1	18	18
				Borewell recharge				
				Dugwell recharge				
				Total	13	4.6	18	18
4	Pandharpur	15	0	Recharge shaft	0	0		
				Recharge trench			12	12
				Borewell recharge				
				Dugwell recharge				
				Total	0	0	12	12
5	Sangola	57	3	Recharge shaft	6	1.5		
				Recharge trench			12	12
				Borewell recharge				
				Dugwell recharge				
				Total	6	1.5	12	12
6	Mangalwedha	44	1	Recharge shaft	2	0.5		
				Recharge trench			15	15
				Borewell recharge				
				Dugwell recharge				
				Total	2	0.5	15	15
7	Marshiras	7	0	Recharge shaft	0	0		
				Recharge trench			6	6
				Borewell recharge				
				Dugwell recharge				
				Total	0	0	6	6

CHAPTER 10 - FLOODS

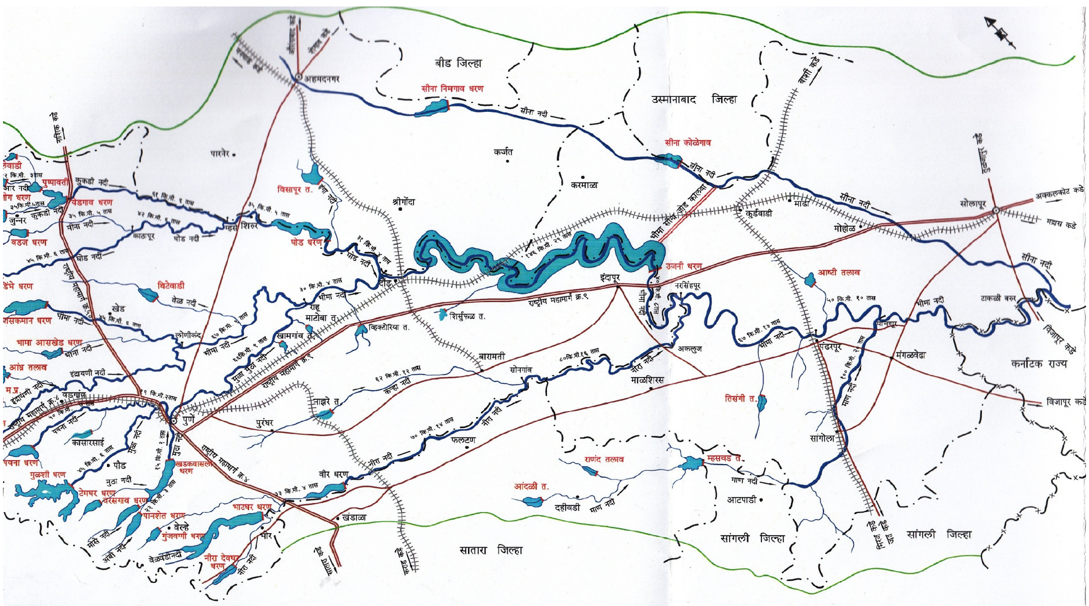
10.1 Introduction:

The geographical area of Maharashtra state is 308,000 Km2. Major river basins in the state are the Krishna River with its major tributary as Bhima, Godavari, Tapi and the West flowing rivers of Konkan strip. Maharashtra receives rainfall from both south-west and north-east monsoon. The state has very highly variable rainfall ranging from 6000 mm in upper catchments to 200 mm in shadow areas of lower catchments. Majority of rainfall mainly occurs in a four months period between June to September with the number of rainy days varying between 40 to 100. The state experiences flash floods particularly in Western Ghats including Krishna basin.& Bhima sub Basin. For instance, Pune, Solapur and Ahmednagar districts in Bhima sub Basin experienced severe floods several times during recent decade.

The Water Resources Department (WRD) of Government of Maharashtra (GoM) is entrusted with the surface water resources planning, development and management. A large number of major, medium and minor water resources development projects (reservoirs and weirs) have been constructed in Maharashtra. Though, the reservoirs in Maharashtra are not specifically provided with flood cushion, they have moderated flood peaks to considerable extent by proper reservoir operations.

10.2 Upper Bhima River Sub Basin (K-5):

The river Bhima, which is one of the major rivers of Maharashtra covering an area of 14856 Sqkm is 300 km long in Maharashtra. Bhima originates from Bhimashankar in Pune district and flows through Pune, Ahmednagar and Solapur Districts. It mainly flows from north to south. Main tributaries in Upper Bhima river sub basin are Man, Bori, Nira, Bhama, Sina, Indrayani, Ghod, Mula-Mutha, flowing from west to east and come under Upper Bhima sub basin. There are 24 major and medium projects in Upper Bhima sub basin.



SUB BASIN K-5

10.3 Flood Prone Areas:

Flood, by definition means an overflow of water that submerges land which is usually dry. It can also be described as a covering by water of land not normally covered by water.

10.3.1 Panshet - In the history of Maharashtra state which came into existence on 1st May, 1960, Panshet dam burst causing flood and catastrophic effects on 12th July 1961 is everlasting. It was the worst flood experienced in decades by Pune city.

Panshet Dam, also called Tanajisagar Dam, is a dam on the Mutha River about 50 km southwest of the city of Pune . The dam was constructed in late 1950s for irrigation and, along with three other dams nearby, Varasgaon,Temghar and Khadakwasla, it supplies drinking water to Pune. Panshet Dam burst in its first year of storing water on 12 July 1961.

The Panshet Dam was under construction when the dam had failed. It was zoned at a height of 51 m and having an impervious central core outlet gates located in a trench of the left abutment and hoists were not fully installed when floods occurred at the site of construction. The reservoir had a capacity of 300 Mcum. Between June 18 and July 12, 1961, the recorded rainfall was 1778 mm. The rain caused such a rapid rise of the reservoir water level that the new embankment could not adjust to the new loading condition. The peak flow was estimated at 4870 m3 /s. Water rose at the rate of 9 m per day initially, which rose up to 24 m in 12 days. Due to incomplete rough outlet surface the flow through was unsteady which caused pressure surges. Cracks were formed along the edges of the right angles to the axis of the dam causing a subsidence of 9 m wide.

An estimated 1.4 m of subsidence had occurred in 2.5 hours, leaving the crest of the dam 0.6 m above the reservoir level. Failure was neither due to insufficient spillway capacity nor due to foundation effect. It was attributed to inadequate provision of the outlet facility during emergency. This caused collapse of the structure above the outlets.

10.3.4 Flood Prone Area of - MULA MUTHA SUB Basin:

The years 2005 and 2006 observed heavy floods in the basins. Due to heavy rains in the catchment of Indrayani and Mula River, town Lonavala experienced heavy flood and low lying area of Pune city adjacent to river bank was affected in 2005.

Table10.3.4.1 – Details of Project

Sr. No	Name of Projects	FRL Content in Mcum	Length of Dam in m	No. Of Gates	Size of Gates	Max. Design Flood in cumecs
A	Major Projects					
1	Khadakwasla	86.0	1939	11	12.19 × 4.77	2564
2	Panshet	303.30	765	4	12.19 × 4.77	871
3	Warasgaon	374.10	780	5	12.19 × 4.77	1033
4	Pawana	305.0	1329	6	12.19 × 4.77	1250
5	Chaskaman	241.69	958	5	12.19 × 4.77	3963

Irri = Irrigation , HEP = Hydro Electric Project

10.3.2 Ujjani Dam

1) Daund – This city situated up streme of Ujjani dam and the distance is 146 k.m. from Ujjani dam. Discharged measuaring unit at Daund of up coming flow of Pune districts Dam. The upper Bhima Sub Basin includes Chaskaman, Bhama Aaskhed, Andhra, Wadiwale, Valvan and Ujjani. Also, Kukdi Basin Kedgaon, Manikdoh, Dimbhe,WadaJ. Pimpalgaon Joge, Chilhewadi and Ghod etc. The flow coming from Kukdi basin ends in Ghod Dam and this Ghod Dam flow coming in Bhima River near Daund city. From this situation dangerous flood conditions can happen in Daund city. The flood alert level is 505.00m.and the discharged of this level is 1, 55,385 Cusecs and dangerous level is 508.00 m and discharge of this level is 2,61,329 cusecs.

2) Nira-Narsihpur - On downstream side of Ujjani dam at 40 k.m. Nira River reached to River Bhima at Nira-Narsihpur. Discharge came from veer dam & Ujjani dam reaches together at this place. After reaching of these rivers renamed at Bhima River and Bhima goes to Pandharpur. Alert level of Nira-Narsihpur is 458.403 m. And discharge of alert level is 1, 86,885 cusecs and danger level is 459.033 m and discharge danger level is 1, 99,457 cusecs.

3) Pandhapur city is one of the most flood prone areas in the Bhima sub basin. Notable floods in the recent past were also observed in 1956 and 1984 . From Nira-narsihpur at 67 k.m. Pandharpur pilgrim town is situated at right side of Bhima river, at pandharpur alert level is 443.00 m and discharge alert level is 1,16,256 cusecs and danger level is 445.400 m and discharge danger level is 1,87,168 cusecs

A normal day at Pandharpur as above. But when floods havoc, it is like below.

Some areas of the upper Bhima river sub basin suffer from floods. Due to heavy rains in the catchments of Bhima and Nira rivers created flood havocs in Solapur, and Vijapur (Karnataka) districts in July 2005

It is reported that about 149 villages in the district of Solapur, Pune & Ahmednagar are prone to floods. The extent of flooding could be so severe that these villages remain cut off from the rest of the area for about a week.

Case study of flood moderating of Ujjani Dam.

The height of radial gates of Ujjani Dam was raised by 0.50m by joining flaps of 0.60m curved height.Due to this, capacity of reservoir is increased by 6.34 TMC. D/S of Ujjani Dam there is a holy Pandharpur City. To avoid danger situation at Pandhar city, the flood discharge coming from Nira & Bhima river can be regulated. This can be possible by moderating flood discharge by accuMulating excess flood water in Ujjani Dam against these raised flood pocket. Average 25 % discharge in Bhima river can be accuMulated in Ujjani Dam for short period. When flood from Nira river passes, the accuMulated flood water in Ujjani Dam in flood pocket can be passed safely. During last 10 years, in 2006 @ 3 Lacs cusecs flood discharge is reaching at Ujjani Dam from Daund, at the same time Nira river also carrying flood up to 75000 cusecs. at this time to avoid danger situation at pandharpur city 25000 cusecs discharge was witheld and moderated at Ujjani Dam for three days.

Probited level, Dischage level (Blue Line) & Ristrictive level of Bhima River

Sr. No.	Place	Prohibited level, flood discharge (Blue line) cusecs	Prohibited level, flood discharge (Red line) cusecs
1	Nira-Narsihpur	462.393 m. 3,19,000 cusecs	467.243 m. 8,19,000, cusecs
2	Pandharpur	449.600 m. 3,24,302, cusecs	458.036 m. 8,18,000, cusecs

Probable area / locality of Pandharpur town getting affected due to Bhima River Flood Discharge.

Sr.No.	Level of River (m)	Flood Discharge (cusecs)	Affected Places
1	443.600	1,30,000	Vyas Narayan Slum area
2	444.500	1,60,000	Gopalpur New Bridge
3	445.500	2,00,000	Sant Peth Slum area
4	446.300	2,25,000	Govindpura
5	447.850	3,00,000	Kabir Math Staircase, Old Corporation Bldg, in this place water level up to 1 to 1.5 ft.
6	448.200	3,25,000	Datta Ghat, Maheshwari Dharmshala, Mahadwar Ghat, Paricharak Wada, Kalika Mandir Chowk in this places waterlevel upto1 ft.

Levels & Discharges at the Time of Flood Control situation in Upper Bhima Sub Basin

Sr. No.	Road Name	Name of Bridge	Name of River	Under Water Bridge Level RL in M	Discharge Cusecs
1	Pune-Solapur NH no 65	Hingangaon	Bhima	469.892	2,75,000
2	State Highway Tembhurni - Akluj	Nira Narsingpur Sangam	Bhima	459.043	1,98,716
3	Solapur – Pandharpur	Old Dagdi Bridge Pandharpur	Bhima	439.200	26,521
4	Solapur – Pandharpur	New Bridge Pandharpur	Bhima	447.200	2,35,000
5	Pandharpur – Mangalvedha	Old Bridge Gopalpur	Bhima	443.400	1,25,932
6	Pandharpur – Mangalvedha	New Bridge Gopalpur	Bhima	444.500	1,60,000
7	Solapur – Mangalvedha	Begampur	Bhima	434.450	2,30,000

Average annual flood damage –

Loss of life – Before construction of Ujjani dam, the worst flood at Pandharpur was recorded in 1956. Though it is not on records, the loss of life was substantial. With better control on outflow from dam, synchronized with flood warnings to the target area, the loss of life has become very far and few. Only 1 person was dead in the floods of 2006-07 at Mangalvedha. The compensation paid was rs. 1.00 lakh. Since then, no casualties reported so far for floods.

Loss of livestock - . With better control on outflow from dam, synchronized with flood warnings to the target area, no loss of live stock is reported, till date.

Loss to agricultural production – As Solapur is pre-dominantly post monsoon Rabi season district, in Kharif season when monsoon is active and floods occur, very little seasonal crops are sown along the river. The sugarcane crop is in a better position to sustain the floodwater. Hence, no flood related loss to agricultural production is reported by Revenue authorities.

Loss of Infrastructure - Nil

Based on this, the villages along with the population (2011), likely to be affected are as below

Table – Status Of population Affected due to flood of Bhima River D/S of Ujjani Dam.

Right Flank				Left Flank			
Sr. No	Name	Taluka	Population	Sr. No	Name	Taluka	Population
1	2	3	4	5	6	7	8
1)	Hingangaon	Indapur	1275	1	Arvi	Shrigonda	902
2)	Bhaulgaon	Indapur	2167	2	Babhulgaon	Karjat	1869
3)	Bhatnimgaon	Innapur	1360	3	Ranzani	Madha	4499
4)	Bhandgaon	Indapur	2568	4	Alegaon(Bk)	Madha	1761
5)	Vakilvasti	Indapur	2073	5	Rui	Madha	857
6)	Bavada	Indapur	9783	6	Alegaon(Kh)	Madha	1632
7)	Ganeshwadi	Indapur	1323	7	Garakole	Madha	1401
8)	Pimpri(Bk)	Indapur	1821	8	Takali	Madha	2351
9)	Tannu	Indapur	1613	9	Chandaj	Madha	2293
10)	Narshingpur	Indapur	2097	10	Vadolo	Madha	1134
11)	Girvi	Indapur	1596	11	Sheware	Madha	2439
12)	Ozar	Indapur	527	12	Malegaon	Madha	1769
13	Goundi	Indapur	906	13	Mitkalwadi	Madha	1516
14	Wadi	Indapur		14	Bembale	Madha	6315
15	Lumewadi	Indapur	2614	15	Kanhapuri	Pandharpur	2697
16	Sarati	Indapur	1861	16	Karolr	Pandharpur	2946
17	Tambave	Malshiras	3263	17	Umbare	Pandharpur	3648
18	Ganesshgaon	Malshiras	1139	18	Sangavi	Pandharpur	1624
19	Sangam	Malshiras	2582	19	Badalkot	Pandharpur	1449
20	Babhulgaon	Malshiras	1643	20	Nadure	Pandharpur	2104
21	Waphegaon	Malshiras	1355	21	Pehe	Pandharpur	1672
22	Wagholi	Malshiras	3412	22	Avhe(Neware)	Pandharpur	2290
23	Lavang	Malshiras	5167	23	Taratgaon(Khalve)	Pandharpur	485
24	Mahalung	Malshiras	19983	24	Pirachikuroli	Pandharpur	4233
25	Mire	Malshiras	1858	25	Patvardhankuroli	Pandharpur	4417
26	Umbre(V)	Malshiras	2315	26	Devde	Pandharpur	1630
27	Chandakachiwa	Malshiras		27	Shelve	Pandharpur	2875
28	Kondharpatta	Malshiras	1238	28	Hole(Bk)	Pandharpur	2943
29	Nevre	Malshiras	2672	29	Gursale	Pandharpur	4480
30	Jambud	Malshiras	4451	30	Takali	Pandharpur	6261
31	Khalve	Malshiras	1608	31	Tarapur	Pandharpur	3790
32	Dasur	Malshiras	1885	32	Pohargaon	Pandharpur	1688
33	Singalnagar	Pandharpur		33	Puluj	Pandharpur	5282
34	Kuroliwadi	Pandharpur	2045	34	Pulujwadi	Pandharpur	1604
35	Bhandi-Shegaon	Pandharpur	5274	35	Shankargaon	Pandharpur	1080
36	Khed(Bhose)	Pandharpur	2102	36	Ambechincholi	Pandharpur	1753
37	Khed(Bhalwani)	Pandharpur	1970	37	Nali	Pandharpur	824
38	Kotthali	Pandharpur	3810	38	Ardhanari	Mohol	1319
39	Shirdhon	Pandharpur	1308	39	Begumpur	Mohol	4874

Right Flank				Left Flank			
Sr. No	Name	Taluka	Population	Sr. No	Name	Taluka	Population
1	2	3	4	5	6	7	8
40	Chincholi(Bhose	Pandharpur	1227	40	Arbeli	Mohol	1097
41	Wakhari	Pandharpur	6099	41	Miri	Mohol	1445
42	Isbavi	Pandharpur		42	Wadapur	S.Solapur	2015
43	Pandharpur	Pandharpur	91379	43	Kusur	S.Solapur	2545
44	Bhatumbare	Pandharpur	2066	44	Khanapur	S.Solapur	315
45	Shegaon	Pandharpur	2391	45	Telgaon	S.Solapur	2197
46	Gopalpur	Pandharpur	4345	46	Bhandarkawthe	S.Solapur	6814
47	Degaon	Pandharpur	4051	47	Baligi	S.Solapur	1231
48	Ajansond	Pandharpur	2195	48	Sadhepur	S.Solapur	1839
49	Mundhewadi	Pandharpur	2990	49	Lavangi	S.Solapur	1546
50	Chale	Pandharpur	6250	50	Karkal	S.Solapur	1944
51	Suste	Pandharpur	4264	51	Auj	S.Solapur	2693
52	Kharsoli	Pandharpur	2148	52	Kurghot	S.Solapur	1793
53	Ambe	Pandharpur	4518	53	Takli	S.Solapur	3029
54	Vite	Pandharpur	1196	54	Chinchpur	S.Solapur	922
55	Sarkoli	Pandharpur	5545	55	Barur	S.Solapur	2820
56	Uchethan	Mangalwedha	1651	56	Hattarsang	S.Solapur	1233
57	Bathan	Mangalwedha	2089	57	Kudal	S.Solapur	667
58	Machnoor	Mangalwedha	1789	58	Rajur	S.Solapur	829
59	Barahampuri	Mangalwedha	2866	59	Bandalgi	S.Solapur	2165
60	Rahatewadi	Mangalwedha	920	60	Bolkavathe	S.Solapur	1507
61	Tamdardi	Mangalwedha	928	61	Sanjwad	S.Solapur	1113
62	Tandoor	Mangalwedha	1021	62	Kumthe	Akkalkot	784
63	Siddhapur	Mangalwedha	3613	63	Korsegaon	Akkalkot	2091
64	Arali	Mangalwedha	2332	64	Kalkarjal	Akkalkot	1366
				65	Dharsang	Akkalkot	570
				66	Shegaon	Akkalkot	1942
				67	Alage	Akkalkot	1535
				68	Guddewadi	Akkalkot	1434
				69	Ankalge	Akkalkot	1903
				70	Khanapur	Akkalkot	1374
				71	Mahisagle	Akkalkot	2065
				72	Devilavatha	Akkalkot	716
				73	Kudal	Akkalkot	551
				74	Andhewadi(Kd)	Akkalkot	470
				75	Andhewadi(Bk)	Akkalkot	1876
				76	Sheval	Akkalkot	2210
				77	Ghungargaon	Akkalkot	457
				78	Kalhipparga	Akkalkot	705
				79	Hilli	Akkalkot	1783

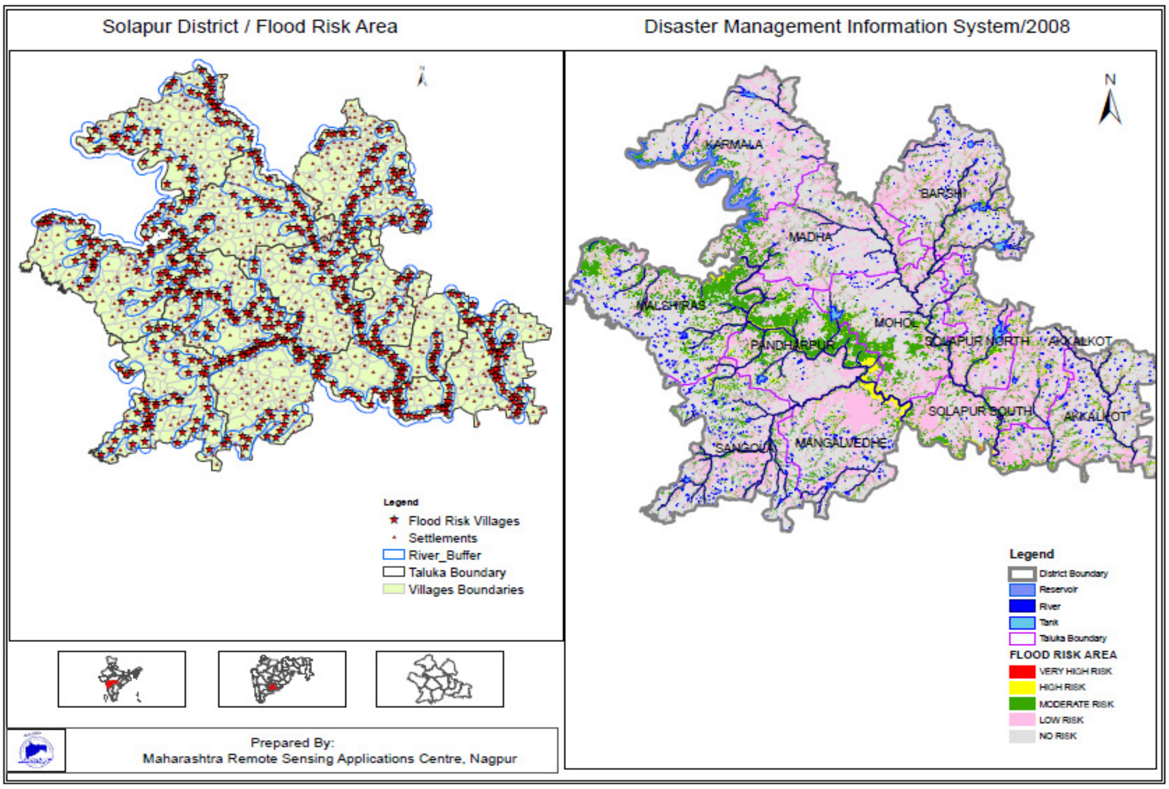
From the above table it can be seen that neither the urban area nor the urban population is affected by the floods

Frequency of Flood - The Table showing the water released from Ujjani Dam spillway from 2004-05 to 2013-14 is as below

Table – Status of Water Flood from Ujjani Dam

year	Date	Time	Highest Discharge Level at Ujjani		Highest Discharge Level at Daund		Highest Discharge Level at sangam		Highest Discharge Level at Pandharpur		Remark
			Water Level	Discharge Qsecs	Water Level	Discharge Qsecs	Water Level	Discharge Qsecs	Water Level	Discharge Qsecs	
2004	30/09/04	14.00		35000							
2005	04/08/05	7.00	496.757	225000	505.750	174834	461.843	254882	448.450	318894	
2006	09/08/06	16.00	497.322	275000	506.550	210118	461.643	259704	448.050	266008	
2007	08/08/07	23.00	496.512	50000	502.370	76152	453.723	58463	439.500	32032	
2008	20/09/08	22.00	497.137	100000	502.250	78046	449.643	83555	440.550	48805	
2009	17/11/09	16.00	497.322	30000	499.000	10912	0.000	0	0.000	0	
2010	27/09/10	26.00	497.337	30000	498.450	5826	450.093	2401	437.350	7240	
2011	04/09/11	27.00	497.092	130000	503.220	100111	457.033	142459	444.200	149734	
2012	0	0.00	0	0	0.000	0	0.000	0	0.000	0	
2013	19/09/13	24.00	497.327	90000	501.580	63200	455.433	105485	442.100	80306	
2014	06/09/14	14.00	497.032	20000	500.570	45697	450.993	9888	437.990	12324	
year	Date	Time	Lowest Discharge Level at Ujjani		Lowest Discharge Level at Daund		Lowest Discharge Level at sangam		Lowest Discharge Level at Pandharpur		Remark
			Water Level	Discharge Qsecs	Water Level	Discharge Qsecs	Water Level	Discharge Qsecs	Water Level	Discharge Qsecs	
2004	26/09/04	16.00		16000							
2005	27/07/05	22.00		30000							
2006	29/07/06	8.00		30000							
2007	06/07/07	11.00	495.482	10000	500.700	41489	450.543	4238	438.200	13490	
2008	09/09/08	13.00	497.182	5000	498.600	7063	452.283	32472	439.950	42766	
2009	17/11/09	10.00	497.312	5000	498.300	4767	0.000	0	0.000	0	
2010	09/09/10	12.00	496.992	5000	498.770	8582	450.203	3002	436.950	4626	
2011	31/08/11	16.00	496.762	10000	501.470	60342	451.043	10383	439.100	23378	
2012	0	0.00	0	0	0.000	0	0.000	0	0.000	0	
2013	13/09/13	16.00	497.257	10000	499.270	15597	450.043	2119	0.000	3971	
2014	06/09/14	9.00	496.957	10000	499.900	26819	450.963	9976	437.970	12324	

SOLAPUR DISTRICT Floods -The flood risk area map of Solapur district is given below.



10.3.3 GHOD & KUKDI

10.3.3.1 Ghod Sub-Basin:

The river Ghod is one of the major tributaries of river Bhima. Ghod originates from Bhimasanker in Pune district and flows through Pune, & Nagar Districts. It mainly flows from north to south. Two of its main tributaries are namely, Kukadi and Mina flow from west to east.

10.3.3.2 Flood Prone Area - Ghod river Sub-basin:

Some areas of the Ghod river basin suffer from floods. The years 1971, 1973, 1976, 1983 and 1997 observed heavy floods in the sub basin. Due to heavy rains in the catchment of Ghod and Kukadi Rivers created flood situation in village's d/s of Ghod dam.

The spillway discharge of Ghod dam during these years was about 1.00 lack cusecs. It is reported that about 4 villagesd/s of Ghod dam in the district of Pune & Nagar are affected by floods from Ghod River.

Flood affectes spots of Ghod Sub Basin

Sr. No.	Town	Taluka	Sr. No.	Town	Taluka
1	Kashti	Shrigonda Dis-A'nagar	8	Tandali	Shirur Dist-Pine
2	Pachpute vasti	Shrigonda Dis-A'nagar	9	Ganegaon	Shirur Dist-Pine
3	Sangavi	Shrigonda Dis-A'nagar	10	Inamgaon	Shirur Dist-Pine
4	Bori	Shrigonda Dis-A'nagar	11	Kalaskarwadi	Shirur Dist-Pine
5	Hangewadi	Shrigonda Dis-A'nagar	12	Pimpalsuti	Shirur Dist-Pine
6	Wangdari	Shrigonda Dis-A'nagar	13	Chinchani	Shirur Dist-Pine
7	Tandali	Shirur Dist-Pine	14	Shirasgaon	Shirur Dist-Pine

10.3.3.3 Frequency of Flood

The Table showing the water released from Yedgaon, Wadaj, Manikdoh, Pimpalgaon Joge & Dimbhe Dam spillway from 2004-05 to 2013-14 is as below

Table-10.3.3.3 – Status of Water Flood from Kukadi complex

Sr.No.	Date	Name of dam	Discharge in cumecs
1	31.8.2010	Yedgaon	43.40
2	31.8.2010	Wadaj	90.00
3	28.8.2011	Wadaj	210.00
4	7.9.2011	Yedgaon	130.00
5	12.9.2013	Wadaj	70.00
6	31.7.2013	Yedgaon	210.00
7	**30.7.2014**	**Yedgaon**	**566.00**
8	30.7.2014	Wadaj	215.00
9	1.8.2013	Dimbhe	290.00

The maximum discharge released through spillway is **566** Cumecs.

After maintaining reservoir water levels as per above schedule, excess discharge is released to downstream of Dam as mentioned in above Table. The information regarding the same is communicated immediately to Revenue and Police Authorities by WRD.

Status of Population Affected due to Kukadi Sub Basin Flood of Yedgaon, Wadaj, Manikdoh, Pimpalgaon-Joge & Dimbhe Dam is given below.

Right Flank				Left Flank			
Sr. No	**Name**	**Taluka**	**Population**	**Sr. No**	**Name**	**Taluka**	**Population**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Yedgaon dam						
1)	Kandali	Junnar	802	1	Pimpalwandi	Junnar	681
2)	Shiroli	Junnar	394	2	Bori	Junnar	586
3)	Nimgaon	Junnar	542	3	Jadhavwadi	Junnar	359
4)	Pargaon	Junnar	310	4	Sakori	Junnar	401
5)	Jambut	Shirur	620	5	Mangrul	Junnar	252
6)	Wadner Bk	Shirur	348	6	Wadner Kd	Parner	452
				7	Renwadi	Parner	227
	Wadaj dam						
1	Wadaj	Junnar	200	1	Nimgaon	Junnar	100
2	Nimdari	Junnar	100	2	Basti	Junnar	90
3	Savargaon	Junnar	250	3	Vadgaon sahani	Junnar	130
4	Warulwadi	Junnar	350	4	Pimpalgaon	Junnar	210
5	Ranjani	Ambegaon	180	5	Arvi	Junnar	180
				6	Narayangaon	Junnar	610
				7	Hivare	Junnar	110
				8	Khodad	Junnar	98
				9	Valati	Ambegao	70
				10	Shingave	Ambegao	130
	Manikdoh dam						
1	Junnar	Junnar	6000	1	Golegaon	Junnar	100
2	Shiroli Bk	Junnar	200	2	Kukshet	Junnar	90
3	Dhalewadi	Junnar	90	3	Shiroli Kd	Junnar	90
				4	Tejewadi	Junnar	90
				5	Ozar	Junnar	150
				6	Hivare Bk	Junnar	100
	Pimpalgaon Joge dam						
1	Dingore	Junnar	100	1	Pimpalgaon	Junnar	100
2	Netwad	Junnar	70	2	Udapur	Junnar	90
				3	Thikekarwadi	Junnar	90
				4	Dholwad	Junnar	200
				5	Umbraj	Junnar	450

Right Flank				Left Flank			
Sr. No	Name	Taluka	Population	Sr. No	Name	Taluka	Population
1	2	3	4	5	6	7	8
	Dimbhe dam						
1	Dimbhe	Ambegaon	100	1	Mahalunge	Ambegaon	50
2	Supedhar	Ambegaon	90	2	Gangapur	Ambegaon	150
3	Shinoli	Ambegaon	200	3	Gonwadi	Ambegaon	200
4	Pimpalgaon	Ambegaon	190	4	Chincholi	Ambegaon	250
5	Ghodegaon	Ambegaon	650	5	Chass	Ambegaon	300
6	Narodi	Ambegaon	150	6	Sakori	Ambegaon	90
7	Wadegaon	Ambegaon	150	7	Nandur	Ambegaon	250
8	Sultanpur	Ambegaon	100	8	Kalamb	Ambegaon	160
9	Chandoli Kd	Ambegaon	90	9	Chandoli	Ambegaon	120
10	Pimpalgaon	Ambegaon	150	10	Khadaki	Ambegaon	250
11	Nirgudsar	Ambegaon	90	11	Bharadi	Ambegaon	120
12	Pargaon	Ambegaon	130	12	Kathapur	Ambegaon	90
13	Kathapur Kd	Ambegaon	70	13	Pimparkhed	Shirur	50
14	Devgaon	Ambegaon	50	14	Chandoh	Shirur	70
15	Lakhangaon	Ambegaon	130	15	Fakate	Shirur	80
16	Kawate	Shirur	70	16	Sabalewadi	Shirur	50
17	Ahmadabad	Shirur	50	17	Takali Hazi	Shirur	300
18	Kohakadi	Shirur	70	18	Nimgaon dude	Shirur	50
				19	Tamkarwadi	Shirur	40
				20	Mhase Kd	Shirur	100

10.3.5 NIRA SUB BASIN

There is a Veer Dam on Neera River & therefore a watch is required to be kept on the flood passing over Veer Dam spill way during Monsoon. Flood can be controlled to some extent by operation of gates. Reservoir Operation schedule is approved by the Chief Engineer , Water Resources Department , Pune's office letter No. CE/EE-2/PB-7/ROS/3122 dated 26/5/2010.

There is a river gauging station at Malwadi on Neera River upstream of Veer Dam. This gauge and the details of release of Bhatghar Dam gives and idea of total inflow coming in Veer lake and considering the position if lake filling. The floods are to be intercepted or released over spillway.

Communication of flood massage:-

The details of intensity of floods and spillway released in the Neera River downstream of Veer dam are to be communicated daily to concerned officers of irrigation Department by Canal phones & Trunk phones and Wireless Communication. In Case of severe and abnormal flood message of "Aler" "Action" and "Cancle" are to be given to all concerned officers Viz. collectors Pune and Satara Prant Officers phaltan. Tahasildar Phaltanl, Khandala , Purandhar, Baramati, Indapur, Malshiras, Pandharpur.

In flood message of different fold discharge of Veer Dam are finalized as under:

1.	Alert Message	80,0000	Cusecs	2265.32	Cumecs
2.	Action Message	1,00,000	Cusecs	2831.66	Cumecs
3.	Cancel Message	60,000	Cusecs	1739.08	Cumecs

.The Normal flood passing over Veer Dam spillway is 50,000 cusecs (1416 Cumecs) & the maximum flood that can pass over spillway is 1,82,000 cusecs (5154.34 cumecs)

Communication :- Trunk phone as well as canal phone and wireless facilities are available at Veer Dam. Wireless communication between Veer Dam and Phaltan and further up to Pandharpur is feasible and wireless network is installed recently along entire length of Neera Right Bank Canal. A note described network station along N.R.B.C.

Table 10.3.5.1 – Details of Project in NIRA SUB BASIN

Sr. No	Name of Projects	FRL Content in Mcum	Length of Dam in m	No. Of Gates	Size of Gates	Max. Design Flood in cumecs
A	**Major Projects**					
1	Bhatghar	665.570	1625	81	3.12 × 2.44	1462.00
2	Nira deoghar	332.126	2330	5	12.00 × 5.00	1852.00
3	Bhama Askhed	217.10	1425	4	12.00 × 5.00	3432.00
4	Tata Hydro (5 Dams)	1154.18	6737.6	37	30 Nos. 5.00x1.40 and 7 nos. 12.00x6.00	4695.62
B	**Medium Projects**					
1	Wadivale	30.39	488	5	11.20 × 3.00	1176.00
2	Kasarsai	16.06	1035	3	12.00 × 5.00	933.00
3	Nazare	16.652	2060	26	5.00 x 1.80	2425.00
4	Shetphal	16.78	4410	0	0	feeding tank
5	Andra	82.75	330	0	0	3021

Table 10.3.5.2 - Catchment Area, Average Rainfall of Project

Sr. No	Name of Projects	Catchment Area Km2	Average Rainfall mm
A	**Major Projects**		
1	Bhatghar	331.50	1000
2	Nira deoghar	114.48	2050
3	Bhama Askhed	198.08	1000
4	Tata Hydro (5 Dams)	413.54	4500
B	**Medium Projects**		
1	Wadivale	46.88	4087
2	Kasarsai	39.45	1446
3	Nazare	397.82	545
4	Shetphal	5.96	406
5	Andra	214.46	1100

Status of Population Affected due to Neera basin is given below.

Veer Dam Project - Flood effected village list

Sr.No	Left side		Right side	
	First Proirity	**Second Proirity**	**First Proirity**	**Second Proirity**
1	Jeur	Veer (Partly)	Papare bull	Vatar bull (Partly)
2	Murum	Pipare (khurd)	Yelevadi	Ravadi (khurd)
3	Hol (partly)	Neera	Ravadi (bud)l	Murum
4	Koralr (partly)	Nimbut	Kambleshawar	Khamgaon
5	Late (partly)	Kanavadi (partly)	Sangavi (partly)	Hol
6	Kambleshawar (partly)	Hol (partly)	Songaon (partly)	Jinti

7	Sangavi	Late (partly)	Sarade	Khute
8	Khandaj	Kambleshawar	Aasu (partly)	Somthali
9	Mekhali	Sangvi (partly)	Kurbavi (partly)	Sangvi
10	Songaon	Shirvli	Bangarde	Songaon
11	Udhat (partly)	Khandaj (partly)	Palasmandal	Sathe
12	Jamb	Wagaj	Chakore	Gokhali
13	Kurwali	Ghadagewadi	Malinagar	Dhawalrwadi
14	Nimsakhar	Mekhli	Rajewadi	Aasu
15	khorachi	Songaon	Tambhave	Kurbavi (partly)
16	Bopatewadi	Tawashi	Ganeshagaon	Yakshiv
17	Chakati	Udhawat	Sangam	kalmboli
18	Nimbodi	Chikhadi		Bangarde
19	Giravi (partly)	Kalamb		Palasmandal
20	Narsingpur	Nirwangi		Kalamb
21		Bopatewadi (partly)		Umbrae
22		Pitewadi		Tirwadi
23		Nirnimgaon		Chakore
24		Bhagatwadi		Kondbhavi (partly)
25		Sarati		Beradwadi (partly)
26		Musalmanwadi		Aklaug
27		Gondi		Malinagar
28		Katkaewasti		Bijwadi
29		Narutewasti		Aozare
30		Girvi (partly)		Tambave

From the experience of the past, it is seen that no population is affected by the floods and flood EVACUATION Scheme was not felt necessary so far. However in the case of natural Calamity and exceptional heavy downpour this aspect will have to be considered , Warning in such case will be given to Revenue officers and police department who will take further remedial steps in the matter.

Chapter 11 - Drainage.

11.1 Introduction

Maharashtra has a long history of irrigation. During British era, in the year 1885, Irrigation from Nira Left and Right Bank Canal started. In the command of these canals, it was observed that some area of the irrigated land in the command became waterlogged and saline. The fertility of land goes on reducing. No crop could be grown on these lands. It is due to excessive use of irrigation water and topographical features. The Bombay Government had set up a Special Irrigation Division at Pune in 1916, to study the problems of water logged area and suggest remedial measures. DIRD (Directorate of Irrigation Research & Development) is established in the year 1916. Since then DIRD is collecting data of water logged and saline land from the command of various major projects and monitoring the affected area. DIRD is working with 7 Irrigation Research Divisions and 32 sub divisions in all over the state. DIRD, monitors damage area of major and medium irrigation projects.

11.2 IDENTIFICATION AND NORMS OF DAMAGED AREA

Damaged area can be classified in two categories.

1. Water logged area
2. Saline area.

11.2.1 Identification of water logged area.

Water logged area is identified by observing ground water table levels in the command. Generally, water levels in the wells are observed twice a year i.e. pre monsoon (March, April & May) and post monsoon (Nov. Dec. and Jan.) period. The water logged area is classified in two categories as fully waterlogged and slightly water logged. The area where ground water is observed on the ground in period 1st Nov. to 31st Jan. is classified as fully water logged area. The area where water table is within 2 m from the ground surface is classified as slightly or partially water logged area.

11.2.2 Identification and norms of salt affected area

Saline soils contains excess amount of soluble salts like sodium chloride, sodium sulphate, calcium chloride, calcium sulphate, magnesium chloride, magnesium sulphate etc. The saline soil patches are identified by visual inspection and by laboratory test.

A) Visual inspections

The saline soil patches are identified initially by visual inspection. The key points in the visual inspections are as follows.

- These soils often have white patches.
- A white line of salt deposition is seen along online field channel and field courses.
- In some cases visible signs of salt injuries such as pick burn of leaves and chlorosis (Pale yellow colour of crops) of leaves are seen.

B) Laboratory test

After identifying the saline patches, PH value and Ec (electrical conductivity) tests are carried on soil to evaluate exact severity.

a) Test to obtain PH value of soils.

b) Test to determine electrical conductivity of soil (Ec)

When Ec is upto 1 decisiemens / m, the agricultural land is non saline. When Ec is in the range of 1 to 3 decisiemens / m, the agricultural land is demarked as slightly or partially saline. Where the Ec values are more than 3 decisiemens / m, the agricultural land is termed as fully saline.

11.3 Drainage system –

In the Upper Bhima Basin (K-5 Basin), Irrigation Research Division, Pune is monitoring the affected area in the 6 Major Projects from the point of water logging and salination of the soil. The information based on Damage Demarcation report is furnished below.

Table 11.1 Drainage Demarcation Report

Sr. No	Name of project	Area under observation (ha)	Affected area in (ha)	No. of natural drains	No. of artificial drains constructed	Proposed artificial drains for 2015-16
1	Nira Left Bank Canal	60656	2356	73	78	3
2	Nira Right Bank Canal	67358	997	106	59	2
3	**Khadakwasla Project**					
	New Mutha Right Bank Canal	62146	2255	37	95	8
4	**Ujjani Project**					
	Ujjani Left Bank Canal	80403	2587	37	55	5
	Ujjani Right Bank Canal	44900	834	17	4	5
5	**Ghod Project**					
	Ghod Left Bank Canal	21268	862	15	36	6
	Ghod Right Bank Canal	10160	936	8	28	8
6	**Chaskaman Project**					
	Chaskaman Left Bank Canal	21100	326	31	0	2
	Chaskaman Right Bank Canal	1970	19	4	0	0
7	**Kukadi Project**					
	Kukadi Left Bank Canal	20031	303	55	11	0
	Manikdoh Left Bank Canal	1744	12	8	0	0
	TOTAL	**391736**	**11487**	**391**	**366**	**39**

The carrying capacity of natural drains in the comand area has reduced considerably. The natural drains are encroached by the farmers in many cases. Almost all the natural drains are covered with vegetation like Pankanis and heavy siltation. This is mainly due to wastage / seepage of water from sugar cane field. Some farmers have encroached in the nalla and put bunds to divert the water. This leads to Water logging and salination of the agricultural land. The Irrigation Research Division, Pune, has completed 39 artificial drains upto March 2014 in K 5 Basin.

11.4 Water logging and soil salinity - The details of area under water logging and salinity as per "Affected Area Report" for the year 2013-2014 are as below –

Table 11.2 Affected area Report

Sr. No.	District	Taluka	Water logged Area (ha.)	Saline Area (ha.)	Total Affected Area (ha.)
1	Nira Left Bank Canal				
	Pune	Purandar	2	21	23
		Baramati	53	1634	1687
		Indapur	12	635	647
		TOTAL:-	**67**	**2290**	**2357**
2	NiraRight Bank Canal				
	Satara	Khandala	1	10	11
		Phaltan	17	454	471
	Solapur	Malshiras	24	473	497
		Pandharpur	1	13	14
		Sangola	0.00	5	5
		TOTAL:-	**43**	**955**	**998**
3	New Mutha Right Bank Canal				
	Pune	Hawale	127	77	204
		Daund	457	1515	1972
		Indapur	15	64	79
		TOTAL:-	**599**	**1656**	**2255**
4	Ujani Left Bank Canal				
	Solapur	Madha	42	134	176
		Pandharpur	165	1058	1223
		Mohol	62	921	983
		South Solapur	4	98	102
		North Solapur	9	97	106
		TOTAL:-	**282**	**2308**	**2590**
5	Ujani Right Bank Canal				
	Solapur	Malshiras	31	176	207
		Pandharpur	111	377	488
		Mangalvedha	53	86	139
		TOTAL:-	**195**	**639**	**834**
6	Ghod Left Bank Canal				
	Ahamadnagar	Shrigonda	334	317	651
		Karjat	76	135	211
		TOTAL:-	**410**	**452**	**862**

Sr. No.	District	Taluka	Water logged Area (ha.)	Saline Area (ha.)	Total Affected Area (ha.)
7	Ghod Right Bank Canal				
	Pune	Shirur	844	92	936
		TOTAL:-	**844**	**92**	**936**
8	Chaskaman Left Bank Canal				
	Pune	Khed	185	0.00	185
		Shirur	83	58	141
		TOTAL:-	**268**	**58**	**326**
9	Chaskaman Right Bank Canal				
	Pune	Khed	19	0.00	19
		TOTAL:-	**19**	**0.00**	**19**
10	Kukadi Left Bank Canal				
	Pune	Junner	35	0	35
	Ahamadnagar	Parner	163	10	173
		Shrigonda	93	1	94
		TOTAL:-	**291**	**11**	**302**
11	Manikdoh Left Bank Canal				
	Pune	Junner	11	2	13
		TOTAL:-	**11**	**2**	**13**
	GRAND TOTAL:-		**3029**	**8463**	**11492**

The total affected area due to water logging ,and soil salinity is 11487 Ha. In Upper Bhima Sub Basin. (K-5 Basin)

11.5 Land Damage Index –

Land Damage Index for command area is defined as percentage ratio of damaged area and irrigable command area.

$$\text{Land Damage Index} = \frac{\text{Damage area in Ha.}}{\text{Irrigable command area in Ha.}} \times 100$$

The damage area (in Ha) in the above definition includes both, Waterlogged area and area affected due to soil salinity. Every year DIRD collects data of damaged area and the land damage index is worked out and monitored. In Upper Bhima Basin, the land damage index of these 7 projects is 2.93%.

11.6 BROAD REASONS OF DAMAGES –

1) Topographical conditions
2) Soil structure
3) Excess irrigation
4) Method of irrigation
5) Encroachment in natural drains
6) Obstruction to natural drains
7) Leakages through canal
8) Water pollution
9) Excessive use of chemical fertilizer

11.7 Specific reasons of damages in this sub basin –

Apart from above common reasons there are special reasons for water logging and salinity which are listed below-

11.7.1 Uncontrolled lifting of water by private and co-operative lifts from the river –

Main Rivers in Upper Bhima Basin, namely Mula-Mutha, Ghod, Bhama,, Nira, Bhima & Indrayani are almost Perennial. Water is released from the storage for drinking purpose to feed the domestic water supply sources. The farmers on both the banks of rivers upto 5 to 10 km lift water from these rivers. Both the banks are fully irrigated, resulting in water logging and salinity of the soil.

11.7.2 Series of KT weirs –

Chain of KT weir is formed at specific interval on shallow rivers like Mula-Mutha, Ghod, Bhama,, Nira, Bhima & Indrayani. On the upstream side of chain of KT weirs, there are large dams. Water is released through these dams for various reasons like drinking, etc. and the KT weirs are filled. The farmers in the vicinity of KT weirs lift the water without any control, resulting in water logging and salinity of the soil.

11.7.3 Water pollution –

Most of the villages and cities in the command, do not have sewage treatment plants. Hence untreated or partially treated effluents, which contains heavy chemicals are emitted directly into the rivers. This water is lifted for irrigation from rivers creates salinity.

11.8 Following remedies are proposed to reduce water logging and salinity-

1) Create awareness among farmers regarding water logging and salinity.
2) Reducing cultivation of perennial crops
3) Cropping pattern of the project should be restricted to approved cropping pattern of the projects
4) Volumetric supply of water as per requirement of the crops
5) Use of straight furrow method of irrigation for sugarcane crops.
6) Use of micro irrigation methods.
7) Crop rotation.
8) Clearing water ways of natural drains.
9) Constructing artificial drains.
10) Conjunctive use of water. (Canal water with ground water).

11.9 Case studies-

The Ujani Project was completed in 1980 and Irrigation commenced during the year 1985. The water logging problem is observed in the command of Ujani Project. Irrigation Research Division, Pune, suggested the remedial measures for reclamation of these waterlogged areas. In Bembale, Magarwadi and Tungat villages of Solapur district in the command of Ujani Project observed 170.00 Ha. Water logged area. The farmers from these villages demanded to reclaim the waterlogged area as the yield and quality of crops has reduced resulting in financial loss. The financial loss as per actual crops grown in command, for these schemes was worked out Rs. 62000/Ha./year i.e. every year it is Rs. 105.40 lakhs. Irrigation Research Division, Pune, has proposed following drainage schemes for reclamation of waterlogged area.

Table -11.3 Drainage schemes under Ujjani Project

Sr No	Name of schemes	Length in KM.	Estimated affected area in Ha.	Estimated cost (in lakhs)	Affected area in 2013-14 in Ha.	Reclaimed area. in Ha.
1	Bemba;e-2	0.90	23	3.00	7	16
2	Bemba;e-3	0.36	11	1.00	4	7
3	Magarwadi-3	1.88	31	12.00	7	24
4	Magarwadi-4	1.94	34	10.00	12	22
5	Tungat	2.81	71	14.00	19	52
	TOTAL	**7.89**	**170**	**40.00**	**49**	**121**

Fig.-1 Land Before Drain Execution

Fig.-2 Land After Drain Execution

These schemes were executed in the year 2008-2010. Gradually the area is reclaiming. In four year 121 Ha. Area is reclaimed. On this reclaimed area, farmers are now growing crops. The yield and quality of crops has improved.

Chapter 12 – Drinking Water (Municipal & Rural)

12.1 INTRODUCTION

All water supply schemes designed for 15 years projected population. As per the availability, Bore wells, Percolation Wells, Percolation Tanks, Dams are the main sources for water supply schemes. Maharashtra Jeevan Pradhikaran, Zilla Parishad and local bodies under takes various types of schemes i.e. Regional/Individual Schemes, Full Deposit Schemes depends upon the requirement of local bodies. As the Govt. of India incorporated Bharat Nirman Programme for drinking water in rural areas. I.e. NRDWP (National Rural Drinking Water Programme.)

There are various type of heads like, UIDSSMT (Urban Infrastructure Development Scheme for Small & Medium Town), MSNA (Maharashtra Sujal Nirmal Abhiyan), NAGROTTHAN etc. to execute the schemes in Urban areas, depends upon the cost of the scheme or requirement of local body. Maharashtra Jeevan Pradhikaran executes the schemes, cost more than Rs. 7.50 crores and the schemes up to Rs. 7.50 crores executed by local Zilla Parishad as per the Govt. resolution. After the successful completion of the one year trial runs all the scheme (individual/regional) handed over to the local body for regular operation and maintenance.

In rural area rate of water supply is 40 to 70 LPCD depends upon the population. In Urban areas the design rate of water supply scheme is 100 LPCD. For the underground drainage system, design rate of water supply scheme is considered as 135 LPCD which is minimum requirement for running the drainage system. All water supply schemes are based on guideline issued by GOI/GOM. All projects have been developed based on sector reforms adopted of GOI/GOM.

Our approach in this respect should therefore be that the local bodies should essentially stick up to the supply norms after fulfillment of the conditions prescribed by CPHEEO Manual. Till the time this is achieved, they should be content with and accept a lower supply rate from the municipal system. In other words the local bodies even for larger towns and cities should manage their present demand with 100 LPCD supply. Concurrently they should take up sewerage schemes and after the schemes are completed (which is a time consuming process) proposals for augmentation of water supply for increasing supply rate from 100 LPCD to 135 LPCD a requisite for sewerage schemes can be initiated. It is possible that this would be resisted by the people at large and also by the local Politicians. However in the larger interest this has to be insisted.

As per the State Water Board guidelines, requirement of rural water is worked @100 LPCD including cattle demand and the Urban Water demand is considered @ 135 LPCD.

Alternative source for the local bodies, such as,

a) Roof rain water harvesting,
b) Recharging /restoring of groundwater,
c) Making best use of local wells which might have been abandoned,

12.2 Coverage of Scheme in the Sub Basin

Sub Basin includes seven districts i.e. Pune, Satara, Sangli, Solapur, Osamanabad, Ahmednagar & Beed & its 42 talukas

Municipal Corporation		-	04 No
Nagar Parishad	A	-	00 No
	B	-	08 No
	C	-	27 No
No of Schemes	Urban	-	28 No
	Rural	-	4084 No

12.3 POPULATION, WATER DEMAND AND SUPPLY –

Estimation of Rural Population – The details of rural area such as the village names, population (Year 2014) and projected population (Year 2030). The population growth rate is depending upon last five decades population. The trend of population growth is reducing due to urbanization as well as due to up-gradation of few villages from Village Panchayat status to Municipal Council level, and therefore the future growth of village population in the villages under Sub Basin K-5 is considered as 16% per decade up-to year 2030.

2) For rural area (villages), the design rate of water supply is at 40 liters/capita/day. The water demand at 100 liters/day/person including live stock. (gross at source) for the year 2030 is considered which includes the system losses and other use and at this rate of supply, the gross annual water demand at the abstraction points would be **518** Mm^3 of ground and surface water.

It is a common experience that villages face water scarcity during summer. It is therefore proposed that every village shall have a storage tank (similar to village tank) to store raw water and its capacity shall be to meet needs for 100 days. This will be in the form of a water bank and would enable villages to tide over the situation during scarcity period the combined grid system, every year.

The details of rural and urban Water Supply Schemes as received from MJP, ZP and other local bodies. The drinking water requirement for urban and rural area is given in following Table-12.1 –The rural water requirement including live stock is considered @ 100 liters/capita/day and the urban water requirement is considered @ 135 liters/capita/day.

TABLE 12.1 -DOMESTIC USE

Category	No. of Schemes	Present Population	Present Water Use (Mm^3)		Population in 2030	Water Requirement (Mm^3) @ 100 Liters/day/ capita for rural & @ 135Liters/day/capita for Urban		
			Surface Water	Ground Water		Surface Water	Ground Water	Total
Urban Councils	28	7916247	730	0	11739408	960	0	960
Rural	4084	8792352	176	153	11338545	285	234	519
Total	**4112**	**16708599**	**906**	**153**	**23077952**	**1245**	**234**	**1479**

Note: In future, the supply rate in rural areas is expected to be adopted as 100 LPCD (which would be inclusive of demand of cattle) and in that case the requirement of water would be **285** Mm3 from surface water and **234** Mm^3 from groundwater. For scarcity purpose, Water requirement of **0.46 Mm3 @ 20** lpcd is assumed

There are 28 Nos. Urban schemes covering their future population **11739408** with total demand of water **960** Mm^3. This requirement will be met with from surface source. Similarly, requirement of rural population **11338545** will also be met from surface & ground source. The total water requirement for domestic purpose as seen from above table is **1059** Mm^3 and future requirement by **2030 is 1479** Mm^3.

12.4 MANAGEMENT OF WATER RESOURCES

The Rural as well as Urban Water Supply Schemes (WSS) are based on lifting the water from some source like irrigation tanks or weirs and supplying water through piped distribution system. At present the water supply is not metered but water meter fixing work is in progress, so in future the supply will be made on meter basis.

To calculate the actual water losses for schemes the water audit is in progress and accordingly the remedies will be done.

Following problems are faced by domestic water supply agencies –

i) The water supply schemes are not self supporting.
ii) The supply is not metered.
iii) Losses are high due to illegal connections/ tapping, leakages in pipes and valves. Local organizations (Gram Panchayat /Municipalities /Corporations) are not willing to take WSS for O&M.
iv) In some areas, there is no sewerage system so much water is used to drain sewage. Also polluted water directly mix in source causing high load on purifying the water.
v) Refusing permissions to use tap water from municipal system for activities like construction of buildings, gardening etc.

TABLE 12.2- STATUS OF COMPLETED WATER SUPPLY SCHEMES

Sr. No.	Sub Basin	Name of District	No. of Rural W.S. Schemes	No. of Urban Schemes
1	K 5	Pune	766	13
		Satara	532	2
		Sangli	257	1
		Solapur	1329	7
		Osmanabad	381	3
		Beed	171	0
		Ahmednagar	648	2
		Total	**4084**	**28**

TABLE 12.3- INCOME AND O&M EXPENDITURE

Sub Basin	Dist	Type of Connections	No.	Rate/No. In Rs. (Av.)	Income (Lakhs)	O&M Expenditure (Lakhs)
K 5	Pune	Domestic	299685	1400	9535	19614
		Commercial	6511	5500		
	Satara	Domestic	56427	1600	667	707
		Commercial	596	4000		
	Sangli & Solapur	Domestic	144928	1350	4810	5269
		Commercial	9047	7559		
	Osmanabad	Domestic	15884	100	163	544
		Commercial	283	600		
	Beed	Domestic	33000	30	11	7
		Commercial	600	100		
	Ahmednagar	Domestic	52265	1800	900	1941
		Commercial	683	6000		
			619909		**16086**	**28082**

12.4.1 FOLLOWING PLANS ARE SUGGESTED

- Total domestic water requirement for the village/town to be worked out based on standard norms. Deduct from it the existing water supply available from the local sources (e.g. Wells, Tanks, etc.)
- Augmenting the existing water sources through watershed development works and deducts it from the total requirement.
- Balance requirement, if any, may be satisfied from the resource available outside of the area.
- Supply should be metered and charged on volumetric basis.
- Training should be provided to operating staff.
- Sewerage system in each area shall be done to avoid water pollutions.
- Recycling of waste water.
- Participation of Local bodies, (e.g. G.P., M.C.s,) for operation and maintenance of water supply scheme.
- While permission for Construction of buildings, roof rain water harvesting should be made compulsory.
- Making best use of local sources (wells, bores ,tanks etc)

12.5 DISTRIBUTION AND MANAGEMENT (O&M)

In urban areas, the distribution of drinking water is through underground pipeline network. The Zonal Elevated Service Reservoirs supply water to the distribution network. Mostly, there is limited time (3 to 4 hours/day) water supply and timing varies from area to area in the city.

There are no sincere efforts from local bodies to minimize the losses but these are about 20% to 30% or may be more in some towns. There is prime need to identify the leakage spots and rectify the leakages regularly. Zone wise water meter should be provided to control uniform distribution of water.

For rural area, previously the water supply is through stand post. There are no water meters and line losses are more but not definitely assessed. Now as per the NRDWP norms, 100% water connections are to be provided.

Assessment of the present situation of the O and M of water in cities / towns reveals:

i) Meters are fixed at source.
ii) Flow meters should be provided as per the zones.
iii) As well as water meters should be provided in distribution system.

12.6 MANAGEMENT PLAN AND INFRASTRUCTURE

i) Survey of leak detection in the distribution system be taken up. In the mean time there should be focus on replacement of old, unserviceable distribution mains.
ii) Installation of ultrasonic flow meters for raw as well as treated water system. Requirement of meters needs to be assessed and provided. In addition adequate staff for measurement and maintenance needs to be provided.
iii) Installation of wireless flow monitoring system for better water supply management has to be adopted. Supervisory Control and Data Acquisition i.e. "SCADA" system to be adopted.
iv) Improve quality of services of old water supply system.
v) Ensure connectivity to 100% area should be tanker free.
vi) Ultimate aim should be to adopt 24 x 7 water supply, In Malkapur town of Satara Dist., such continuous supply is introduced which has shown appreciable improvement in the system and thereby achieved consumers' satisfaction.
vii) a) Supply of water through piped system from source.
    b) Financial management.
    c) Telescopic tariff.
    d) Water Quality Monitoring.

12.7 SPECIAL CONSIDERATION FOR RURAL WATER SUPPLY SCHEMES

It is a common experience that Rural Schemes are not properly operated and maintained. This is observed both in case of individual as well as Regional water supply Schemes. Reasons are however different. In case of individual schemes, apart from source getting dried up, there are un-attended leakages and that electricity bills are not paid which is often the result of poor recovery of water charges.

In case of Regional water supply Schemes, another aspect needs serious consideration. Since electricity bill charges are not paid, the system stops functioning but this is mostly due to differences among villages covered and Apex committee. Sustainability of the schemes is thus in danger. With the result valuable assets remain unutilised and this is a serious case of wastage of assets. There are cases where, instead of finding a solution, New individual schemes are proposed and implemented.This is essentially a sensitive issue but nobody appears to pay any attention.

It is, therefore, suggested that in case of Regional water supply Schemes, the Statewide agency (MJP) shall be involved, which has a long standing experience and technically expertise. This Agency shall take responsibility of supplying water upto the point of bulk supply (Metered) on the village boundary. If required, an underground storage be constructed to store day's requirement. The local body shall be responsible for further pumping and distribution including additional disinfection if required. The statewide agency shall bear all the expenses for bulk supply inclusive of electric bills, so that the system does not stop functioning for non payment of electricity bills. The agency shall fix water charges to recover both the operating charges as well as capital cost.

12.8 RECYCLE & REUSE OF WATER FOR IRRIGATION

In view of recycling of water it is proposed to construct a Sewerage Treatment Plant(STP) in urban areas by which the B.O.D. & C.O.D. can be brought to accepteble limits so that the treated water can be use for irrigation & other purpose.

At the Municipal council area, waste water can be collected from sewerage treatment plant and any other measures available with local body. As per the water supply norms, nearly 80% waste water is proposed for Irrigation & other purpose after recycle and reuse.

In future, out of 80 % of waste water, nearly 40 to 70 % waste water is proposed for recycle and reuse

Hence, additional water that can be made available after recycling for non irrigation & other purpose would be 424.15 Mm^3 by the year 2030. The details of Expected cost of the water after the treatment are given in table 12.4 below,

TABLE 12.4- RECYCLE & REUSE

Dist.		Use of Water for Urban/ Rural & Industries (Mm3)	Return flow expected (80%) (Mm3)	Qty. of water for recycle & Reuse (Mm3)	Investment Cost. Rs. Crores	Remark
Pune	Urban	775	620	212	201	
	Rural	146	117	0	0	
Satara	Urban	3	3	0	0	
	Rural	8	6	0	0	
Sangli	Urban	4	3	2	9	
	Rural	13	10	8	7	
Solapur	Urban	133	106	74	297	
	Rural	200	160	128	103	
Osmanabad	Urban	15	12	0	0	
	Rural	14	11	0	0	
Beed	Urban	0	0	0	0	
	Rural	0	0	0	0	
Ahmednagar	Urban	20	16	0	0	Ahmednagar M.C.
	Rural	0	0	0	0	
Total		**1331**	**1064**	**424**	**617**	

ANNEXEURE :- I – Present Use & Future Requirement of Water

Dist.	Taluka	Purpose			Present use (Mm^3) (2014)	Future Requirement (Mm^3) (2030)
Pune	Junnar Ambegaon Khed Wadgaon Shirur Mulashi Daund Velhe Bhor Purandar Baramati Indapur Haveli	Domestic	URBAN		620	776
			RURAL	MJP	146	192
				ZP		
Satara	Dahiwadi Phalatan Khandala	Domestic	URBAN			
			RURAL	MJP	4	13
				ZP	11	14
Sangali	Atapadi Jat	Domestic	URBAN			
			RURAL	MJP	16	20
				ZP		
Solapur	Sangola Pandharpur Mangalwedha Solapur (S)&(N) Mohol Madha Barshi Karmala Malshiras Akkalkot	Domestic	URBAN			
			RURAL	MJP	213	350
				ZP		
Osmanabad	Osmanabad Tulajapur Washi Paranda Kalamb	Domestic	URBAN			
			RURAL	MJP	9	29
				ZP	7	9
Beed	Ashti Patoda	Domestic	URBAN			
			RURAL	MJP	1	7
				ZP	N.A.	N.A.
Ahmednagar	Parner Shrigonda Karjat Jamkhed Pathardi Ahmednagar	Domestic	URBAN		20	23
			RURAL	MJP		
				ZP	12	44
7 Districts	**42 Taluka's**		**TOTAL**		**1059**	**1477**

ANNEXURE –II RECYCLE AND REUSE OF WATER

Dist	Taluka	Urban / Rural	Use of Water for Urban/ Rural & Industries (Mm3)	Return flow expected (80%) (Mm3)	Qty. of water for recycle & Reuse (Mm3)	Invest ment Cost Rs. Crores
Pune	Junnar Ambegaon Khed Wadgaon Shirur Mulashi Daund Velhe Bhor Purandar Baramati Indapur Haveli	Nagarparishads–(Urban)	775	620	212	201
		Rural –	146	117	0	0
Satara	Dahiwadi Phalatan Khandala	Nagarparishads–(Urban)	3	3	0	0
		Rural –	8	6	0	0
Sangali	Atapadi Jat	Nagarparishads–(Urban)	4	3	2	9
		Rural –	13	10	8	7
Solapur	Sangola Pandharpur Mangalwedha Solapur Mohol Madha Barshi Karmala Malshiras Akkalkot	Nagarparishads–(Urban)	133	106	74	297
		Rural –	200	160	128	103
Osmanabad	Osmanabad Tulajapur Washi Paranda Kalamb	Nagarparishads–(Urban)	15	12	--	--
		Rural –	14	11	--	--
Beed	Ashti Patoda	Nagarparishads–(Urban)	-	-	-	-
		Rural –	-	-	-	-
Ahmednagar	Parner Shrigonda Karjat Jamkhed Pathardi Ahmednagar	Nagarparishads–(Urban)	20	16	-	-
		Rural –		-	-	-
7 Districts	**42 Taluka's**	**Total**	**1331**	**1064**	**424**	**617**

ANNEXURE –III No of W.S. Schemes

Name of Dist.	No of Rural W.S. Schemes	No of Urban W.S. Schemes.
Pune	766	13
Satara	532	2
Sangali	257	1
Solapur	1329	7
Osmanabad	381	3
Beed	171	0
Ahmednagar	648	2
Total	**4084**	**28**

ANNEXURE-IV Income and O.& M. Expenditure

Dist	Taluka	Type of Connections	No.	Rate/No. (Rs.)	Income (Lacs)	O&M Expenditure (Lacs)
Pune	Junnar Ambegaon Khed Wadgaon Shirur Mulashi Daund Velhe Bhor Purandar Baramati Indapur Haveli	Domestic	299685	1400	9535	19614
		Commercial	6511	5500		
Satara	Dahiwadi Phalatan Khandala	Domestic	56427			
					667	707
		Commercial	596			
Sangali	Aatpadi Jat	Domestic	144928	1350		
					4810	5269
		Commercial	9047	7559		
Solapur	Sangola Pandharpur Mangalwedha Solapur Mohol Madha Barshi Karmala Malshiras Akkalkot	Domestic	0	0		
					0	0
		Commercial	0	0		
Osmanabad	Osmanabad Tulajapur Washi Paranda Kalamb	Domestic	15884	100		
					163	544
		Commercial	283	600		
Beed	Ashti Patoda	Domestic	33000	30		
					11	7
		Commercial	600	100		
Ahmed nagar	Parner Shrigonda Karjat Jamkhed Pathardi Ahmednagar	Domestic	52265	1800		
					900	1941
		Commercial	683	6000		
7 Districts	**42 Taluka's**	**Total**	**619909**		**16086**	**28082**

ANNEXURE-V Water Losses from Municipal Corporation

Dist	Taluka	Municipal Corporation/ Nagarparishad	% of Losses Rising Main	Treatment Plant	Distribution	Total
Pune	Junnar Ambegaon Khed Wadgaon Shirur Mulashi Daund Velhe Bhor Purandar Baramati Indapur Haveli	Pune	3%	2%	10%	15%
		PCMC	0%	2%	23%	25%
		Other 11	12%	3%	23%	38%
Satara	Dahiwadi Phalatan Khandala	2	2%	3%	7%	12%
Sangali	Atapadi Jat	8	8%	5%	14%	27%
Solapur	Sangola Pandharpur Mangalwedha Solapur Mohol Madha Barshi Karmala Malshiras Akkalkot	0	0%	0%	0%	0%
Osmanabad	Osmanabad Tulajapur Washi Paranda Kalamb	3	2%	3%	15%	20%
Beed	Ashti Patoda	N.A.	N.A.	N.A.	N.A.	N.A.
Ahmednagar	Parner Shrigonda Karjat Jamkhed Pathardi Ahmednagar	2	2%	3%	15%	20%

ANNEXURE-VI (A) Urban Scheme

Part of Dist. Falling in sub basin K-5)		Population			Cost/ Capita (Rs.) - 2014 (Av.)	Total Cost (Crores)		
Dist	Taluka	2001	2014	2030		2001	2014	2030
Pune	Junnar Ambegaon Khed Wadgaon Shirur Paud Daund Velhe Bhor Purandar Baramati Indapur	3860075	5969654	9264294	6870	1252	1252	3329
Satara	Dahiwadi Phalatan Khandala	71300	77265	87464	9016	44	55	70
Sangali	Atapadi Jat	41447	43436	54710	3600	15	16	20
Solapur	Sangola Pandharpur Mangalwedha Solapur Mohol Madha Barshi Karmala Malshiras	1358542	1423752	1793276	3600	489	513	646
Osmanabad	Osmanabad Tulajapur Washi Paranda	18758	21718	37516	6290	12	14	24
Beed	Ashti Patoda	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Ahmednagar	Parner Shrigonda Karjat Jamkhed Pathardi Ahmednagar	307615	380421	502148	7706	0	152	189
	Total	**5657737**	**7916247**	**11739408**		**1812**	**2002**	**4278**

Taluka	Population			Cost/ Capita (Rs.) -2014	Total Cost (Crores)		
	2001	2014	2030		2001	2014	2030
Junnar Ambegaon Khed Wadgaon Shirur Paud Daund Velhe Bhor Purandar Baramati Indapur	2218303	3460551	4519796	2953	6550	10219	13346
Dahiwadi Phalatan Khandala	586674	772112	1050072	2757	162	213	289
Atapadi Jat	336923	353095	444738	1800	61	64	80
Sangola Pandharpur Mangalwedha Solapur Mohol Madha Barshi Karmala Malshiras	2772412	2905489	3659585	1800	499	523	659
Osmanabad Tulajapur Washi Paranda	0	198847	259502	2100	0	42	55
Ashti	27731	33601	5032	4494	12	15	22
Patoda	108837	125273	145057	13443	146	168	195
Parner Shrigonda Karjat Jamkhed Pathardi Ahmednagar	N.A.	943584	1209763	2800	N.A.	267	339
Total	**6050880**	**8792352**	**11338545**		**7430**	**11511**	**14985**

Chapter -13 Industrial Use

13.1 Introduction - Industries dept is instrumental for development of industries in the state. To speed up the industrial development, Maharashtra Industrial Development Corporation (MIDC) was constituted on August 1, 1962 under the provisions of Maharashtra Industrial Development (MID) Act, 1961. Industrial areas managed by MIDC are located in different parts of the States with major industrial centers at Mumbai, Pune, Aurangabad, Nasik, Nagpur and Kolhapur. These industrial areas have been classified as five star industrial area, major industrial area, minor industrial area and growth centers based on certain criteria. The broad objectives of MIDC are as follows:

• To achieve balanced industrial development of Maharashtra with an emphasis on developing parts and underdeveloped parts of the State

• Infrastructural development of each and every district of Maharashtra and

• Facilitate entrepreneurs in setting up industries at various locations

The MIDC has been declared as an agent of the State Government for carrying out the activities within the framework of the MID Act and the MID Rules. These activities can be divided under following 3 broad categories.

• Acquisition and disposal of land • Provision of infrastructure facilities • Providing of services.

In the context of provision of various services, the Corporation provides water supply services to the units in its industrial areas. The investment on the water supply scheme (Head works) made by MIDC is more than Rs. 1000 Crore with installed capacity of water supply of 1941 Million Liter per Day (MLD).

13.2 Regulation of Water Supply in MIDC Areas

For the purpose of regulating the water supply operations of the Corporation the GoM has prescribed a legal and financial mechanism between them. The salient features of the mechanism are as given below:

• A water supply scheme providing water to more than one industrial area in grid system is termed as centralized water supply scheme, the asset ownership of which remains with the MIDC. On the other hand a water supply scheme catering the need of only one industrial area is termed as localized water supply scheme with asset ownership remaining with Government.

• The water supply made either from centralized or localized water supply scheme is treated as supply made on behalf of Government and the revenue thus collected is shown as revenue accruing to the Government.

• The operating expenditure of centralized water supply scheme is debited to the Corporations account while the operating expenditure of localized water supply scheme is debited to the account of Government through its function agency.

• The Corporation is allocated the portion of the water revenue so as to meet its net operating and other expenses.

• The surplus/deficit accrued after deducting operating expenses for water supply from the water revenues is borne by the Government.

13.3 Majoir Water Consuming Industrial sectors

- ✓ Boiler and Cooling
- ✓ Paper Pulp and Processing
- ✓ Beverages and Food processing
- ✓ Chemicals and Pharmaceuticals
- ✓ Textiles, Jute fiber, Wool Silk etc
- ✓ Repair and Services
- ✓ Washing, Cleaning, Solvent

The details of Water use in various sector is classified as below:

Type of Industry	Water Use Intensity
Manufacture of Food Products	Medium
Manufacture of Beverages, Tobacco & Related Products	High
Manufacture of Cotton Textiles	Low
Manufacture of Wool, Silk and Man – made Fiber Textiles	Low
Manufacture of Jute and other Vegetable Fiber Textiles (except Cotton)	Low
Manufacture of Paper and Paper Products and Printing, Publishing & Allied Industries	High
Manufacture of Leather and Leather Products, Fur & Leather Substitutes	Medium
Manufacture of Basic Chemicals and Chemical Products (Except Products of Petroleum and Coal)	Medium
Manufacture of Rubber, Plastic, Petroleum and Coal Products; Processing of Nuclear Fuels	Low
Manufacture of Non Metallic Mineral Products	Low
Basic Mental and Alloys Industries	Low
Manufacture of Metal Products and parts, except machinery and Equipment	Low
Electricity	Medium
Gas and Steam Generation and Distribution Through Pipes	High

13.4 Present Scenario

Rapid industrialization and urbanization coupled with continuous decline in per capita water availability is putting a lot of pressure on the available water resources. As per the Central Water Commission (India) estimates, the future water requirements for meeting the demands of various sections would be about 1093 BCM for the year 2025 and 1447 BCM for the year 2050. The increasing gap between water availability and demand highlights the need for conservation of water.

All the water supply schemes in designated Industrial are of MIDC are based on efficient Water Use and Conservation Efficient water use means reducing the demand by improving personal habits; reducing wastes; creating an adequate rate schedule; deriving benefits from technical developments as well as from water management techniques, coordinating the management of hydraulic resources with that of the land and economical and social aspects; promoting norms and regulations. In short, efficient water use consists of optimizing water usage. There is absolute efficiency, to use the least amount of water possible; economic efficiency, which seeks to derive maximum economical benefits; social efficiency, which strives to fulfill the needs of the user community; ecological efficiency, which guarantees natural resources \conservation; and institutional efficiency, which qualifies the function of an institution regarding its water related tasks.

13.5 Present use of Water Basin wise:

13.5 (i) - Pune- Baramati Divisions:

Table-13.5 (i).1 – Status of Water for Industries

Sr. No.	Category of Industries	No. of Units	Present Water Use (Mm^3)			Industrial Development in 2030 (No. of Units)	Water req. for Industries in 2030(Mm3)
			Surface Water	Ground Water	Total		
1	Baramati	372			4	750	7
2	Jejuri (Engg.)	210			1	600	1
3	Lonand (Engg.)	39			1	117	3
4	Phaltan (Engg.)	5			1	300	3
5	Kurkumbh	100			3	175	4
6	Indapur	07			0	70	3
7	Pandare	20				32	
	Total	**753**			**10**	**2044**	**21**

Table-13.5 (i).2 – Details of Industries

Sr.No.	Type of Industries	Annual Turnover (in Lacs)	No. of Workers
1	Baramati	437600	34300
2	Engineering (Jejuri)	50000	5000
3	Engineering (Lonand)	40000	4000
4	Engineering (Phaltan)	80000	1000
5	Kurkumbh	2590	10750
6	Indapur	0	0
7	Pandare	425	80
	Total	**610615**	**55130**

a)	Urban Water Supply –	:	Nill
b)	Urban Centers	:	Nill
c)	Total Demand of Urban Area	:	Nill
d)	Rural Areas	:	Nill
e)	Industrial use	:	As above
	Total	:	

13.5 (i).3 RECYCLING & REUSE OF WATER

Table-13.5 (i).3 – Present Use & Future Requirement of Water

Sr. No.	Purpose	Present Use (Mm^3) (2014)	Future Requirement (Mm^3) (2030)
Areas under Baramati Division			
1)	Domestic	0	0
2)	Industrial	10	21
	Total	**10**	**21**

Table- Table-13.5 (i). 4 – Domestic Use

Sr. No.	Use of Water for Urban/ Rural & Industries (Mm^3)	Return flow expected (80%) (Mm^3)	Qty. of water for recycle & Reuse (Mm^3)	Investment Cost Rs. Crores	Remark
Areas under Baramati Division					
1)	Nagarparishads	Nill			
2)	Industries –				
3)	Rural –				
	Total				

Table- Table-13.5 (i).5 – Industrial Water Consumption –

Sector	Average Water consumption in Indian Industry	Globally Best
Areas under Baramati Division	Nill	
Non Agro Based Industries (Auto)		

13.5 (i).6 MANAGEMENT OF WATER RESOURCES

Table-13.5 (i).6 – Status of Industries

Sr. No.	Agro Based Industries	Number	Sr. No.	Non-Agro Based Industries	Number
1	Baramati	4	1	Baramati	368
2	Jejuri	3	2	Jejuri	191
3	Lonand	2	3	Lonand	37
4	Phaltan	0	4	Phaltan	5
5	Kurkumbh	0	5	Kurkumbh	100
6	Indapur	0	6	Indapur	7
	Total	**9**			**708**

Table-13.5 (i).7 – Status of Water Losses in MIDC

Year	Percentage Losses
JEJURI	1.5 %
LONAND	3%
PHALTAN	1.0%
BARAMATI	1.5%

Table-13.5 (i).8 – Agro-based Industries

Sr. No.	Type of Industries	Existing Units	Proposed Additional Units (at District & Taluka places)
1	FOOD PROCESSER (JEJURI)	3	2
2	BREVERIES (LONAND)	2	1
3	PHALTAN	--	--
4	BARAMATI	3	--
5	KURKUMBH	--	--

13.5 (i).9 – PREVENTION OF LOSSES

Table-13.5 (i).9 – Status of Water Losses through Pipe Line

JEJURI

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-12	0.5 %
2)	2012-13	0.5 %
3)	2013-14	0.5 %

LONAND

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-12	1 %
2)	2012-13	1 %
3)	2013-14	1 %

PHALTAN

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-12	0.5 %
2)	2012-13	0.5 %
3)	2013-14	0.5 %

BARAMATI

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-12	8.20 %
2)	2012-13	9.38 %
3)	2013-14	23.56 %

KURKUMBH

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-12	1.28 %
2)	2012-13	1.43 %
3)	2013-14	1.63 %

13.5 (ii) Pimpri Chinchwad Indl. Area:-

13.5 (ii).1: INDUSTRIAL USE:

As per the state water policy 2003, water for industrial use is to be supplied on priority and @ 90 % dependability. Government has already prescribed 10% reservation of water for industrial use on all Irrigation projects. This has already impacted area under Irrigation.

Status of Industrial area in the basin, perspective plan for industrialization, requirement of water for industrial use & Present Sanction and Consumption with source of water is given in the Table 11.2.2 (A), (B), (C). There are large, medium and small scale industries as well as commercial units in Pimpri Chinchwad Industrial Area. The area comprising of @ 1224.12 Ha. is almost fully occupied and there is there still demand for plots.

Table 13.5 (ii).1 (A) Category of MIDC & Sanctioned Water Requirement.

Sr. No.	Name	Category	Area Ha.	Water requirement sanctioned in Mm3 with source
1	Pimpri Chinchwad Indl. Area	A	1224	59 From Pawana Dam.

Various types of industries in the MIDC Pimpri Chinchwad Indl. Areas are listed below.

Tata Motors, Bajaj Auto, Philips India, Thermax Ltd., Formica, Finolex Pipes, KSB Pumps, Mahindra Hinoday.

Also some major industries like Atllas Copco, Alpha Laval, Premier Automobiles, Hindustan Antibiotics Ltd. etc. are also the major consumers of Pimpri Chinchwad water supply scheme. MIDC have developed water supply scheme @ Ravet. The 1st stage of this water works developed in 1975 to capacity 40 MLD. To meet the water requirement of the Industrial Consumers outside this area and to some extent of domestic need. Then it is subsequently augmented to 80 MLD in 1980 and 1984 respectively. Hence total capacity of water supply scheme is 120 MLD. Filter house is constructed in three phases.

Table 13.5 (ii).1 (B) Types of industries in Pimpri Chinchwad Indl. Area MIDC.

Engg	Chemical	Textile	Pharma	Electronics & services	Agro	Total
3563	29	-	-	85	-	3677

The present water use of these industries is to the tune of 18.25 Mm^3 per year against the sanctioned quantum of 19.25 Mm^3 (Ultimate) and for Domestic use to the tune of 27.37 Mm^3 per year against the sanctioned quantum of 30 Mm^3.

The area of industry in the Pimpri Chinchwad industrial area is given in column 3 of Table 11.2.2 (A) & total area put to industrial use is 1224.12 Ha.

Table 13.5 (ii).1 (C) Status of MIDC in the Mula Mutha Sub-Basin.

Name of Industrial Area	Area in Ha.	No. of plots developed	No. of plots alloted	No. of units under production	No. of units on-going projects	Yet to be taken up	Type of Industries
Pimpri Chinchwad, Industrial Area	1224	1902	1784	1700	84	-	Engg. Chemical services,misc.

Small Scale industreis :

There are few small scale industries located outside industrial estates. These are scattered & their water supply requirements are not significant and is made by local Gram panchayats.

Table 13.5 (ii).1 (D) Industrial Investment & Employment Generated

Sr. No.	Activity	Investment Rs. lacs	Employment to	Mandays in lac
1	Industrial units in MIDC	56770.00	170435 souls	--

Map showing the Industrial Area of Mula Mutha sub basin

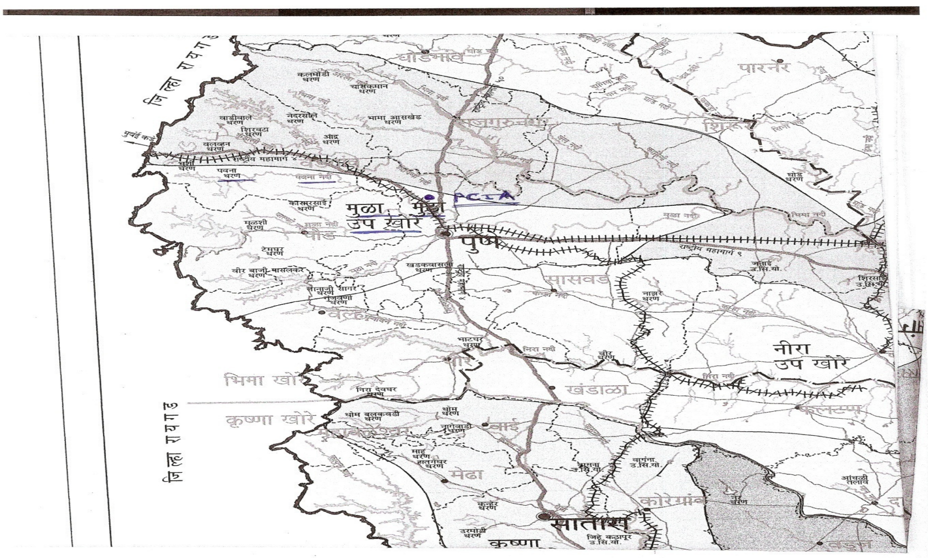


Table 13.5 (ii).1 (E): Industrial Water Requirement and Consumption

Sr. No.	Name of Industrial Area	Reservation of Water Requirement MM^3	Present Water Consumption (Demand for 2014) Mm^3	Source of Water
1	Pimpri Chinchwad Industrial Area	59	46	Pawana River

Table 13.5 (ii).1 (F) : DETAILS OF INDUSTRIES IN THE SUB-BASIN

Industrial Zone/ Location	Location i.e.			Classification of Industry			Total	Type of Industries		Source of water	Industrial Data			Annual Turnover (Rs. in Lakhs)
	Village	Tahsil	District	Major	Medium	Minor		No. of Agro Based	No. of Non Agro Based		Men	Material (prod uction) lacs	Machinery (prod uction) lacs	
Pimpri Chinchwad Industrial Area	Pimpri, Chinchwad, Bhosari, Akurdi	Haweli	Pune	25	3547	105	3677	--	--	Pawana River	170435	--		56770

Table 13.5 (ii).1 (G) – Status of Water for Industries (Pimpri Chinchwad Indl. Area)

Sr. No.	Category of Industries	No. of Units	Present Water Use (Mm^3)			Industrial Development in 2030 (No. of Units)	Water req. for Industries in 2030 (Mm3)
			Surface Water	Ground Water	Total		
1)	Engineering	3563	18 mm3 / year	0.00	18 mm3 / year	3600	19 mm3 / year
2)	Chemical	29		0.00		29	
3)	Electric & Electronics	85		0.00		85	

a)	Urban Water Supply – PCMC & Other consumers	:	28 mm3/yr
b)	Urban Centres	:	NIL
c)	Total Demand of Urban Area	:	NIL
d)	Rural Areas	:	NIL
e)	Industrial use	:	18 mm3/yr
	Total	:	**46 mm^3/yr**

Table 13.5 (ii).1 (H) – Present Use & Future Requirement of Water (Pimpri Chinchwad Indl. Area)

Sr. No.	Purpose	Present Use (Mm^3) (2014)	Future Requirement (Mm^3) (2030)
1)	Domestic	28	30
2)	Industrial	18	19
	Total	**46**	**49**

NOTE :- Future requirement is as per reservation with Irrigation Department.

Table 13.5 (ii).1 (I) – Domestic Use (Pimpri Chinchwad Indl. Area)

Sr. No.	Return flow expected (80%) (Mm^3)	Qty. of water for recycle & Reuse (Mm^3)	Investment Cost Rs. Crores
1)	Nagarparishads– (Urban)	22	15
2)	Industries –	15	10
3)	Rural –	-	-
	Total	**37**	**25**

Table 13.5 (ii).1 (J)– Status of Water Losses in MIDC (Pimpri Chinchwad Indl. Area)

Year	Percentage Losses
2011-2012	19 %
2012-2013	21 %
2013-2014	22 %

13.5 (iii) Ranjangaon Indl. Area :-

13.5 (iii).1 INDUSTRIAL USE : As per the state water policy 2003. water for industrial use is to be supplied on priority and @ 90 % dependability. Government has already prescribed 10% reservation of water for industrial use on all Irrigation projects. This has already impacted area under Irrigation. Status of Industrial area in the basin, perspective plan for industrialization, requirement of water for industrial use & Present Sanction and Consumption with source of water is given in the Table 11.2.2 (A), (B), (C). There are large, medium and small scale industries as well as commercial units in Ranjangaon Industrial Area. The area in phase –I & II comprising of @ 1000.01 Hects is almost fully occupied and there is there still demand for plots.

Table 13.5 (iii).1 (A) Category of MIDC & Sanctioned Water Requirement.

Sr. No.	Name	Category	Area	Water requirement sanctioned in Mm3 with source
1	Ranjangaon I.A. ph-I	C	929 Ha	Combined demand 6.00 mm3 For phase –I & II
2	Ranjangaon I.A. ph-II	C	71 Ha	Combined demand 6.00 mm3 For phase –I & II

The category indicates the level of development in that taluka.A is the most developed.

Presently out of 738 plots carved,528 plots are alloted so far. The water for industries has been sanctioned from Ghod dam to the tune of 6.00 Mm3(Annual) & 9.00 Mm3(ultimate) and the use is @ 17.00MLD i.e.@ 6.20 Mm3 .

Table 13.5 (iii).1 (B) Types of industries in Ranjangaon MIDC.

Sr. No.	Engg	Chemical	Textile	Pharma	Electronics	Misc. Agro	Total
1	216	3	1	3	5	12	240

The present water use of these industries is to the tune of 6.20 Mm3 per year against the sanctioned quantum of 9.00 mm3(Ultimate).

The area of industry in the Ranjangaon industrial area is given in column 3 of Table 11.2.2 (A) & total area put to industrial use is 1000.01Ha. The map on page 398 pinpoints the locations of industrial areas, source of water supply & disposal of used water.

Table 13.5 (iii).1 (C) Status of MIDC in the Sub-Basin.

Sr.No.	Name of Industrial Area	Area in Ha.	No. of plots developed	No. of plots alloted	No. of units under production	No. of units on-going projects	Yet to be taken up	Type of Industries
1	Ranjangaon Industrial Area	1000	718	528	240	243	45	Engg. Chemical sevices,misc/Pharma

Small Scale industreis : There are few small scale industries located outside industrial estates. These are scattered & their water supply requirements are not significant and is made by local Gram panchayats.

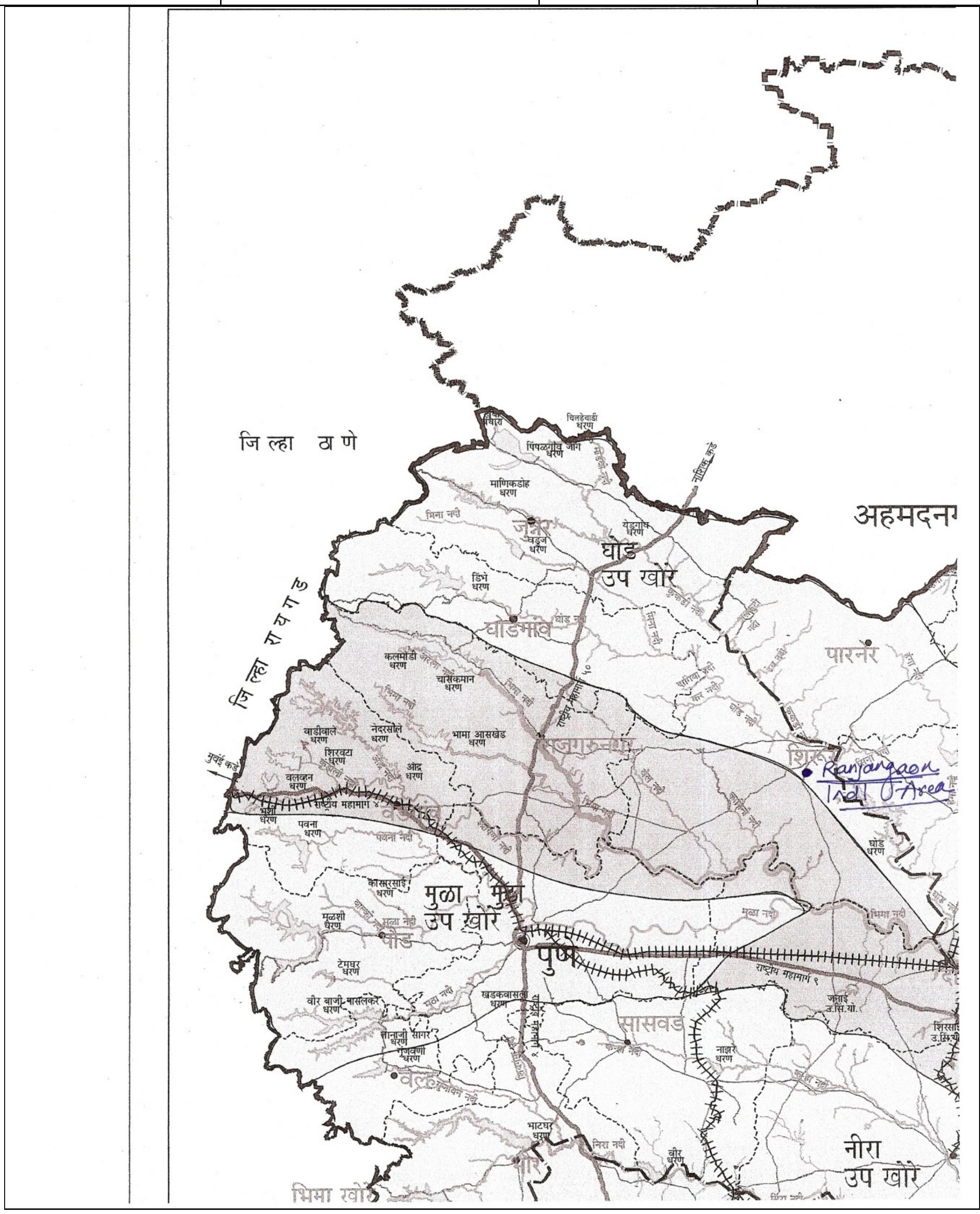
Auto mobile / Engineering Udyog : The Ranjangaon Industrial area is located at @ 65 Km away both from Pune and Ahemadnagar and land is acquired from Karegaon, Kardelwadi,Dhoksangavi and Ranjangaon Ganapati grampanchayat limits.There is a major automobile unit, M/s Fiat and other venders.

Electronics Udyog : There are major electronics units like LG, Whirlpool, Haier etc. where major products are Washing machines, Refrigerators, televisions etc. Poona is the nearest place providing skilled manpower, required for these units.

Pharmaceutical Udyog : There are three pharmaceutical units like Fresinesskabi, Tulip and Murali Krishna. One textile unit like Bombay dying, Apollo tyres, Bekart etc. There are small plots carved for small scale industries as well as for Project Affected Persons (PAP) alongwith commercial plots for Hotel etc.

Industrial Investment & Employment Generated

Activity	Investment Rs. lacs	Employment to	Mandays in lac
Industrial units in MIDC	131000	6000 souls	66



Map showing Industrial Area of Bhima-basin(A-2)

Table 13.5 (iii).1 (D) : Industrial Water Requirement and Consumption

Name of Industrial Area	Reservation of Water Requirement MM^3	Present Water Consumption Mm^3	Source of Water	Remarks
Ranjangaon Industrial Area	9.00	6.20	Ghod dam	Presently only 240 industries are in production.

TABLE 13.5 (iii).1 (E) : DETAILS OF INDUSTRIES IN THE SUB-BASIN

Industrial Zone / Location	Location i.e.			Classification of Industry			Total	Type of Industries		Source of water	Industrial Data			Annual Turnover (Rs. in Lakhs)
	Village	Tahsil	Dist.	Major	Medium	Minor		No. of Agro Based	No. of Non Agro Based		Men	Material (production) lacs	Machinery (production) lacs	
Ranjangaon Industrial Area	Ranjangaon , Karegaon	Shirur	Pune	13	27	200	240	--	--	Ghod River	81761	--		131010

TABLE 13.5 (iii).1 (F): Status of Water for Industries (Ranjangaon Indl. Area)

Sr. No.	Category of Industries	No. of Units	Present Water Use (Mm^3)			Industrial Development	Water req. for
			Surface Water	Ground Water	Total	in 2030 (No. of Units)	Industries in 2030 (Mm3)
1	Engineering	475	5.00	--	5.00	570	7.00
2	Chemical	3	2.00 (Domestic)		2.00 (Domestic)	5	
3	Electronics	5				8	
4	Other i.e. Service industries, Pharmaceuticals etc.	7				15	2.00
	Total		**7.00**		**7.00**		**9.00**

TABLE 13.5 (iii).1 (G) – Present Use & Future Requirement of Water

Sr.No.	Purpose	Present Use (Mm^3) (2014)	Future Requirement (Mm^3) (2030)
1)	Domestic	2.00	2.00
2)	Industrial	5.00	7.00
	Total	7.00	9.00

TABLE 13.5 (iii).1 (H) – Status of Water Losses through Pipe Line **(Ranjangaon Indl. Area)**

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-2012	8
2)	2012-2013	9
3)	2013-2014	8

13.5 (iv) Talegaon Indl. Area:-

13.5 (iv).1 INDUSTRIAL USE: As per the state water policy 2003. water for industrial use is to be supplied on priority and @ 90 % dependability. Government has already prescribed 10% reservation of water for industrial use on all Irrigation projects. This has already impacted area under Irrigation. Status of Industrial area in the basin, perspective plan for industrialization, requirement of water for industrial use & Present Sanction and Consumption with source of water is given in the Table 11.2.2 (A), (B), (C). There are major/medium industries in the sub-basin. Thus there is demand for large quantum of industrial water as there is heavy demand of water for use.

Table 13.5 (iv).1 (A) Category of MIDC & Sanctioned Water Requirement.

Name	**Category**	**Area**	**Water requirement sanctioned in Mm3 with source**
Talegaon Indl. area Phase -I	B	578 Ha	25 Mm3 from Andra dam on river Indrayani. For Talegaon & Chakan Indl area.

Some of the major units are as - General Motors, JCB, L&T, POSCO, INA bearings, Cosma international, Husco hydraulics, etc.

The category indicates the level of development in that taluka.A is the most developed & D is the least developed.

Presently there is development only in Talegaon Indl. Area Phase-I, out of five phases. Regarding other phases of Talegaon Indl. Area, phase-II (@450.00Ha) is likely to be acquired in coming one or two years & phase III to V (@95Ha, 345Ha&365Ha. resp.) are under process of acquisition. Various types of industries in Talegaon indl. Area Ph –I of MIDC, are listed below.

Table 13.5 (iv).1 (B) Types of industries in Talegaon MIDC.

Engg	Chemical	Textile	Pharma	Services	Misc. Agro	Total
27	0	0	0	0	96	123

The present water use of these industries is 2.75 Mm3 per year against the sanctioned quantum of 25.00 Mm3, Which is sanctioned for All five phases of Talegaon indl. Area & four phases of Chakan indl area.

The area of industry in the various industrial areas are given in column 3 of Table 11.2.2 (A) & total area put to industrial use is 1578.00Ha.(Talegaon indl area only). The map on page 398 pinpoints the locations of industrial areas, source of water supply.

Table 13.5 (iv).1 (C) Status of Talegaon MIDC in the Sub-Basin.

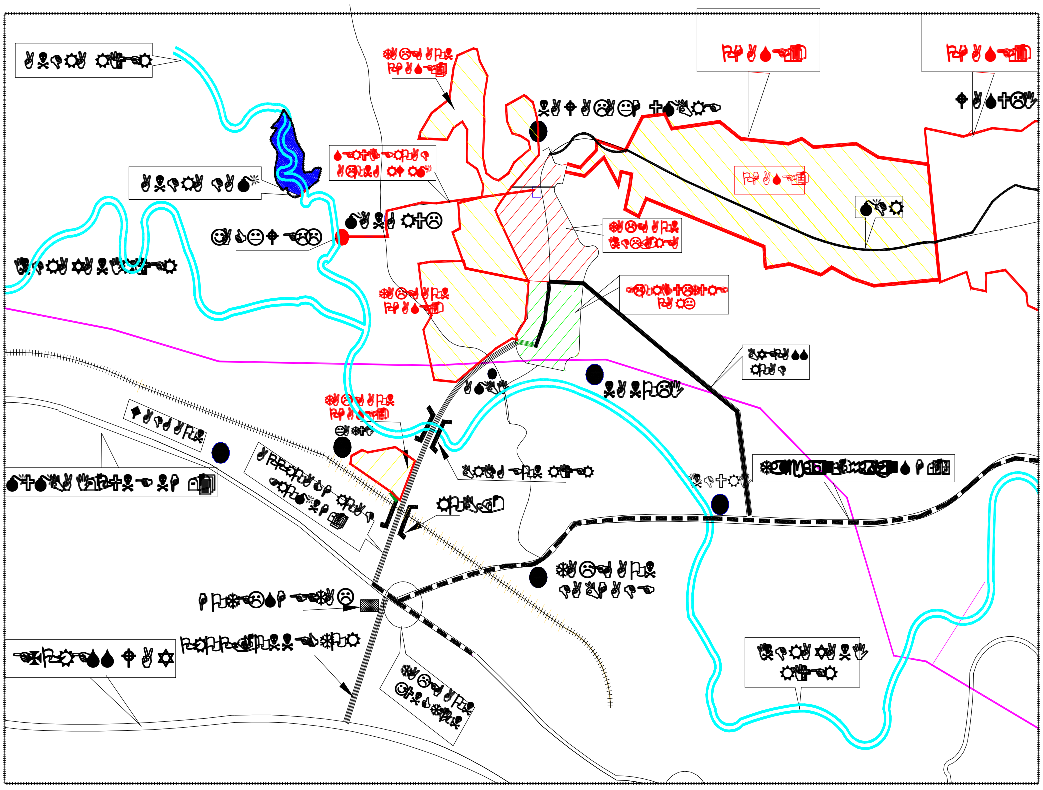
Sr.No.	Name of Industrial Area	Area in Ha.	No. of plots developed	No. of plots alloted	No. of units under production	No. of units on-going projects	Yet to be taken up	Type of Industries
1	Talegaon Indl. area Phase -I	578	123	152	123	11	18	Engineering & agro based.
2	Talegaon Indl. area Phase -II	455	NA	NA	-	-	-	Area yet to be acquired.
3	Talegaon Indl. area Phase -III to V	545	NA	NA	-	-	-	Area yet to be acquired.
Total		**1578**	**123**	**152**	**123**	**11**	**18**	

Source : Talegaon Sub dn. M.I.D.C., Chinchwad..

Table 13.5 (iv).1 (D) Industrial Investment & Employment Generated

Sr.No.	Activity	Investment Rs. lacs	Employment to	Mandays in lac
1	Industrial units in MIDC	107490	5780 souls	21
2	Units outside MIDC but in sub-basin	Information pertains to D.I.C.		
Total		**107490**	**5780**	21

The above information is based on statistical data for year 2013-2014.



Map showing Talegaon Industrial Area & Andra dam.

Table 13.5 (iv).1 (E) : Industrial Water Requirement and Consumption

Sr. No.	Name of Industrial Area	Reservation of Water Requirement MM^3	Present Water Consumption (Demand for 20014 – 15) Mm^3	Source of Water	Remarks
1	Talegaon Industrial Area Ph.- I		3.00	Andra dam	Developed.
2	Talegaon Industrial Area Ph.- II to V	25.00	-	Andra dam	Area yet to t o be acquired.
3	Chakan Industrial Area Ph I to IV		-	Andra dam	-----
	Total	**25**	**3.00**	**-**	

The above information is for Talegaon Industrial area (Existing & proposed) only. Information for Chakan Industrial area needs to be incorporate.

Table 13.5 (iv).1 (F) : DETAILS OF INDUSTRIES IN Talegaon Industrial area Ph-I

Sr. No.	Industrial Zone/ Location	Location i.e.			Classification of Industry			Total	Type of Industries		Source of water	Industrial Data			Annual Turnover (Rs. in Lakhs)
		Village	Tahsil	District	Major	Medium	Minor		No. of Agro Based	No. of Non Agro Based		Men	Material (production) lacs	Machinery (production) lacs	
1	Talegaon Industrial Area Ph.- I	Navlakh Umbre & Ambi	Maval (Vadgaon)	Pune	10	17	96	123	96	27	Andra dam.	5780	-----		107490
2	Talegaon Industrial Area Ph.- II to V	Navlakh Umbre , Ambi , Jadhavwadi, Katvi, etc.	Maval (Vadgaon)	Pune	-	-	-		Area yet to be acquired.			-	-	-	-

3) Table 13.5 (iv).1 (G) Perspective Plan of Industrialization under Andra dam.

Sr. No.	Name of Industrial Area	Proposed Area in Hector	Water Requirement sanctioned MM^3	Source Proposed	*Remarks*
1	Talegaon Industrial Area	1000.00	10.00	Andra Dam	Area yet to be acquired.

Future demand for industrial use :

Data regarding future (projected) demand for industrial use will be depend on acquisition of phases in Talegaon Indl. Area. is presented in the tabular form on Table 11.2.2 (D).

Table 13.5 (iv).1 (H) Industrial Water Requirement under Andra dam in Mm^3

Sr. No.	Name of Industrial Area	Year wise Requirement in Mm^3			Source
		2015	**2020**	**2030**	
I)	Talegaon Industrial Area Ph.- I to V	3.00	7.00	10.00	Andra dam
II)	Chakan Indl. area Ph I to IV	---	---	15.00	Andra dam
Total Water Requirement in Mm3		3.00	7.00	25.00	

The above information is for Talegaon Industrial area (Existing & proposed) only. Information for Chakan Industrial area needs to be incorporate.

Table 13.5 (iv).1 (I) – Status of Water for Industries

Sr. No.	**Category of Industries**	**No. of Units**	**Present Water Use (Mm^3)**			**Industrial Development in 2030 (No. of Units)**	**Water req. for Industries in 2030 (Mm3)**
			Surface Water	**Ground Water**	**Total**		
1	Chakan Industrial Area Non Agro Based Industries (Auto, Auto Spare parts, Engineering)	327	3.00 Source – Andra Dam	0	3.00	2462	14

Table 13.5 (iv).1 (J) – Details of Industries

Sr. No.	Type of Industries	Annual Turnover (in Lacs)	**No. of Workers**
	Chakan Industrial Area - Non Agro Based Industries (Auto, Auto Spare parts, Engineering)	1069328	13295

a)	Urban Water Supply –	:	0
b)	Urban Centres	:	0
c)	Total Demand of Urban Area	:	0
d)	Rural Areas	:	1.00 Mm3 (Grampanchayat)
e)	Industrial use	:	3.00 Mm3
	Total	:	**4.00 Mm3**

Table 13.5 (iv).1 (K) – Present Use & Future Requirement of Water Chakan Industrial Area

Sr. No.	Purpose	Present Use (Mm^3) (2014)	Future Requirement (Mm^3) (2030)
	Chakan Industrial Area		
1)	Domestic	1.00	2.00
2)	Industrial	3.00	14.00
	Total	**4.00**	**16.00**

Table 13.5 (iv).1 (L) – Domestic Use

Sr. No.	Use of Water for Urban/ Rural & Industries (Mm^3)	Return flow expected (80%) (Mm^3)	Qty. of water for recycle & Reuse (Mm^3)	Investment Cost Rs. Crores	Remark
	Chakan Industrial Area				
1)	Nagarparishads (Urban)	0	0		
2)	Industries –	2.00	0.30	11.00	The recycle & reuse scheme is to be implemented by industries
3)	Rural –	1.00	0		
	Total	**3.00**	**0.30**	**11.00**	

Table 13.5 (iv).1 (M) – Industrial Water Consumption –

Sector	Average Water consumption in Indian Industry	Globally Best
Chakan Industrial Area		
Non Agro Based Industries (Auto, Auto Spare parts, Engineering)	15 Cum/Hector/day	

Table 13.5 (iv).1 (N) – Status of Water Losses in MIDC

Year	Percentage Losses
2011-12	19 %
2012-13	21 %
2013-14	22 %

Note : Losses mentioned are for centralised water supply Scheme at Pimpri Chinchwad I. A.

Table 13.5 (iv).1 (O) – Status of Water Losses through Pipe Line

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-12	19 %
2)	2012-13	21 %
3)	2013-14	22 %

Note : The losses are mentioned are for centralized water supply scheme at Pimpri Chinchwad I. A.

13.5 (v) - RGIP Hinjawadi Indl. Area

Table-13.5 (v) .1 – Status of Water for Industries (RGIP Hinjawadi Indl. Area)

Sr. No.	Category of Industries	No. of Units	Present Water Use (Mm^3)			Industrial Development	Water req. for
			Surface Water	Ground Water	Total	in 2030 (No. of Units)	Industries in 2030 (Mm3)
1	IT Industries	75	4.00		4.00	150	5.00
2	Biotech Industries	5				40	
3	Other	10	1.00		1.00	20	5.00

a)	Urban Water Supply –	:	
b)	Urban Centres	:	
c)	Total Demand of Urban Area	:	10.00
d)	Rural Areas	:	
e)	Industrial use	:	
	Total	:	**10.00**

Table-13.5 (v) .2 – Present Use & Future Requirement of Water

Sr. No.	Purpose	Present Use (Mm^3) (2014)	Future Requirement (Mm^3) (2030)
1)	Domestic	4.00	5.00
2)	Industrial	1.00	5.00
	Total	5.00	10.00

Table-13.5 (v) .3 – Status of Water Loss through Pipe line

Sr. No.	Year	Water Loss through Pipe Line (%)
1)	2011-2012	7
2)	2012-2013	6
3)	2013-2014	7

13.5 (vi) IT Division Pune

Sr. No.	Name of Industrial Area	Type of Industries	Annual Turnover (in lacs)	No. of workers
1	Rajiv Gandhi Infotech Park Ph-I @ Hinjawadi	IT Industriy	152009	67749
2	Rajiv Gandhi Infotech Park Ph-II @ Hinjawadi		183653	61843
3	Rajiv Gandhi Infotech Park Ph-III @ Hinjawadi		105503	6963
4	Talawade Software Technology Park		317758	12138
5	Kharadi Knowledge Park.		224139	9490
	Total		**983062**	**158183**

13.6 RECYCLING MANAGEMENT& REUSE OF WATER

Appropriate Water conservation is needed, not only to restore the fast deteriorating eco-system but also to meet the inevitable emergency of shortage even for drinking and domestic water in the near future. Water management basically aims at matching demand and supply. The strategies for water management may be either demand oriented or supply oriented. Water resources are theoretically "renewable" through hydrological cycle. However, what is renewable is only the quantity, but pollution after all types of uses by humans, contamination, have affected the water quality and reduced the amount of 'usable water'. Better water management practices especially in urban areas by industries, municipal uses and domestic uses can reduce the demand appreciably, in addition to minimizing pollution of surface and groundwater resources.

In Maharashtra there are many industries which require huge quantities of water & can be termed Water Intensive Industries. Specifically in textile processing sector, chemical sector, many industries are most water polluting industries and release large quantities of Waste Water creating pollution problem. Since environmental pollution control norms are getting stricter day by day, it is Sensible to treat waste water not just to meet environmental norms for discharge, but to treat and make it for reuse as process water in industries. Ideal before the industries should be zero allotment by recycling and reusing all water.

This will reduce load not only on fresh water requirement, but will also reduce pollution. Now based on new technology, there should be long term plan to formulate strategy for water recycle and reuse.

Industries are using new technique of wastewater treatment method like, ion exchange, coagulation / cavigulation/ solvent extraction, membrane separation and cavitations etc.

Some of the important action plans towards the industrial sectors are the following:
• Modernizing of industrial process to reduce water requirement.
• Setting-up of norms for water budgeting.
• Recycling water – especially re-circulating cooling system.
• Proper processing of effluents by industrial units to adhere to the norms for disposal.
• Rational pricing of industrial water requirement to ensure consciousness / action for adopting water saving technologies.

. Water rates should act as economic instrument to induce the industrialists to treat, recycle and reuse the effluent.

13.7 Water Conservation and Management Possibilities -

It is imperative that users from all sectors of water use, stakeholders including state and central governments, agencies, institutions, organizations, NGOs, municipalities, village panchayats, public -sector undertakings and other agencies providing services to the users, may need to be involved for making integrated and continuous efforts for creating mass awareness towards importance of saving and conservation of water, and duties and responsibilities of individuals as well as organizations and institutions towards judicious and optimal use of water. Some of the possible ways for water conservation in industries and domestic and municipal uses are briefly described below (CWC Report, 2005).
Use of recycled water.

In case of big establishments like hotels, large offices and industrial complexes, community centers etc. dual piped water supply may be insisted upon. Under such arrangement, one supply may carry fresh water for drinking, bathing and other human consumptions whereas recycled water from second line may be utilized for flushing of human solid wastes. Similarly, water harvesting through storing of water runoff including rainwater harvesting in all new buildings on plots of 100 sq.m and above may be made mandatory.

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Integrated Basin Plan for Krishna Basin

Legal Issues

Preamble:

1. Krishna is the second largest river in the peninsular India. The river Krishna rises in the western ghats at an altitude of 1337 meters just north of Mahabaleshwar about 64 Km. from the Arabian Sea and flows from west to east through the States of Maharashtra, Karnataka and Andhra Pradesh before falling in the bay of Bengal near Vijaywada. The major tributaries of Krishna are Koyna, Warna, Panchganga, Dudhganga, Ghatprabha, Malprabha, Bhima, Tungbhadra, Musi, Palleru and Maneru. The Government of India had appointed Krishna Godavari Commission in 1961 to review the position of availability of supplies in Krishna and Godavari rivers. Krishna Godavari Commission divided the Krishna basin into 12 sub-basins and designated them from K1 to K12, which designations have since been followed by Tribunals adjudicating water disputes.

First Krishna Water Disputes Tribunal (KWDT-I):

2. Maharashtra and Mysore, two of the three basin States had filed complaints with the Central Government under the the Inter State River Water Disputes Act, 1956 (ISRWD Act) and demanded constitution of a Tribunal to adjudicate the water disputes. After the efforts to resolve the disputes through negotiations and discussions failed, the Central Government on 10th April 1969,constituted the Krishna Water Disputes Tribunal under the Chairmanship of Justice R. S. Bachawat. The Bachawat Tribunal forwarded its Report under section 5(2) of the ISRWD Act to Government of India on 24th December 1973 and the further Report under section 5(3) of ISRWD Act, on 27th May 1976. Upon publication of the decision of the Tribunal by the Government of India in the Official Gazette

on 31st May 1976, the decision became binding on three States Maharashtra, Karnataka and Andhra Pradesh. The final order of Bachawat Tribunal is attached as **Annexure-I.**

3. KWDT-I distributed 75% dependable basin flow of 2060 TMC and likely return flow of 70 TMC, aggregating 2130 TMC among the States. The share of Maharashtra was 585 TMC. The Bachawat Tribunal distributed this 2130 TMC water in three States as below:

Sr.	State	Allocation from Dependable Flow	Allocation from Return flow	Total Allocation
1	Maharashtra	560	25	585
2	Karnataka	700	34	734
3	Andhra Pradesh	800	11	711
	Total	2060	70	2130

4. Andhra Pradesh has plans of diverting 80 TMC of Godavari water into Krishna Basin from Polavaram Project across river Godavari. By virtue of Inter - State agreements between Andhra Pradesh, Maharashtra and Karnataka (agreements collectively attached as **Annexure-II**), upon clearance by the Central Water Commission to Polavaram Project in Andhra Pradesh, Maharashtra has become entitled to use additional 14 TMC water in Krishna basin at 75% dependability.

5. Maharashtra, by another inter State agreement between Karnataka, Andhra, and Tamilnadu (agreement attached as **Annexure-III**) – has agreed to make available 5 TMC from its allocation at 75% dependability for water supply to Chennai City.

Thus, the allocation of Maharashtra in 75% dependable flows of river Krishna now stands at 594 TMC (585 + 14 – 5).

Restrictions imposed on Maharashtra by KWDT-I:

6. The following restrictions were imposed by KWDT-I on use by Maharashtra of Krishna waters:

(a) Not to use more than 7 TMC in Ghataprabha (K-3) sub basin. (Clause IX)

(b) Not to use more than 95 TMC from the main stream of river Bhima. (Clause IX)

(c) Not to divert more than 67.5 TMC from upper Krishna (K-1) sub basin for power generation. (Clause X)

(d) Not to divert more than 54 TMC in any year, and more than 213 TMC in any consecutive five years from upper Bhima (K-5) sub basin. (Clause X)

(e) Not to divert any water outside the basin except specifically permitted above. (Clause X)

Provisions of Review:

7. The KWDT-I in Clause XIV (A) of its final order provided for review of its decision by a competent Tribunal, at any time after 31st May 2000.

Second Krishna Water Disputes Tribunal (KWDT-II)

8. All the Krishna basin States filed their respective complaints under ISRWD Act to the Government of India in 2002-2003 and requested for constitution of Tribunal for adjudication of water disputes, including review of the decision of the previous Tribunal.

9. The Central Government constituted the second Krishna Water Disputes Tribunal (KWDT-II) on 02/04/2004 under the Chairmanship of Justice Brijesh Kumar. The KWDT-II forwarded its Report under section 5(2) of the Inter State River Water Disputes Act, 1956 (ISRWD Act) to Government of India on 30th December 2010 and the further Report under section 5(3) of ISRWD Act, on 29th November 2013. The final order of KWDT-II is attached as **Annexure-IV**.

10. The final decision of KWDT-II has not been notified by the Central Government in the Official Gazette as the Reports are under challenge before the Supreme Court by the States of Andhra Pradesh and Karnataka. As such the decision of KWDT-II is not yet implementable.

Salient features of the Decision of KWDT-II:

11. The following are salient features of the decision of KWDT-II.

(a) Allocations made by KWDT-I have been maintained;

(b) Water has been freshly assessed at dependabilities of 65% & average, and available flows in excess of allocations already made have been allocated;

(c) Allocations in respect of basin states in TMC are as follows:

Dependability	75% (KWDT-I)	65% Dependable Flow			Average	
State		Addit-ional	Mini-mum Flow	Total	Addit-ional	Total
1. Maharashtra	585	43	3	631	35	666
2. Karnataka	734	61	7	806	105	907
3. Andhra Pradesh	811	43	6	856	145	1005
Total	2130	147	16	2293	285	2578

(d) Regulating body named "Krishna Water Decision-Implementation Board" would be constituted to regulate and oversee the use of water by the States.

(e) Ten daily rule curves in respect of all water resources projects to be got approved from KWD-IB, and use to be made in accordance with such approved rule curves;

(f) Written, prior no objection certificate form KWD-IB has been made mandatory before taking up any new project.

(g) Volumetric measurement of storage and use of water has been made mandatory for all projects, including minor irrigation projects.

Restrictions imposed on Maharashtra:

12. KWDT-II has maintained the restrictions imposed by KWDT-I in years where availability is equal to or less than 75% dependable flow (Basin availability 2130 TMC). The following relaxations have been made

in years of excess availability, and restrictions on use of additional allocation have been imposed.

(a) Not to use more than 98 TMC in a 65% dependable year, and 123 TMC is an average year from the main stream of river Bhima. (Clause X- 1.(a))

(b) Not to divert more than 92.5TMC in a 65% dependable year from upper Krishna (K-1) sub basin for power generation. (Clause X- 1.(b))

(c) Not to use more than 628 TMC in a 65% dependable year, and 663 TMC in an average year. (Clause X- 1.(c))

(d) New projects for using allocation made by KWDT-II (43 TMC at 65% dependability and 35 TMC at average or 57.9% dependability) shall not - (i) use water in non scarcity / DPAP area, and (ii) divert water from one sub basin to another. (Clause X- 1.(e)(i)&(ii))

Use of Water Post Implementation of KWDT-II Decision:

13. Two of the most significant provisions made by KWDT-I in respect of storage of water and measurement of use of water have been changed by KWDT-II by the special provisions made in Clause IX of its Final Order specifying the manner of drawal of allocations by the States. The original provisions in the decision of KWDT-I were the following.

1. KWDT-I provided in Clause XIII of its Final Order that the use of minor irrigation projects would be derived from the areas of crops irrigated by applying agreed district-wise duties.

Thus volumetric accounting of the water stored in minor irrigation projects (tanks, weirs etc.) was not necessary.

2. KWDT-I provided in Clause VII of Final Order that mere storage of water would not be counted as use of water. It provided that the diversion of water from the river would be reckoned as use.

3. KWDT-I further provided in Clause VII of Final Order that the use of water for domestic / municipal supply and industrial supply would be accounted for at 20% and 2.5% respectively, of the quantum of water actually diverted for the said purposes.

14. The effect of these provisions taken together was that the water stored in minor irrigation projects of Maharashtra could be used without any volumetric accounting. Secondly, Maharashtra could legitimately plan projects to impound water far in excess of its planned consumptive use by citing need of water for domestic and industrial supplies.

Manner of Use Specified by KWDT-II:

15. KWDT-II has laid down in great detail the manner in which the allocations are to be used by the respective States in future. A supervisory monitoring body to be known as "Krishna Water Decision – Implementation Board" is to be constituted to oversee the use of water in the basin and ensure that no State uses water in excess of its allocation. An upper State would be entitled to use its allocation at lesser dependability (say 65%) only after the lower States have received adequate flows to realise their allocation at the next higher dependability (75%). In order that

the board is able to take timely decision regarding the use to be permitted, the data about storage and use of water on all projects (major, medium and minor) is required to be furnished on daily basis to the board by all the States.

16. While laying down the manner of use KWDT-II has made the following changes in provisions made by KWDT-I.

1. Volumetric accounting of water has been made mandatory for even minor projects.

2. For the purpose of regulating use of water in terms of its decision, KWDT-II has provided that water stored shall be counted as use.

17. Because of these changes Maharashtra at any point of time in a water year will not be able to store water in excess of its allocation in that water year less the use already made in that water year.

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CHAPTER VII

216 The Final Order set forth in Chapter XVI of the Original Report Vol. II pages 776-800 modified in accordance with the explanations given by the Tribunal under section 5(3) of the Inter-State Water Disputes Act, 1956 is given below :—

Final Order of the Tribunal

The Tribunal hereby passes the following Order :—

Clause I

This Order shall come into operation on the date of the publication of the decision of this Tribunal in the Official Gazette under section 6 of the Inter-State Water Disputes Act, 1956.

Clause II

The Tribunal hereby declares that the States of Maharashtra, Karnataka and Andhra Pradesh will be free to make use of underground water within their respective State territories in the Krishna river basin.

This declaration shall not be taken to alter in any way the rights, if any, under the law for the time being in force of private individuals, bodies or authorities.

Use of underground water by any State shall not be reckoned as use of the water of the river Krishna.

217 **Clause III**

The Tribunal hereby determines that, for the purpose of this case, the 75 per cent dependable flow of the river Krishna up to Vijayawada is 2060 T.M.C.

The Tribunal considers that the entire 2060 T.M.C. is available for distribution between the States of Maharashtra, Karnataka and Andhra Pradesh.

The Tribunal further considers that additional quantities of water as mentioned in sub-Clauses A(ii), A(iii), A(iv), B(ii), B(iii), B(iv), C(ii), C(iii) and C(iv) of Clause V will be added to the 75 per cent dependable flow of the river Krishna up to Vijayawada on account of return flows and will be available for distribution between the States of Maharashtra, Karnataka and Andhra Pradesh.

Clause IV

The Tribunal hereby orders that the waters of the river Krishna be allocated to the three States of Maharashtra, Karnataka and Andhra Pradesh for their beneficial use to the extent provided in Clause V and subject to such conditions and restrictions as are mentioned hereinafter.

Clause V

(A) The State of Maharashtra shall not use in any water year more than the quantity of water of the river Krishna specified hereunder :—

(1) as from the water year commencing on the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette up to the water year 1982-83. 218

560 T.M.C.

(ii) as from the water year 1983-84 up to the water year 1989-90
560 T.M.C. plus

a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisations for irrigation in the Krishna river basin during the water years 1975-76, 1976-77 and 1977.78 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(iii) as from the water year 1990-91 up to the water year 1997-98
560 T.M.C. plus

a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisations for irrigation in the Krishna river basin during the water
years 1982-83, 1983-84 and 1984-85 from its own projects using 3 T.M.C. or 219
more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(iv) as from the water year 1998-99 onwards 560 T.M.C. plus
a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisation for irrigation in the Krishna river basin during the water years 1990-91, 1991-92 and 1992-93 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(B) The State of Karnataka shall not use in any water year more than the quantity of water of the river Krishna specified hereunder :—

(i) as from the water year commencing on the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette up to the water year 1982-83.

700 T.M.C.

(ii) as from the water year 1983-84 up to the water year 1989-90
700 T.M.C. plus

a quantity of water equivalent to 10 per cent of the excess of the average of the 220
annual utilisations for irrigation in the Krishna river basin during the water years 1975-76. 1976-77 and 1977-78 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(iii) as from the water year 1990-91 up to the water year 1997-98
700 T.M.C. plus

a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisations for irrigation in the Krishna river basin during the water years 1982-83, 1983-84 and 1984-85 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(iv) as from the water year 1998-99 onwards 700 T.M.C. plus
a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisation for irrigation in the Krishna river basin during the water

years 1990-91, 1991-92 and 1992-93 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

221 (C) The State of Andhra Pradesh will be at liberty to use in any water year the remaining water that may be flowing in the river Krishna but thereby it shall not acquire any right whatsoever to use in any water year nor be deemed to have been allocated in any water year water of the river Krishna in excess of the quantity specified hereunder :—

(i) as from the water year commencing on the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette up to the water year 1982-83.

800 T.M.C.

(ii) as from the water year 1983-84 up to the water year 1989-90 800 T.M.C. plus a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisations for irrigation in the Krishna river basin during the water years 1975-76, 1976-77 and 1977-78 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

222 (iii) as from the water year 1990-91 up to the water year 1997-98 800 T.M.C. plus a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisations for irrigation in the Krishna river basin during the water years 1982.83, 1983-84 and 1984-85 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(iv) as from the water year 1998-99 onwards 800 T.M.C. plus a quantity of water equivalent to 10 per cent of the excess of the average of the annual utilisation for irrigation in the Krishna river basin during the water years 1990-91, 1991-92 and 1992-93 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(D) For the limited purpose of this Clause, it is declared that—

(i) the utilisations for irrigation in the Krishna river basin in the water year 1968-69 from projects using 3 T.M.C. or more annually were as follows :—

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From projects of the State of Maharashtra	..	61.45 T.M.C.
From projects of the State of Karnataka	..	176.05 T.M.C.
From projects of the State of Andhra Pradesh	..	170.00 T.M.C.

(ii) annual utilisations for irrigation in the Krishna river basin in each water year after this Order comes into operation from the projects of any State using 3 T.M.C. or more annually shall be computed on the basis of the records prepared and maintained by that State under Clause XIII.

(iii) evaporation losses from reservoirs of projects using 3 T.M.C. or more annually shall be excluded in computing the 10 per cent figure of the average annual utilisations mentioned in sub-Clauses A(ii), A(iii), A(iv), B(ii), B(iii), B(iv), C(ii), C(iii), and C(iv) of this Clause.

Clause VI

Beneficial use shall include any use made by any State of the waters of the river Krishna for domestic, municipal, irrigation, industrial, production of power, navigation, pisciculture, wild life protection and recreation purposes.

Clause VII

(A) Except as provided hereunder a use shall be measured by the extent of 224
depletion of the waters of the river Krishna in any manner whatsoever including losses of water by evaporation and other natural causes from man made reservoirs and other works without deducting in the case of use for irrigation the quantity of water that may return after such use to the river.

The water stored in any reservoir across any stream of the Krishna river system shall not of itself be reckoned as depletion of the water of the stream except to the extent of the losses of water from evaporation and other natural causes from such reservoir. The water diverted from such reservoir by any State for its own use in any water year shall be reckoned as use by that State in that water year.

The uses mentioned in column No. 1 below shall be measured in the manner indicated in column No. 2.

Use	Measurement
Domestic and municipal water supply.	By 20 per cent of the quantity of water diverted or lifted from the river or any of its tributaries or from any reservoir, storage or canal.
Industrial use	By 2.5 per cent of the quantity of water diverted or lifted from the river or any of its tributaries or from any reservoir, storage or canal.

(B) Diversion of the waters of the river Krishna by one State for the benefit 225
of another State shall be treated as diversion by the State for whose benefit the diversion is made.

Clause VIII

(A) If in any water year any State is not able to use any portion of the water allocated to it during that year on account of the non-development of its projects or damage to any of its projects or does not use it for any reason whatsoever, that State will not be entitled to claim the unutilised water in any subsequent water year.

(B) Failure of any State to make use of any portion of the water allocated to it during any water year shall not constitute forfeiture or abandonment of its share of water in any subsequent water year nor shall it increase the share of any other State in any subsequent water year even if such State may have used such water.

Clause IX

As from the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette

(A). Out of the water allowed to it, the state of Maharashtra shall not use in any water year —

(i) more than 7 T.M.C. from the Ghataprabha (K-3) sub-basin. 226

(ii) more than the quantity of water specified hereunder from the main stream of the river Bhima.

(a) as from the water year commencing on the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette upto the water year 1989-90.

90 T.M.C.

(b) as from the water year 1990-91.

95 T.M.C.

(B). Out of the water allocated to it the State of Karnataka shall not use in any water year—

(i) more than the quantity of water specified hereunder from the Tungabhadra (K-8) sub-basin

(a) as from the water year commencing on the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette up to the water year 1982-83.

295 T.M.C.

(b) as from the water year 1983-84 up to the water year 1989-90

227 295 T.M.C. plus

a quantity of water equivalent to 7 ½ per cent of the excess of the average of the annual utilisations for irrigation in the Krishna river basin during the water years 1975-76, 1976-77 and 1977-78 from its own projects using 3 T.M.C. or more annually over the utilisations from such irrigation in the water year 1968-69 from such projects.

(c) as from the water year 1990-91 up to the water year 1997-98

295 T.M.C.

a quantity of water equivalent to 7 ½ per cent of the excess of the average of the annual utilisations for irrigation in the Krishna river basin during the water years 1982-83, 1983-84 and 1984-85 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

(d) as from the water year 1998-99 onwards 295 T.M.C. plus

228 a quantity of water equivalent to 7 ½ per cent of the excess of the average of the annual utilisation for irrigation in the Krishna river basin during the water years 1990-91, 1991-92 and 1992-93 from its own projects using 3 T.M.C. or more annually over the utilisations for such irrigation in the water year 1968-69 from such projects.

For the limited purpose of this sub-Clause, it is declared that—

The utilisations for irrigation in the Krishna river basin in the water year 1968-69 from projects of the State of Karnataka using 3 T.M.C. or more annually shall be taken to be 176.05 T.M.C.

Annual utilisations for irrigation in the Krishna river basin in each water year after this Order comes into operation from the projects of the State of Karnataka
229 using 3 T.M.C. or more annually shall be computed on the basis of the records prepared and maintained by that State under Clause XIII.

Evaporation losses from reservoirs of projects using 3 T.M.C. or more annually shall be excluded in computing the 7 ½ per cent figure of the average annual utilisations mentioned above.

(ii) more than 42 T.M.C. from the Vedavathi (K-9) sub-basin and
(iii) more than 15 T.M.C. from the main stream of the river Bhima.
(C) Out of the water allocated to it, the State of Andhra Pradesh shall not use in any water year—
(i) more than 127 T.M.C. from the Tungabhadra (K-8) sub-basin and more than 12.5 T.M.C. from the Vedavathi (K-9) sub-basin.
(ii) more than 6 T.M.C. from the catchment of the river Kagna in the State of Andhra Pradesh.

(D) (i) The uses mentioned in sub-Clauses (A), (B) and (C) aforesaid include evaporation losses.

(ii) The use mentioned in sub-Clause (C) (i) does not include use of the water flowing from the Tungabhadra into the river Krishna.

(E) (1) The following directions shall be observed for use of the water available for utilisation in the Tungabhadra Dam in a water year— **230**

(a) The water available for utilisation in a water year in the Tungabhadra Dam shall be so utilised that the demands of water for the following Projects to the extent mentioned below may be met :—

(i) Tungabhadra Right Bank Low Level Canal .. 52.00 T.M.C.

Water available for Tungabhadra Right Bank Low Level Canal shall be shared by the States of Karnataka and Andhra Pradesh in the following proportion :

State of Karnataka	22.50
State of Andhra Pradesh	29.50

(ii) Tungabhadra Right Bank High Level Canal—Stages I and II .. 50.00 T.M.C.

Water available for Tungabhadra Right Bank High Level Canal shall be shared by the States of Karnataka and Andhra Pradesh in the following proportion :

State of Karnataka	17.50
State of Andhra Pradesh	32.50

(iii) Tungabhadra Left Bank Low Level and High Level Canals .. 102.00T.M.C.

(iv) Raya and Basavanna Channels of the State of Karnataka .. 7.00T.M.C.

(v) Assistance by way of regulated discharges to Vijayanagar Channels other than Raya and Basavanna Channels of the State of Karnataka .. 2.00 T.M.C.

(vi) Assistance by way of regulated discharges to the Rajolibunda Diversion Scheme for use by the States of Karnataka **231** and Andhra Pradesh in the proportion mentioned in Clause XI (C) .. 7.00T.M.C.

(vii) Assistance by way of regulated discharges to the Kurnool-Cuddapah Canal of the State of Andhra Pradesh.. 10.00T.M.C.

230.00T.M.C.

The utilisations of the Projects mentioned in sub-Clauses (a)(i). (ii) and (iii) above include the evaporation losses in the Tungabhadra Dam Which will be shared in accordance with Clause XI(D).

(b) If, in any water year, water available for utilisation in the Tungabhadra Dam is less than the total quantity of water required for all the Projects as mentioned above, the deficiency shall be shared by all the Projects proportionately. The proportions shall be worked out after excluding the evaporation losses.

(c) If, in any water year, water available for utilisation is more than the total quantity of water required for all the Projects as mentioned above, the requirements for all the Projects for the month of June in the succeeding water year as estimated by the Tungabhadra Board or any authority established in its
232 place shall be kept in reserve and the State of Karnataka shall have the right to utilise the remaining water in excess of such reserve in the Tungabhadra Dam for its Projects mentioned in sub-Clauses (a)(i), (ii) and (iii) above drawing water from that dam even though thereby it may cross in any water year the limit on the utilisation of water from Tungabhadra (K-8) sub-basin placed under Clause IX(B) of the Final Order but in no case such utilisation shall exceed 320 T.M.C.

(d) The balance water, if any, shall be kept stored in the dam for use in the next year.

(2) The working tables for the utilisation of the water in the Tungabhadra Dam shall be prepared as hithertofore by the Tungabhadra Board or any other authority established in its place so as to enable the States of Karnataka and Andhra Pradesh to utilise the water available for utilisation in the Tungabhadra Dam as aforesaid.

(3) If in any water year, either of the two States of Karnataka and Andhra Pradesh finds it expediet to divert the water available to it in the Tungabhadra Dam for any one of its Projects to any other of its Project or Projects mentioned above for use therein, it may give notice thereof to the Tungabhadra Board or any other authority established in its place and the said Board or authority may, if
233 it is feasible to do so, prepare or modify the working table accordingly.

(4) The States of Karnataka and Andhra Pradesh may use the water available in the Tungabhadra Dam in accordance with the aforesaid provisions and nothing contained in Clause V shall be construed as overriding the provisions of Clause IX(E) in the matter of utilisation of the water available in the Tungabhadra Dam nor shall anything contained in Clause IX(E) be construed as enlarging the total allocation to the State of Karnataka or as enlarging the limit of acquisition of any right by the State of Andhra Pradesh in the waters of the river Krishna.

(5) The States of Karnataka and Andhra Pradesh may by agreement, without reference to the State of Maharashtra, alter or modify any of the provisions for the utilisation of the water available in the Tungabhadra Dam mentioned above in any manner.

Clause X

(1) The State of Maharashtra shall not out of the water allocated to it divert or permit the diversion of more than 67.5 T.M.C. of water outside the Krishna river basin in any water year from the river supplies in the Upper Krishna (K-l) sub-basin for the Koyna Hydel Project or any other project.

Provided that the State of Maharashtra will be at liberty to divert outside the **234**
Krishna river basin for the Koyna Hydel Project water to the extent of 97 T. M. C. annually during the period of 10 years commencing on the 1st June, 1974 and water to the extent of 87 T.M.C. annually during the next period of 5 years commencing on the 1st June, 1984 and water to the extent of 78 T.M.C. annually during the next succeeding period of 5 years commencing on the 1st June, 1989.

(2) The State of Maharashtra shall not out of the water allocated to it divert or permit diversion outside the Krishna river basin from the river supplies in the Upper Bhima (K-5) sub-basin for the Projects collectively known as the Tata Hydel Works or any other project of more than 54.5 T.M.C. annually in any one water year and more than 213 T.M.C. in any period of five consecutive water years commencing on the 1st June, 1974.

(3) Except to the extent mentioned above, the State of Maharashtra shall not divert or permit diversion of any water out of the Krishna river basin.

Clause XI

(A) This Order will supersede—

(i) the agreement of 1892 between Madras and Mysore so far as it related to the Krishna system ;

(ii) the agreement of 1933 between Madras and Mysore so far as it related to the Krishna river system ; **235**

(iii) the agreement of June, 1944 between Madras and Hyderabad ;

(iv) the agreement of July, 1944 between Madras and Mysore so far as it related to the Krishna river system ;

(v) the supplemental agreement of December, 1945 among Madras, Mysore and Hyderabad ;

(vi) the supplemental agreement of 1946 among Madras, Mysore and Hyderabad.

Copies of the aforesaid agreements are appended to the Report of the Tribunal.

(B) The regulations set forth in Annexure ' A' (1) to this Order regarding protection to the irrigation works in the respective territories of the States of Karnataka and Andhra Pradesh in the Vedavathi sub-basin be observed and carried out. *

(1) Annexure ' A' mentioned above is the same as Annexure ' A' to the Final Order appearing at pages 792 to 794 of Vol. II of the Report.

236 (C) The benefits of utilisations under the Rajolibunda Diversion Scheme be shared between the States of Karnataka and Andhra Pradesh as mentioned herein below :—

Karnataka 1.2 T.M.C.

Andhra Pradesh—15.9 T.M.C.

(D) The reservoir loss of Tungabhadra reservoir shall be shared equally by the works of the State of Karnataka on the left side and the works on the right side of the reservoir. The half share of the right side in the reservoir loss shall be shared by the States of Andhra Pradesh and Karnataka in the ratio of 5.5 to 3.5.

Clause XII

The regulations set forth in Annexure ' B' (1) to this Order regarding gauging and gauging sites in the Krishna river system be observed and carried out.

Clause XIII

(A) Each State shall prepare and maintain annually for each water year complete detailed and accurate records of—

(a) annual water diversions outside the Krishna river basin.

(b) annual uses for irrigation works using less than 1 T.M.C. annually.

237 (c) annual uses for irrigation from all other projects and works.

(d) annual uses for domestic and municipal water supply.

(e) annual uses for industrial purposes.

(f) annual uses for irrigation within the Krishna river basin from projects using 3 T.M.C. or more annually.

(g) areas irrigated and duties adopted for irrigation from irrigation works using less than 1 T.M.C. annually.

(h) estimated annual evaporation losses from reservoirs and storages using 1 T.M.C. or more annually.

(i) formulae used and co-efficient adopted for measuring discharges at project sites.

Each State shall send annually to the other States a summary abstract of the said records.

The said records shall be open to inspection of the other States through their accredited representatives at all reasonable times and at a reasonable place or places.

(B) The records of gauging mentioned in Annexure ' B' to this Order shall be open to inspection of all the States through their accredited representatives at all reasonable times and at a reasonable place or places.

(1) Annexure ' B' mentioned above is the same as Annexure ' B' to the Final Order appearing at pages 795 to 800 of Vol. **II of the Report.**

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Clause XIV 238

(A) At any time after the 31st May, 2000, this Order may be reviewed or revised by a competent authority or Tribunal, but such review or revision shall not as far as possible disturb any utilisation that may have been undertaken by any State within the limits of the allocation made to it under the foregoing Clauses

(B) In the event of the augmentation of the waters of the river Krishna by the diversion of the waters of any other river, no State shall be debarred from claiming before any authority or Tribunal even before the 31st May, 2000 that it is entitled to a greater share in the waters of the river Krishna on account of such augmentation nor shall any State be debarred from disputing such claim

Clause XV

Nothing in the Order of this Tribunal shall impair the right or power or authority of any State to regulate within its boundaries the use of water, or to enjoy the benefit of waters within that State in a manner not inconsistent with the Order of this Tribunal

Clause XVI

In this Order,

(a) Use of the water of the river Krishna by any person or entity of any nature whatsoever within the territories of a State shall be reckoned as use by that State 239

(b) The expression "water year" shall mean the year commencing on 1st June and ending on 31st May

(c) The expression "Krishna river" includes the main stream of the Krishna Iyer, all its tributaries and all other streams contributing water directly or indirectly to the Krishna river

(d) The expression " T M C " means thousand million cubic feet of water

Clause XVII

Nothing contained herein shall prevent the alteration amendment or modification of all or any of the foregoing clauses by agreement between the parties or by legislation by Parliament

Clause XVIII

(A) The Governments of Maharashtra, Karnataka and Andhra Pradesh shall bear their own costs of appearing before the Tribunal The expenses of the Tribunal shall be borne and paid by the Governments of Maharashtra Karnataka and Andhra Pradesh in equal shares These directions relate to the reference under Section 5(1) of the Inter-State Water Disputes Act, 1956

(B) The Government of India and the Governments of Maharashtra, Karnataka and Andhra Pradesh shall bear their own costs of appearing before the Tribunal 240
in the references under Section 5(3) of the said Act The expenses of the Tribunal in respect of the aforesaid references shall be borne and paid by the Governments of Maharashtra, Karnataka and Andhra Pradesh in equal shares.

ANNEXURE "C"

ANNEXURE I—GODAVARI

SUMMARY RECORD OF THE DISCUSSIONS OF THE MEETING HELD BETWEEN THE CHIEF MINISTERS OF KARNATAKA AND ANDHRA PRADESH AT BANGALORE ON 4TH AUGUST 1978

The following were present :—

KARNATAKA

1. Sri D. Devraj Urs, Chief Minister
2. Sri N. Narasimha Rau, Chief Secretary
3. Sri J. C. Lynn, Secretary to Chief Minister
4. Sri B. C. Angadi, Special Secretary, P.W. & E. Deptt. (Irrigation).
5. Sri S. R. S. Sastry, Chief Engineer, W. R. D. O.
6. Sri B. Subramanyam, Chief Engineer, Bangalore Water Supply and Sewerage Board.

ANDHRA PRADESH

1. Dr. M. Chennareddy, Chief Minister
2. Sri G. V. Sudhakara Rao, Irrigation Minister
3. Sri M. Gopalakrishnan, Secretary, Irrigation & Power
4. Sri B. Gopalakrishna Murthy, Adviser, Irrigation & Power
5. Sri K. R. Chudamani, Adviser, Irrigation & Power
6. Sri M. Satyanarayana Singh, Special Officer, Water Resources

After discussion, the following points were agreed to :

Andhra Pradesh and Karnataka agree that Karnataka would, in addition to its existing utilisation above the proposed Singur project in the Manjra sub-basin and the utilisation for Karanja and Chulkinala projects, as per the agreement of 17-9-1975 read with the agreement of 19-12-1975 utilise one TMC of water more for lift irrigation from the Manjra river.

2. In order to utilise this quantity or any other additional quantity that may be agreed to later, on the Manjra, Karnataka may put up such pondage as may be necessary and as may be agreed to between Andhra Pradesh and Karnataka to utilise one TMC or such additional agreed quantities as may become available for this purpose.

3. Andhra Pradesh and Karnataka agree that Karnataka may utilise 2.5 (two point five) TMC of water in the Manjra sub-basin in its territory in the catchment below Nizamsagar project.

4. Andhra Pradesh and Karnataka agree that Andhra Pradesh may go ahead with the construction of the Singur project, as proposed by Andhra Pradesh, with the maximum capacity of 30 TMC of gross storage with FRL/MWL of plus 523.6 metres (1717.41 ft.) above MSL.

5. Karnataka will take necessary action to acquire any land or structure that may be submerged and/or affected under Singur project and Andhra Pradesh agrees to bear the cost of acquisition, the cost of rehabilitation of the displaced families and the cost of construction of bridges and roads that may become necessary. Such acquisition and rehabilitation shall be as per the norms prevailing in Karnataka at the time of acquisition/rehabilitation. Karnataka also agrees to the submergence of the river bed and its stream-beds.

6. In the event of Andhra Pradesh developing hydro-electric power at Singur Project, Karnataka and Andhra Pradesh agree to share the cost and benefits of such power in such proportion as may be agreed upon.

7. (a) Subject to the clearance of Polavaram Project by the Central Water Commission for FRL/MWL plus 150 ft. the State of Andhra Pradesh agrees that a quantity of 80 TMC at 75 percent dependability of Godavari waters from Polavaram project can be diverted into Krishna river above Vijayawada Anicut displacing the discharges from Nagarjunasagar Project for Krishna Delta, thus enabling the use of the said 80 TMC for projects upstream of Nagarjunasagar.

(b) The States of Andhra Pradesh and Karnataka agree that the said quantity of 80 TMC shall be shared in the proportion of Andhra Pradesh 45 TMC, Karnataka and Maharashtra together 35 TMC.

(c) Andhra Pradesh agrees to submit the Polavaram project report to Central Water Commission within three months of reaching an over-all agreement on Godavari waters among the five-party States.

(d) Andhra Pradesh agrees to bear the cost of diversion fully.

(e) Maharashtra and Karnataka are at liberty to utilise their share of 35 TMC mentioned in sub-para 7(b) above from the date of clearance of the Polavaram Project by Central Water Commission with FRL/MWL of plus 150 ft. irrespective of the actual diversion taking place.

(f) It is also agreed that if the diversion at 75 percent dependability as stated in clause (a) above exceeds the said quantity of 80 TMC due to diversion of Godavari waters from the proposed Polavaram Project into Krishna river, further diminishing the releases from Nagarjunasagar project such excess quantity shall also be shared between the three States in the same proportion as in sub-clause (b) above.

MR. S. CHAUDHURI
of Counsel for the
State of Karnataka

MR. P. RAMACHANDRA REDDY
Advocate General for the
State of Andhra Pradesh

ANNEXURE II—KRISHNA

SUMMARY RECORD OF THE MEETING HELD BETWEEN THE CHIEF MINISTERS OF KARNATAKA AND ANDHRA PRADESH AT BANGALORE ON 4TH AUGUST, 1978

The following were present :—

KARNATAKA

1. Sri D. Devraj Urs,
   Chief Minister
2. Sri N. Narasimha Rau,
   Chief Secretary.
3. Sri J. C. Lynn,
   Secretary to
   Chief Minister
4. Sri B. C. Angadi
   Special Secretary,
   P.W. & E. Dept. (Irrigation)
5. Sri S. R. S. Sastry,
   Chief Engineer, W.R.D.O.
6. Sri B. Subramanyam
   Chief Engineer,
   Bangalore Water Supply
   & Sewerage Board.

ANDHRA PRADESH

1. Dr. M. Chennareddy,
   Chief Minister
2. Sri G. V. Sudhakara Rao,
   Irrigation Minister
3. Sri M. Gopalakrishnan,
   Secretary,
   Irrigaton & Power
4. Sri B. Gopalakrishna Murthy
   Adviser,
   Irrigation & Power
5. Sri K. R. Chudamani,
   Adviser,
   Irrigation & Power
6. Sri M. Satyanarayana Singh,
   Special Officer
   Water Resources.

After discussion, the following points were agreed to :—

Karnataka and Andhra Pradesh agree that Andhra Pradesh would go ahead with the proposed Jurala Project with FRL/MWL of plus 1045 feet above MSL in Krishna basin.

2. Karnataka will take necessary action to acquire any lands or structures that may be submerged and/or affected under Jurala Project and Andhra Pradesh agrees to bear the cost of acquisition, the cost of rehabilitation of the displaced families and the cost of construction of bridges and roads and cost of protection or shifting of temples and other religious shrines that may become necessary as decided by Karnataka. Such acquisition and rehabilitation shall be as per the norms prevailing in Karnataka at the time of acquisition/rehabilitation. Karnataka also agrees to the submergence of river bed and stream beds.

3. Karnataka and Andhra Pradesh also agree that in the event of Andhra Pradesh generating power from this project, the cost and benefits of hydro-power will be shared equally between the two States. The question of what would constitute the cost of hydro-power was not discussed and will be agreed upon separately.

MR. S. CHAUDHURI
of Counsel for the
State of Karnataka.

MR. P. RAMACHANDRA REDDY
Advocate General for the
State of Andhra Pradesh

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ANNEXURE "D"

GODAVARI

PROCEEDINGS OF THE MEETING BETWEEN THE CHIEF MINISTERS OF ANDHRA PRADESH AND ORISSA AT HYDERABAD ON THE 15TH OF DECEMBER 1978

The following were present :—

ANDHRA PRADESH

1. Dr. M. Channa Reddy, Chief Minister.
2. Sri G. Rajaram, Minister for Finance and Power.
3. Sri G. V. Sudhakar Rao, Minister for Major Irrigation & Commercial Taxes.
4. Sri I. J. Naidu, IAS, Chief Secretary.
5. Sri S. R. Rama Murthy, IAS, Secretary to Chief Minister.
6. Sri P. Ramachandra Reddy, Advocate General.
7. Sri C. N. Shastry, IAS, Secretary, Irrigation and Power.
8. Sri M. Gopalakrishnan, IAS, Secretary, Primary & Secondary Education.
9. Dr. N. Tata Rao, Chairman, A.P.S.E.B.
10. Sri Satyanarayan Singh, Special Officer, Water Resources.
11. Sri D. V. Sastry, Advocate.

ORISSA

1. Sri Nilamani Routroy, Chief Minister.
2. Sri Pratap Chandra Mohanty, Minister for Revenue & Power.
3. Sri Prahllad Mallik, Minister for Irrigation.
4. Sri B. M. Patnaik, Advocate General.
5. Sri B. Ramadorai, IAS, Secretary, Irrigation & Power.
6. Sri A. K. Biswal, Secretary to Chief Minister.
7. Sri S. C. Tripathy, Chief Engineer, Irrigation.
8. Sri B. Mishra, Chief Engineer, Electricity.
9. Sri M. L. Lath, Executive Engineer, Irrigation.

After full discussions, the following agreement was reached :

I. G-11 *Indravati sub-basin* :

The State of Orissa can utilise its share of water in G-11 Indravati sub-basin in terms of the Inter State agreement dated 19-12-1975 affirming the bilateral agreement dated 9-12-1975 between the States of Orissa and Madhya Pradesh.

II. G-12 *Sabari sub-basin* :

(A) The State of Orissa can use all the water of the river Sabari (Kolab) upto the point (at near about Lat. 18°-55'-04"N and Long. 82°-14'-53"E) where the river Sabari forms the common boundary between the State of Orissa and the State of Madhya Pradesh in terms of the Inter-state Agreement dated 9-12-1975, Clause V.

(B) The States of Orissa and Andhra Pradesh agree for utilisation of all waters upto the following project sites on the tributaries and sub-tributaries of the river Sabari (Kolab) by the State of Orissa.

(i) Govindapalle Project on :—

(a) Dharmgedda nalla site near Lingiyaput village Lat. 18°-36′-07″N. and Long. 82°-16′-11″E.

(b) Jamnadi site near Govindpalli village Lat. 18°-36′-13″N, and Long. 82°-16′-48″E.

(c) Garianadi site near Deraguda village. Lat. 18°-34′-03″N, and Long. 82°-17′-18″E.

(ii) Satiguda Project site on the tributary of Potteruvagu.
Lat. 18°-18′-57″N. and Long. 81°-56′-24″E.

(iii) Parasanapalle project site on the tributary of Sabari near village Parasanapalli.
Lat. 18°-16′-44″N. and Long. 81°-36′-44″E.

(iv) Potteru project site on Potteruvagu near Surliuknta village.
Lat. 18°-12′-30″N. and Long. 82°-01′-30″E.

(C) The State of Orissa, in addition to the uses as specified in clauses II(A) and II(B) above, can use 40 Tmc., for its existing, under construction and proposed project/schemes each using not more than 1.5 Tmc., annually.

(D) Downstream of the point where the Sabari forms the common boundary between the States of Orissa and Madhya Pradesh (at near about Lat. 18°-55′-04″N and Long. 82°-14′-53″E.) and upto the confluence of the Sileru and the Sabari, the State of Orissa, can use not more than 27 tmc., for irrigation by withdrawals from the main river for its existing, under construction and proposed schemes/projects.

(E) The quantum of water to meet the evaporation losses of project under clause II D and power projects across the Sabari by the States of Madhya Pradesh and Orissa in terms of clause V of bilateral agreement dated 9-12-1975 between Orissa and Madhva Pradesh will be in addition to the quantum specified in clauses II A, B, C & D above and shall be shared in such proportion as the said two States may agree. However the share of Orissa in excess of 10 T.M.C. in the evaporation losses mentioned above shall b met from its quantum specified in clauses II A, B, C & D above.

(F) The States of Orissa and Andhra Pradesh shall utilise the Sileru river waters in terms of :

(a) 1946 Agreement between the Governments of Madras and Orissa regarding development of Hydro-electric power at Dudma falls on the Machkund river.

(b) Final agreement between the Governments of Orissa and Andhra Pradesh in relation to the use of the waters of the Sileru river dated the 4th September, 1962.

(c) Any other subsequent agreement/agreements that the two States of Orissa and Andhra Pradesh may mutually conclude in future.

(d) All use of water for beneficial purpose by the States of Orissa and Andhra Pradesh for their existing, under construction and proposed schemes/projects upstream of Machkund Project the total utilisation under which shall not exceed 2 TMC by each State will be charged to their respective shares at Machkund correspondingly reducing their respective share of power at Machkund & Dudma falls. Similarly, use under Schemes/projects which shall not exceed 2 TMC by each State downstream of Machkund project and upstream of Balimela Dam, will be charged to their respective shares at Balimela dam project reducing their respective shares of water by the total quantity used both above Machkund project and between Machkund and Balimela project. All such use should be intimated to the other Government.

(e) Notwithstanding any restriction imposed under the past agreements, the State of Orissa will be permitted to utilise not exceeding 2 TMC of Sileru water for beneficial use downstream of Balimela dam for its existing, under construction and future projects out of the yield of the catchment lying down-stream of Balimela dam project. This quantity will be out of 40 TMC as specified in Clause II(C) above.

(G) The State of Orissa agrees for the construction of Lower Sileru Irrigation scheme with FRL +235 ft. and MWL +262 ft. by the State of Andhra Pradesh, which involves some submergence in the State of Orissa. The State of Andhra Pradesh shall bear the cost of compensation for submergence of land and properties both of the Government as well as private parties that may be agreed to. The provision of rehabilitation of the oustees will be made as per the norms in vogue in the State of Orissa at the time of construction of the project.

(H) The State of Andhra Pradesh can, subject to agreement dated 7-8-1978, use the remaining waters in the Sabari Sub-basin excluding Sileru river vide clause F above for the existing, under construction and proposed schemes/projects after the uses by the State of Orissa for projects/Schemes as specified in Clauses I & II A to E above.

(I) The States of Orissa and Andhra Pradesh agree for the construction of Polavaram Project of the State of Andhra Pradesh, so that the maximum submersion in the State of Orissa territory at Motu/Konta does not exceed R.L. +150 ft. due to all effects including back water effect. The Polavaram project shall be designed for the maximum probable flood in consultation with the Central Water Commission so as not to exceed the limit of submergence mentioned above. For the submerged lands and properties both of the Government as well as private parties, the cost of compensation and rehabilitation on the basis of the norms in vogue in the State of Orissa at the time of the construction of the projects shall be charged to the project. Model villages with facilities/amenities etc. shall be constructed at the cost of the project before the submergence actually takes place.

The sovereignty over the land shall continue to vest with the respective States. The State of Orissa can lift 5 Tmc from the Polavaram lake, without bearing any cost of the storage for its use in the territory and this use shall be reckoned against the allocation made to that State as specified in clause II bove. The State of Orissa can transport their forest or mineral produce through all navigational facilities/lock etc.; which shall be provided, by the State of Andhra Pradesh at its own cost at Polavarm. These facilities will be available to the State of Orissa at the Polavaram Project at the rates applicable to the State of Andhra Pradesh for their own cargo at Polavaram. The State of Orissa can develop and exploit pisciculture and boating facilities in their own territory. The States are agreeable to the level of R.L +150 feet for Polavaram storage as defined above only on the express conditions that any of the provisions, facilities and liberties given for utilisation of waters of the Godavari and its tributaries, to each other in this Agreement herein above or here under are not at all disturbed.

III. *General clauses* :

(1) (a) The State of Orissa may vary the location of sites of projects using more than 1.5 Tmc., annually which have been specifically mentioned in the above clauses by informing the lower State/States. If as a result of shifting or alteration in the case of any such specified sites upto which a State has been permitted to use all the water more or less catchment area than what is indicated in the above clauses is intercepted, a corresponding reduction/increase will be made in the catchment area of other specified sites, so that the total catchment area allowed for each State for interception of all the water is not exceeded.

(b) It is also agreed that with respect to projects as specified in clauses I & II above if there is a marginal increase of utilisation over 1.5 TMC, but not exceeding 2 TMC, for each project, such increase may be permitted by mutual consultation between the States concerned and the lower Riparian State/States, provided that the total utilisation as specified in each of the said clauses is not exceeded by the concerned State.

(2) In the above agreement, wherever specified quantities of the water has been mentioned as permitted use by any States it is agreed the use shall be measured in the manner indicated below :

Use	*Measurement*
(i) Irrigation use.	100 per cent of the quantity diverted or lifted from the river or any of the tributaries/or from any reservoir, storage or canal and 100 percent of evaporation losses in these storages.
(ii) Power use.	100 per cent of evaporation losses in the storage.
(iii) Domestic and Municipal water supply within the basin.	By 20 per cent of the quantity of water diverted or lifted from the river or any of its tributaries or from any reservoir, storage or canal.
(iv) Industrial use within the basin.	By 2.5 per cent of the quantity of water diverted or lifted from the river or any of its tributaries or from any reservoir or storage or canal.
(v) All uses outside the basin.	100 per cent of the quantity diverted or lifted from the river or any of the tributaries or from any reservoir, storage or canal.

(3) It is agreed that in using the waters permitted to each State in the above agreement no State can construct a project other than those already specifically agreed to submerging the territory of another State/States, without prior consent and acceptance by mutual discussions by that State for such submergence.

(4) It is agreed that all the States can make use of underground water within their respective State territories in the Godavari basin and such use shall not be reckoned as use of the water of the river Godavari.

(5) The sub-basins referred to in this agreement are according to the division of Godavari basin into sub-basins made in the report of the Krishna Godavari Commission in Chapter-III paragraph 4.27 at page 28.

(6) Use shall include any use, made by any State of waters of the river Godavari and its tributaries or domestic, municipal, irrigation, industrial, production of power, navigation, pisciculture, wild life protection, recreation purposes and evaporation losses from the storages created for the above purposes.

(7) All the levels mentioned in the clauses above are with reference to G.T.S. levels.

Sd/-
(DR. M. CHANNA REDDI)
Chief Minister,
Andhra Pradesh

Sd/-
(NILAMANI ROUTROY)
Chief Minister,
Orissa

ANNEXURE "E"

ANNEXURE I

B. C. ANGADI
Special Secretary to Government
Irrigation Department

VIDHAN SOUDHA, BANGALORE
dated 29th January 1979

D.O. No. PWD 25 BRA 78

DEAR SHRI DEUSKAR,

Sub :—Agreement between Maharashtra and Karnataka regarding Godavari waters distribution.

In confirmation of our telephonic talks during the last week, I have to state that we agree that :

(a) 35 TMC of water in Krishna, which is the share of Karnataka and Maharashtra out of 80 TMC of Godavari diversion by the State of Andhra Pradesh from Polavaram Barrage, shall be shared between Karnataka and Maharashtra as under :—

Karnataka	21 TMC
Maharashtra	14 TMC

(b) Karnataka had requested for at least 1 TMC of Manjra waters upstream of Nizamsagar from the share allocated to Maharashtra. Maharashtra has expressed its inability to spare this water. Karnataka accepts that position in the interest of arriving at an agreement.

(c) A copy of this letter with your confirmation to it may be filed before the Godavari Tribunal on 2-2-1979.

Kindly confirm the above points as agreed on telephone.

Yours sincerely,
Sd/-
(B. C. ANGADI)
29-1-1979

Shri V. R. DEUSKAR
Secretary to Government,
Irrigation Department,
Government of Maharashtra,
Mantralaya,
Bombay-400 032.

ANNEXURE II

V. R. DEUSKAR,
Secretary to Government

D.O. No. ISW 5179 KG
Irrigation Department.
Mantralaya, Bombay-400 032.
Camp : New Delhi.
Dated the 30th January 1979

Sub : Agreement between Maharashtra and Karnataka regarding Godavari waters distribution...

Ref : Your D.O. letter No. PWD 25 BRA 78 dated 29th January 1979.

Dear Shri Angadi,

In confirmation of our telephonic talk during the last week and with reference to your above D.O. letter, the points as agreed between the two States mentioned in your letter are hereby confirmed subject to the following understanding :—

> The present ratio of sharing of 35 TMC viz. 14 to Maharashtra and 21 to Karnataka shall not be applicable to any additional water that would become available by virtue of Andhra Pradesh diverting water in excess of 80 TMC.

We may authorise our Counsel before Godavari Water Disputes Tribunal to draw up an agreement in a proper form in terms of our understanding reached between the two States and file it before the Godavari Tribunal.

Yours sincerely,
Sd/-
(V. R. DEUSKAR)

Shri B. C. ANGADI,
Special Secretary,
Irrigation Department,
Government of Karnataka
Bangalore.

ANNEXURE III

B. C. ANGADI,
Special Secretary to Government,
Irrigation Department.

VIDHANA SOUDHA, BANGALORE
Dated the 31st January 1979

D.O. No. PWD 25 BRA 78
Dear Shri Deuskar,

Sub : Agreement between Maharashtra and Karnataka regarding Godavari waters distribution.

I received your D.O. letter No. ISW 5179-KG, dated 30-1-1979 through telex, confirming our telephonic talk and points agreed between the two States as mentioned in my D.O. letter No. PWD 25 BRA 78, dated 29th January 1979.

2. I further agree that the following condition mentioned in your above letter, namely that—

> "The present ratio of sharing 35 TMC viz. 14 to Maharashtra and 21 to Karnataka shall not be applicable to any additional water that would become available, by virtue of Andhra Pradesh diverting water in excess of 80 TMC."

should form part of the agreement which should be drawn up and filed before the Tribunal.

Yours sincerely,
Sd/-
(B. C. ANGADI)

Shri V. R. DEUSKAR,
Secretary to Government,
Irrigation Department,
Government of Maharashtra,
Mantralaya,
Bombay-400 032.

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Annexure 1.4

Extracted Page from A.P.'s Document- C-III-D-12

ANNEXURE – II

AGREEMENT AMONGST THE STATES OF ANDHRA PRADESH, KARNATAKA, MAHARASHTRA AND TAMILNADU REGARDING CONVEYING OF 15 TMC OF KRISHNA WATERS, FOR WATER SUPPLY TO MADRAS CITY.

Whereas an agreement was reached in April 1976 that the Govt. Of Andhra Pradesh, Karnataka and Maharashtra will each allow the use of 5 TMC of Krishna waters to Tamilnadu for water supply to Madras City.

And whereas in pursuance of the said agreement, various alternative schemes were formulated and their costs estimated by officers of the concerned states and the Govt. of India.

The aforesaid studies were considered at a meeting convened by the Union Minister of Agriculture and irrigation on 27th October 1977, which was attended by the Chief Ministers of Karnataka, Tamilnadu and Maharashtra and the Minister for Medium Irrigation of Andhra Pradesh, the Minister for Major Irrigation of Karnataka and the Minister for works, Tamilnadu under the Chairman-ship of the Union Minister of Agriculture and Irrigation and the following decisions are taken:

i) The Govt. of Tamilnadu shall be permitted to draw not more than 15 TMC in a water year from Srisailam reservoir during the period 1st July to 31st October through an open lined channel from Srisailam to Pennar designed to carry a discharge not exceeding 1500 cusecs, which will enable conveyance of water to Madras City. The arrangements for the conductor system shall be agreed upon by Andhra Pradesh and Tamilnadu.

ii) The Govt. of Andhra Pradesh will co-operate in the acquisition of land and in providing necessary storage. Andhra Pradesh will also provide facilities for the construction of the canals and other structures and also for the maintenance and operation of the water supply system.

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iii) Tamilnadu shall bear the cost of the arrangements for conveying of water from Srisailam to Poondi and will bear the maintenance and operational charges. The details can be worked out by the Government of Andhra Pradesh and Tamilnadu.

iv) The lined channel between Srisailam and Somasila from the point of off-take to be agreed upon by Andhra Pradesh and Tamilnadu shall not be utilised for irrigation or other consumptive purposes.

v) The Central Govt. will make arrangements to inspect the system during operational stages and ensure that the withdrawal of water into this water supply system from Srisailam does not exceed 15 TMC in a water year and that the system is utilised only for water supply to Madras City and for no other purpose. This agreement is subject to formal ratification by the respective states.

Sd/-
M.Gopalakrishnan,
Secy. Dept. of I&P,
Govt. of Andhra Pradesh

Sd/-
K.S. Shankar Rao,
Dy.Secy. Dept. of
Irrigation Govt. of Maharashtra.

Sd/-
Ananda Krishna
Commissioner & Secretary
Dept. of Public Works & Electricity
Govt. of Karnataka.

Sd/-
B. Vijaya Raghavan
Commissioner & Secretary
P.W.D. Govt. of Tamilnadu

Sd/-
C.C. Patel
Secy. To the Govt of India
Ministry of Agriculture & Irrigation
(Dept. of Irrigation)
Dt. New Delhi 28th October 1977.

SCHEDULE – II

Reference No. 1 of 2011; Reference No. 2 of 2011;
Reference No. 3 of 2011 & Reference No. 4 of 2011

Further Report : Order Deemed Modified : Enumerated :

Thus, after incorporation of deemed modifications as a result of Further Report under Section 5(3) of the Act, the Decision/Order dated December 30, 2010 of the Tribunal passed under Section 5(2) of the Act, shall be finally read as under :

O R D E R

Clause-I

In view and on the basis of the discussions held and the findings recorded on the issues hereinbefore, the following order is passed in so far as it deviates from, modifies, amends and reviews the decision and the order passed by the KWDT-1.

Clause-II

That for the purposes of this case, so as to assess the yearly yield of the river Krishna afresh, on the data now available, an yearly water series for 47 years has been prepared, accordingly the dependable yield is determined as follows :-

(a) Average yield - 2578 TMC

(b) Yield at 50% dependability - 2626 TMC

(c) Yield at 60% dependability - 2528 TMC

(d) Yield at 65% dependability - 2293 TMC

(e) Yield at 75% dependability - 2173 TMC

Clause-III

That it is decided that the water of river Krishna be distributed amongst the three States of Maharashtra, Karnataka and Andhra Pradesh on 65% dependability of the new series of 47 years i.e. 2293 TMC.

Clause-IV

That it is decided that the allocations already made by KWDT-1 at 75% dependability which was determined as 2060 TMC on the basis of old series of 78 years plus return flows, assessed as 70 TMC in all totaling to 2130 TMC, be maintained and shall not be disturbed.

Clause-V

That it is hereby determined that the remaining distributable flows at 65% dependability, over and above 2130 TMC (already distributed), is 163 TMC (2293 TMC minus 2130 TMC = 163 TMC).

Clause-VI

That it is hereby decided that the surplus flows which is determined as 285 TMC (2578 TMC minus 2293 TMC= 285 TMC)

be also distributed amongst the three States.

Clause-VII

That the balance amount of water at 65% dependability i.e.163 TMC and the surplus flows of 285 TMC is distributed as given below:

State of Karnataka

Allocation at 65% dependability	61 TMC
Allocation out of surplus flows	105 TMC
Total	166 TMC
Flows made available for Minimum flows in the stream out of 65% dependability	7 TMC
Grand Total	173 TMC

State of Maharashtra

Allocation at 65% dependability	43 TMC
Allocation out of surplus flows	35 TMC
Total	78 TMC
Flows made available for Minimum flows in the stream out of 65% dependability	3 TMC
Grand Total	81 TMC

State of Andhra Pradesh

Allocation at 65% dependability	43 TMC
Allocation out of surplus flows	145 TMC
Total	188 TMC
Flows made available for Minimum flows in the stream out of 65% dependability	6 TMC
Grand Total	194 TMC

Clause-VIII

That the total allocations at different dependability including those made by KWDT-1 at 75% dependability with return flows are given below :

State of Karnataka

Allocation at 75% dependability with return flows	734 TMC
Allocation at 65% dependability	61 TMC
Allocation out of surplus flows	105 TMC
Total	900 TMC
Plus 7 TMC provided for Minimum flows	7 TMC
Grand Total	907 TMC

State of Maharashtra

Allocation at 75% dependability with return flows	585 TMC
Allocation at 65% dependability	43 TMC
Allocation out of surplus flows	35 TMC
Total	663 TMC
Plus 3 TMC provided for Minimum flows	3 TMC
Grand Total	666 TMC

State of Andhra Pradesh

Allocation at 75% dependability with return flows	811 TMC
Allocation at 65% dependability	43 TMC
Allocation out of surplus flows	145 TMC
Total	999 TMC
Plus 6 TMC provided for Minimum flows out of 65% dependability	6 TMC
Grand Total	1005 TMC

Clause-IX

That since the allocations have been made at different dependability, the party States are directed to utilize the water strictly in accordance with the allocations. And for that purpose they are further directed to prepare or caused to be prepared ten daily working tables and the Rule Curve and shall furnish copies of the same to each other and on its coming into being, also to the 'Krishna Waters Decision – Implementation Board'.

Clause –IX-A

Detailed Mechanism for Drawal of Water By States at Different Dependability.

PART-I

1(a). That the three States of Maharashtra, Karnataka and Andhra Pradesh shall continue to use the water at 75% dependability plus the return flows according to and in the manner as provided in Clause-V of the Decision of the KWDT-I except the progressive increase in the allocated share, in given percentage, on account of return flows, since the return flows now stand quantified. The total figure of allocations at 75% dependability with quantified return flows is 585 TMC, 734 TMC and 811 TMC for the States of Maharashtra, Karnataka and Andhra Pradesh respectively.

(b) Thus, in the first instance, not more than 2130 TMC shall be utilized in the following manner, as before :-

(i) The State of Maharashtra shall not use more than 585 TMC;

(ii) The State of Karnataka shall not use more than 734 TMC;

(iii) The State of Andhra Pradesh shall use 811 TMC.

2. Thereafter, in the second instance, not more than 163 TMC shall be utilized by all the three States in the following manner:-

(i) The State of Maharashtra shall not use (over and above 585 TMC) more than 46 TMC, only after the State of Karnataka has used 734 TMC and the State of Andhra Pradesh 811 TMC;

(ii) The State of Karnataka shall not use (over and above 734 TMC) more than 68 TMC, only after State of Andhra Pradesh has used 811 TMC;

(a) ALTERNATIVELY, in so far it relates to the upper riparian States viz. Maharashtra and Karnataka, before using/storing their additional allocation of 46 TMC and 68 TMC respectively at 65% dependability, they have released/and/or water flowed down, the balance amount of share of Andhra Pradesh at 75% dependability at the relevant point of time, taking into account the self-generation of water due to rainfall in the State of Andhra Pradesh. Self-generation of water in Andhra Pradesh at 75% dependability may be taken as 369 TMC, as per their own calculation made in the paper dated 16.4.2012.

(b) Notwithstanding anything contained in sub clauses (i) and (ii)(a) of Clause 2 above, the three riparian States, in the light of the opinion of their experts about the assessment of expected rains, or otherwise, in the best of the spirit of cooperation and share and care to achieve their share fairly and smoothly, are free to make any other arrangement by means of a written agreement amongst the three States, in respect of the manner of withdrawal as to at what point of time they may draw their share in full or in parts thereof, at 65% dependability.

(c) The agreement, if any, shall be jointly submitted to the Board and the Board shall see to it that the drawal of water is made by the parties as per the agreement; if necessary it may issue directions to the parties accordingly.

(iii) The State of Andhra Pradesh shall not use (over and above 811 TMC) more than 49 TMC.

3. In the third instance, not more than 285 TMC shall be used by the three States in the following manner:-

(i) The State of Maharashtra shall not use (over and above 585+46=631 TMC) more than 35

TMC, only after the State of Karnataka has used 734+68=802 TMC and the State of Andhra Pradesh 811+49=860 TMC.

(ii) The State of Karnataka shall not use (over and above 802TMC) more than 105 TMC, only after the State of Andhra Pradesh has used 860 TMC.

(iii) The State of Andhra Pradesh shall not use (over and above 860 TMC) more than 145 TMC.

Note: The provisions made above allowing Andhra Pradesh to draw only its allocated shares at different dependability does not affect the drawals/use, which Andhra Pradesh is entitled to, as per provision made in sub-para of para 3 of Clause X of the Order which allows Andhra Pradesh to use the remaining water.

4. That notwithstanding the provision in Clause VII of the Decision of KWDT-I, for the purpose of paragraphs 1 to 3 above only, the expression "use" would mean the water used or diverted plus the amount of water stored by any State at

any point of time in a water year so as to be available in a storage for utilization to achieve its allocation in that water year.

5. That the Krishna Waters Decision – Implementation Board shall monitor and ensure the use of the water by the three States as allocated to them in the manner provided in the aforesaid paragraphs 1 to 3.

PART-II

Procedure to ascertain the use of water by the Riparian States and other related matters.

1. That all the three party States shall exchange data on daily basis with each other relating to opening and the closing balance of the reservoirs, the water which has been released from the reservoir to the canals and the 10 daily and monthly data statement of all major, medium and minor schemes accordingly. The data of measured flows at the sites maintained by the Central Water Commission shall also be obtained by the parties on daily basis. The data so maintained by respective parties and at the gauging sites shall also be furnished by the respective parties and CWC to the Implementation Board.

2. For the purpose of ascertaining as to how much water has been released to/flowed down/used by the States, the data which is maintained and exchanged as indicated in the preceding clause shall be used by the States. If so needed, data may be ascertained from the Implementation Board, which shall maintain a Data Cell for this purpose and shall promptly provide information sought by any party.

3. Any of the upper riparian State which wants to store or utilize water at 65% dependability before the lower riparian State have used their allocation at 75% dependability, shall at that point of time ascertain, from the data exchanged, the quantity of water which has been released to/flowed down and on that basis shall ascertain the shortfall of the remaining unutilized allocation of the lower/lowest riparian States excluding the self-generation of that lower riparian State at 75% dependability. The amount of water which has flown down plus the water generation within the State at 75% dependability, shall be deducted from the allocated share at 75% dependability and the balance amount of water shall be released/flow down, with due intimation along with the calculations to the lower riparian State/States at least 12 hours before storing/using its allocation at 65% dependability.

The gauging sites of CWC at interstate boundaries between Maharashtra and Karnataka and between Karnataka and Andhra Pradesh shall be used for measuring the flows of releases amongst the party States.

4. If the lower/lowest riparian States have any doubt about the correctness of the calculations made by the upper riparian States about the use, storage and the water which has been released/flowed down till that point of time to lower riparian States, in that event the States may ascertain the correct position from the Implementation Board which shall check the same and provide it to them immediately, say within 12 hours. Information so furnished by the Board shall be taken to be the correct position of water having released/flowed down, to the lower/lowest riparian State.

5. In the event the lower/lowest riparian States inform to the upper riparian States that it is not in a position to receive the balance flow of water of its allocation at 75% dependability, at that point of time due to lack of storage capacity or the like, in that case, the parties may enter into an agreement under Clause "(ii)b" allowing storage of that part of the balance of allocation of the lower/lowest riparian States also which may be released later as and when so required by the lower/lowest riparian States or as agreed.

6. In any water year if it is noticed that the self-generation of water in the State of Andhra Pradesh is likely to fall short of 369 TMC and the State of Andhra Pradesh cannot realize its allocation of 811 TMC at 75% dependability and the upper riparian States have used their additional allocation, in that case the State of Andhra Pradesh at the end of winter monsoon season shall intimate about the shortfall in 811 TMC with calculations to the upper riparian states which shall make good the shortfall, if necessary on verifying the correctness of the claim.

7. Any State if defaults in timely exchange of data, will not be entitled to question the calculation made by upper riparian State, which shall be treated as correct. Similarly, if an upper riparian State fails to furnish its data on time, will not be entitled to claim commencement of use of its additional allocation.

8. The party States and the Board shall make use of the latest information technology and install a suitable Real Time Data Acquisition System in the entire Krishna basin for the purposes of acquisition and exchange of reservoir and utilisation data indicated in the foregoing clauses. The same technology shall be used for data to be obtained from the gauging sites of Central Water Commission and the States, if any. The Implementation Board may get, for this purpose, the necessary software and hardware for quick and instant exchange of data amongst the States, the Implementation Board and the Central Water Commission. The Board shall use all facilities in this regard available with the CWC and the party States. The Board shall be responsible for installation and maintenance of the System. The financing of this activity of the Board shall be covered by the Clause 41 of Appendix I of the Decision of this Tribunal.

Clause-X

That on change in availability and the allocation of more water, at different dependability, the restrictions placed on the States on utilizations in some sub-basins would consequently change. The changes in the restrictions are in keeping with the dependability at which allocations have been made. These restrictions, as given below, shall be strictly adhered to by the concerned States :-

1. (a) Maharashtra shall not utilize more than 98 TMC in a 65% dependable water year (it includes 3 TMC allocated for Kukadi Complex) and 123 TMC in an average water year from the main stream of river Bhima.

(b) Maharashtra shall not divert more than 92.5 TMC (including that allowed by KWDT-1 and further 25 TMC now allocated) from K-1 Upper Krishna sub basin for Koyna Hydel Station for west-ward diversion in a 65% dependable or average water year.

(c) Maharashtra shall not utilize more than 628 TMC in a 65% dependable water year and not more than 663 TMC in an average water year.

(d) Maharashtra shall not divert any water out of basin except (b) above from K-1 sub-basin.

(e) (i) Maharashtra shall not utilize water allocated to it by this Tribunal in any non- scarcity /DPAP area either in existing project or in future projects.

(ii) In basin utilization in any other project for DPAP area may be permissible with prior intimation in writing and written no objection of the Krishna Water Decision Implementation Board. It shall not involve any inter basin transfer of water.

2. (a) Karnataka shall not utilize more than 356 TMC from K-8 Tungabhadra sub-basin in a 65% dependable water year (it includes allocation of 36 TMC for Upper Tunga, Upper Bhadra and Singatlur Projects) or in an average water year.

(b) Karnataka shall not utilize more than 194 TMC in a 65% dependable water year and not more than 303 TMC in an average water year from Upper Krishna project (it includes allocation of 130 TMC for UKP Stage-III with reservoir level of Almatti Dam at 524.256 m).

(c) Karnataka shall not utilize more than 795 TMC in a 65% dependable water year and not more than 900 TMC in an average water year.

3. (a) That the State of Andhra Pradesh shall not utilise more than 860 TMC in a 65% dependable year (It includes 30 TMC for carry over in Sirisailam and Nagarjunasagar projects in K-7 sub-basin, 9 TMC for Jurala project, 4 TMC for Right

Main Canal of RDS project and 6 TMC towards Minimum flows).

(b) That the State of Andhra Pradesh shall not utilize more than 1005 TMC as per allocation made in Clause-VIII above in an average water year. (It includes further allocation of 9 TMC for Jurala Project, 25 TMC for Telugu Ganga Project, 4 TMC for RDS Right Main Canal, 150 TMC for carry over storage in Srisailam and Nagarjunasagar Dams and 6 TMC towards minimum flows).

So far as remaining water is concerned, as may be available, that may also be utilized by State of Andhra Pradesh till the next review for consideration by any competent authority under the law. It will be open to each of the parties to raise its claim to the remaining water before the Competent Authority as it may consider necessary and that no right would accrue to Andhra Pradesh over the remaining water on the ground of its user under this clause.

4. The above restrictions are inclusive of evaporation losses.

Clause-XI

That all the three States are hereby directed that for the purposes of drinking water supply for Chennai city, each State shall contribute 3.30 TMC in equal quantity distributed in the months of July, August, September and October and 1.70 TMC distributed similarly in four equal installments in the months of January, February, March and April.

Clause-XII

That all the three States shall release in all 16 TMC of water for maintaining minimum in-stream flow and for environment and ecology, in the manner and the quantity as indicted in Table to the discussion held on the subject of minimum flows.

Clause-XIII

That it is hereby directed, as provided in the discussion held while dealing with Issue No. 14, that the State of Karnataka shall release 8 to 10 TMC of water to the State of

Andhra Pradesh from Almatti Reservoir in the months of June and July, as regulated releases.

Clause-XIII-A

If on periodical survey any significant change is reported in sedimentation within 20 KM of Maharashtra territory of river Krishna the KWD-IB may direct Karnataka and Maharashtra to undertake dredging jointly to clear the same and the cost of which shall be equally borne by them.

Clause- XIV

That it is hereby provided that on the constitution of the 'Krishna Water Decision – Implementation Board' the administrative control and regulation over Tungabhadra Dam and its Reservoir including Head Regulators of all the canal systems both on the left and the right sides and all its gates as well as the administrative control of Rajolibanda Diversion Scheme shall vest in the Board and the notifications dated 29th September, 1953 and the 10th March, 1955 issued under Section 66(1) and (4) respectively of the Andhra State Act, 1953 shall cease to be operative.

Clause-XV

That besides the gauging sites as indicated in Clause-XIII in the final order of the KWDT-1, the ‘Krishna Waters Decision – Implementation Board’ may set up or caused to be set up more gauging sites as the Board may consider necessary. Neither existing site nor any site established hereinafter shall be abolished or downgraded except in consultation with the Board.

Clause-XV-A

That Krishna Water Decision – Implementation Board shall implement the Real Time Flood Forecasting System in the entire Krishna basin. In case, however, if the system is already installed by the CWC covering Krishna Basin and it is in operation, the KWD-IB shall take all necessary help in the matter from CWC and shall make use of the same”.

Clause-XVI

At any time after 31st May, 2050, order may be reviewed or revised by a Competent Authority or Tribunal, but such review or revision shall not as far as possible disturb any utilization that may have been undertaken by any State within the limits of allocation made to it.

Clause-XVII

Nothing contained herein shall prevent the alteration, amendment or modification of all or any of the Clauses by agreement between the Parties.

Clause-XVIII

The scheme which has been framed for implementation of this decision and the decision and directions made by KWDT-I, which have not been modified or reviewed by this Tribunal has been appended as Appendix-I to this decision and forms part thereof. The Board constituted to carry out the functions and duties provided for in the scheme shall be called 'Krishna Waters Decision – Implementation Board'. It shall be constituted as early as possible. The Central Government and the State Government shall nominate the Members of the Board at the earliest, in any case, not later than six months from the date of publication of the decision. The Board shall function as per the provisions of the scheme.

<u>Clause-XIX</u>

That a Map which has been prepared before this Tribunal and brought on record as TD-1 vide orders dated 30th July, 2009 and 9thAugust, 2009 of this Tribunal has been appended as Appendix-II to the decision.

<u>Clause-XX</u>

That the order or directions as contained in this order shall be read in reference and context with the preceding discussions and the findings recorded on different issues along with the reasoning thereof.

It is further provided that any direction given or provision made under any Issue or otherwise, not finding mention in this order shall also be complied with by all the parties as a part of the decision and this order.

<u>Clause-XXI</u>

The Governments of Maharashtra, Karnataka and Andhra Pradesh shall bear their own costs of appearing before the Tribunal. The expenditure of the Tribunal shall be borne and paid by the aforesaid three States in equal shares except the expenditure incurred in Hydrographic Survey in Hippargi Barrage and Almatti Dam conducted by M/s Tojo Vikas International Pvt. Ltd. which shall be borne by the States of Maharashtra and Karnataka in equal shares.

Clause-XXII

This decision and order shall come into operation on the date of publication in the official gazette under Section 6 of the Inter-State River Water Disputes Act, 1956.

Clause-XXIII

The provisions made in the decision/order passed and the decision and directions given by KWDT-I which have not been amended, modified or reviewed by this order shall continue to be operative.

(JUSTICE B.P. DAS)	**(JUSTICE D.K. SETH)**	**(JUSTICE BRIJESH KUMAR)**
MEMBER	**MEMBER**	**CHAIRMAN**

Dated this the 29th day of November, 2013

APPENDIX-I

(To the Decision dated December 30, 2010)

(As Deemed to be Amended)

APPENDIX-1

KRISHNA WATERS DECISION – IMPLEMENTATION BOARD.

1. There shall be a permanent "Krishna Waters Decision – Implementation Board", 'hereinafter referred to as the Board' which will have five Members out of which one Member each shall be appointed by the three riparian States and the remaining two Members shall be nominated by the Central Government (Government of India).

2. The riparian States shall appoint Members on deputation or on re-employment basis, a person who should be a High ranking Engineer not below the rank of Chief Engineer or has

held the office of Chief Engineer having experience in the field of Irrigation Engineering, Hydrology and Water Management.

3. The Central government shall nominate two Members for the "Krishna Waters Decision – Implementation Board" who shall be High ranking Engineer having experience in the field of Irrigation Engineering, Hydrology and Water Management from Central Government services or any organization under the Central Government, one of whom shall be holding or has held the post not below the rank of Joint Secretary and the other not below the rank of Additional Secretary to the Government of India. The latter shall be the Chairman of the Board The nominated Members shall be either on deputation or on reemployment but shall be from any State other than the riparian States of the Krishna river basin and shall have no connection, direct or indirect, with any of the three States.

4. The services of the Members including the Chairman of the Board as well as Officers and employees of the Board shall be subject to the Service and Disciplinary Rules applicable to the Central government Officers and employees except the Members and other Officers and employees serving on deputation who shall be governed by the Service Rules and Disciplinary rules of the parent cadre of the concerned State.

5. On any vacancy occurring in the offices of the Members of the Board, the Central government or the concerned State government, as the case may be, shall appoint on deputation or re-employment basis a suitable person as against the vacant office.

Provided that in case of temporary absence due to illness or for any cause whatever the Central government or the State government by whom he was appointed, as the case may be, appoint, on deputation or re-employment basis or on officiating basis a suitable person as Acting Member during such illness or absence and such Acting Member shall, while so acting, have all the powers and perform all the duties and will be entitled to indemnities of the Member, in whose stead he so acts.

6. The Members of the Board shall have a tenure upto 'five years' each but or beyond the age of 70 years, whichever is earlier.

7. The Board will hold meetings regularly. The data collected as envisaged hereinbelow shall be placed before it in its meetings for appropriate orders/ directions and necessary action.

8. The Board shall record its directions/guidelines by a resolution at a meeting in which the Chairman and the Members are present as provided hereinafter.

9. The Board in its meeting in which all its members are present shall frame its Rules of business, categorize any part of the business of the Board as of a formal or routine nature.

10. The permanent "Krishna Waters Decision – Implementation Board" with five Members as aforesaid shall

be for implementing and carrying out effectively the decision/ orders and directions issued by the this Tribunal including the decision/ orders and directions issued by K.W.D.T.-I which have not been reviewed or modified by this Tribunal.

11. This "Krishna Waters Decision – Implementation Board" shall be a body orporate having perpetual succession and common seal and could sue or be sued and can hold and dispose of properties.

12. No Member, Officer or employee of the Board shall be liable for loss, injury or damage resulting from an action taken by such Member, Officer or employee in good faith and without malice even though such action is later on determined to be unauthorized.

13. The purpose and function of the permanent "Krishna Waters Decision – Implementation Board" shall also be to establish and maintain cooperation between the riparian States to the development of waters in the Krishna river in particular within the limits prescribed by this Tribunal and to ensure compliance of its orders and the directions including the orders

and directions of K.W.D.T.-I which have not been reviewed or modified by this Tribunal.

14. Any question which arises between the riparian States concerning any activity by a riparian State which is claimed by a riparian State to be against the decision and direction of this Tribunal or of the order and direction issued by K.W.D.T.-I which have not been reviewed or modified by this Tribunal, having an adverse effect on that State shall be examined by the Board which will first endeavour to resolve the question amicably but in case no amicable settlement is possible the Board shall solve the question raised by a resolution, by majority, giving reasons in a meeting where all the Members are present and that resolution/direction shall be communicated to the riparian States and will be binding on them.

(14A) **Review Committee** : The resolution/direction of the Krishna Water Disputes Decision Implementation Board shall be reviewable on application of any party State and the decision of the Review Committee on the review petition, if any preferred, shall be final and binding on all the parties.

(i) The Minister for Water Resources, Govt. of India, shall constitute the Single Member Review Authority.

(ii) The Review Authority while dealing with the review petition and taking a decision on it shall take assistance of a panel of three designated personnel consisting of :-

(1) The Secretary, Ministry of Water Resources, Government of India ;

(2) The Secretary, Ministry of Agriculture, Government of India ;

(3) The Chairman, Central Water Commission.

The Review Authority shall take the assistance of the aforesaid panel any time before hearing of the parties, during the course of review proceedings and after that before rendering its decision.

The Secretary, Ministry of Water Resources shall be the Convener of the Review Authority.

(iii) The Review Authority shall give opportunity of hearing to all the parties to the Review Petition, before taking any decision in the matter.

(iv) The Review Authority may also, if necessary, call for the records and the comments of the implementation Board on the Review Petition.

(v) The decision shall be recorded in writing.

15. That the Board shall also be authorized to look into 'any such activity suo moto, on the part of any State which appears to be against the decision and direction of this Tribunal or order and directions issued by KWDT-I which have not been reviewed or modified by this Tribunal and such activity of any State adversely affecting the interest of the other States. All other provisions of para 12 shall be applicable in suo moto action taken by the Board.

16. The quorum to constitute a meeting of the Board for routine business shall be the Chairman or the other nominated Member by the Central Government and the two Members out of the three appointed by the riparian States.

17. The Board shall further ensure that the Dead Storage shall not be depleted except in an unforeseen emergency or

acute urgency. If so depleted, it will be replenished in accordance with the conditions of its initial filling.

18. The Board shall proceed to determine the questions raised with the following definitions in mind for the purposes of this scheme:

(i) The term 'tributary' of a river means any surface channel, whether in continuous or intermittent flow and by whatever name called, whose waters in the natural course would fall into the river, e.g. a tributary, a torrent, a natural drainage an artificial drainage, a nadi, a nallah, a nali. The term also includes any sub-tributary or branch or subsidiary channel, by whatever name called, whose waters, in the natural course, would directly or otherwise

flow into that surface channel.

(ii) 'Reservoir Capacity' means the gross volume of water which can be stored in the reservoir.

(iii) 'Dead Storage Capacity' means that portion of the Reservoir Capacity which is not used for operational purposes and' Dead Storage' means the corresponding volume of water.

(iv) ‘Live Storage Capacity’ means the Reservoir Capacity excluding Dead Storage Capacity, and ‘Live Storage’ means the corresponding volume of water.

(v) “Flood Storage Capacity’ means that portion of the Reservoir Capacity which is reserved for the temporary storage of flood waters in order to regulate downstream flows, and ‘Flood Storage’ means the corresponding volume of water.

(vi) ‘Surcharge Storage Capacity’ means the Reservoir Capacity between the crest of an uncontrolled spillway or the top of the crest gates in normal closed position and the maximum water elevation above this level for which the dam is designed, and ‘Surcharge Storage’ means the corresponding volume of water.

(vii) ‘Conservation Storage Capacity’ means the Reservoir Capacity excluding Flood Storage Capacity, Dead Storage Capacity and Surcharge Storage Capacity, and ‘Conservation Storage’ means the corresponding volume of water.

(viii) The term ‘Agricultural Use’ means the use of water for irrigation, except for irrigation for household gardens and public recreational gardens.

(ix) The term ‘Domestic Use’ means the use of water for:-

(a) drinking, washing, bathing, recreation, sanitation (including the conveyance and dilution of sewage and other wastes), stock and poultry and other like purposes;

(b) household use including use for household gardens and public recreational gardens; and

(x) Industrial purposes (including mining, mining and other like purpose and industrial waste); but the term does not include agricultural use or use for the generation of hydroelectric power.

(xi) The term "Non-consumptive Use" means any control or use of water for navigation, floating of timber or other property, flood protection or flood control, fishing or fish culture, wild life or other like beneficial purposes,

provided that exclusive of seepage and evaporation of water incidental to the control or use the water (undiminished in volume within the practical range of

measurement) remains in, or is returned to the same river or its tributaries.

(xii) The term "Interference with the Waters" means –

(a) Any act of withdrawal therefrom; or

(b) Any man-made obstruction to their flow which adversely affects or causes prejudice to any riparian State or causes a change in the volume (within the practical range of measurement) of the daily flow of the waters. Provided however an obstruction which involves only an insignificant and incidental change in the volume of the daily flow, for example, fluctuations due to afflux caused by bridge piers or a temporary by-pass, etc., shall not be deemed to be an interference with the waters.

(xiii) "Damage" includes -

(a). Loss of life or personal injury;

(b). Loss of or injury to property or other economic losses;

(c) Environmental harm; and

(d) The costs of reasonable measures to prevent or minimize such loss, injury, or harm.

(xiv) "Drainage basin" means an area determined by the geographic limits of a system of interconnected waters, the surface waters of which normally share a common terminus.

(xv) "Ecological integrity" means the natural condition of waters and other resources sufficient to assure the biological, chemical, and physical integrity of the aquatic environment.

(xvi) “Environment” includes the waters, land, air, flora, and fauna that exist in a particular region at a particular time.

(xvii) “Environmental harm” includes -

(a). Injury to the environment and any other loss or damage caused by such harm; and

(b). The costs of the reasonable measures to restore the environment actually undertaken or to be undertaken.

(xviii) “Flood” means a rising of water to levels that have detrimental effects on or in one or more basin States.

(xix) “Flood control” means measures to protect land areas from floods or to minimize damage therefrom.

(xx) “Hazardous substances” means substances that are bioaccumulative,

carcinogenic, mutagenic teratogenic, or toxic.

(xxi) “Management of waters” and “to manage waters” includes the development, use, protection, and control of waters.

(xxii) “Pollution” means any detrimental change in the composition or quality of waters that results directly or indirectly from human conduct.

(xxiii) “Vital human needs” means waters used for immediate human survival, including drinking, cooking, and sanitary needs, as well as water needed for the immediate sustenance of a household. For the expression not defined hereinabove, the Board shall take into consideration the definitions provided in the related Indian Standard Code (I.S. Code).

19. The Board shall employ a Secretary who shall be an Engineer having experience in Hydrology and water management. The appointment shall be on deputation or on re-employment basis not beyond 65 years of age.

20. The Board shall appoint either directly or on deputation or on re-employment basis other officers/ employees in such numbers as may be found necessary to efficiently carryout the functions of the Board.

On the vesting of the functions and duties of the Tunga Bhadra Board in the "Krishna Waters Decision – Implementation Board", the existing staff of Tungabhadra Board may be retained as employees of the "Krishna Waters Decision – Implementation Board" as per requirement and need.

21. The Board shall appoint a qualified and experienced Accounts Officer on deputation or on re-employment basis not beyond 65 years of age.

22. The Board shall ensure that the following data in respect to the flows and utilization of the waters of river Krishna are recorded and exchanged between the riparian States and a copy of the same shall also be furnished by the States to the Board in the same manner.

(a) Daily gauge and discharge data relating to the flow of the river at all observation sites duly established by the Central Water Commission and the States.

(b) Daily extractions for the releases from the various reservoirs maintained by the riparian States.

(c) Daily withdrawals at the heads of all canals including link canals operated by the riparian States.

(d) Daily escapages from all canals including the link canals.

(e) Daily deliveries from link canals.

(f) That the party States namely State of Maharashtra, State of Karnataka and the State of Andhra Pradesh shall prepare the Rule Curves for operation of their Reservoirs of all major projects using more than 3 TMC in a water year. All party

States shall regularly prepare 10 daily Working Tables in every water year. The Rule Curves and the 10 daily Working Tables shall be prepared keeping in view the allocations made to and restrictions imposed on the riparian States at different level of dependability and on an average basis.

23. It shall also be ensured that the States furnish the copies of the Working Tables at 10 daily basis and the Rule Curve to each other. The States shall also furnish such copies to the Board. The Board may vet the Rule Curve and the 10 daily Working Tables to check and ensure that they are prepared in consonance with the provisions of the decision of this Tribunal and the decision and directions of KWDT-I which have not been amended, modified or reviewed by this Tribunal. In case it is found that the 10 daily Working Tables or the Rule Curve does not conform to the decision, order and the directions of this Tribunal or the decision and directions of KWDT-I which have not been amended, modified or reviewed, the Board may make necessary modifications which shall be binding on all the parties.

24. The Board shall be charged with the power and shall be under a duty to do all things necessary and sufficient and expedient for the implementation of the order/ directions of this Tribunal including the decision/ orders and directions of K.W.D.T.-I which have not been reviewed or modified by this Tribunal with respect to –

(i) storage, apportionment and regulated control of the Krishna waters,

(ii) regulated releases from the reservoirs as directed by this Tribunal including the decision and directions of K.W.D.T.-I which have not been reviewed or modified by this Tribunal.

(iii) any other matter incidental to the carrying out and implementation of the order/ direction of this Tribunal including the decision and directions of

K.W.D.T.-I which have not been reviewed or modified by this Tribunal.

(iv) The Board shall make use of the data of the gauging sites already established or as may be established by the Central Water Commission or

cause to be established either by itself or through the Central Water Commission.

(v) Record shall be kept of the flow of the Krishna river at all stations considered necessary by the Board.

25. The Central Water Commission or any riparian States shall not abolish or downgrade any existing gauging sites except in consultation with the Board.

26. The Board shall ensure that the capping and restrictions imposed by this tribunal or directed by the K.W.D.T.-I which have not be reviewed or modified are adhered to by the riparian States and shall check that the flow as directed is maintained.

27. The Board shall collect from the States concerned data for the areas irrigated by Krishna waters in each season of withdrawals for irrigation, domestic, municipal and industrial or any other purposes and of water going down the river from the project.

28. In case, however, it is found that any State is not following the instructions of the Board or is violating the directions or the decision of the Tribunal or any State over utilizing or fails to make regulated releases the Board may

depute any of its responsible Officer/ Engineer for the purposes of the joint operation of any reservoir.

29. The Board shall determine the volume of water flowing in the river Krishna and its tributaries in a water year i.e. 1st June to 31st May.

30. The Board shall check from time to time the volume of water stored by each State in its reservoirs and other storages and may for that purpose adopt any approved and tested device or method.

31. It shall be ensured by the concerned States that the following reports of the water accounts are prepared and submitted to the Board for consideration:-

(a) South West monsoon 1st June to 30th September.

(b) Full water year 1st June to 30th May.

32. The control over the maintenance and operation of the entire Tungabhadra dam and all the canals on the Right and Left side of the Bank as well as reservoir and the spillway gates on the entire Left and Right side including the operation of

Rajolibunda Diversion Scheme (RDS), shall be the responsibility of the Board. The Board shall carry out the contour surveys of the entire reservoir from time to time with a view to ascertain whether its storage capacity has been reduced due to silting and prepare revised capacity tables if necessary.

The Board shall have the charge for the works on or connected with the Tungabhadra project and all the powers of the Tungabhadra Board shall vest in the Board.

33. The Board shall prepare and transmit to each of the three riparian States before the end of the current water year (1st June to 31st May of the next year) an Annual Report covering the activities of the Board for preceding year and to make available to the Central Government and to the Government of each of the riparian States on its request any information within its possession in time and always provide access of its records to the Central government and to the government of each riparian States and their representatives.

34. The Board shall keep a record of all its meetings and proceedings, maintain regular accounts and have a suitable office where documents, records, accounts and gauging data

shall be kept open for inspection by the Central government and the Government of each of the riparian States or their representatives at such time and under such regulations as the Board may determine.

35. The Board shall determine the place of its headquarters and locations at Central and suitable places for its Regional and Sub-regional Offices as the need be.

36. The resolution of the Board on all matters referred to hereinabove shall be binding on all the parties.

37. The Board shall be funded by the Government of India and all capital and revenue expenditure as may be required shall be incurred.

38. The Board shall in the month of September each year prepare detailed estimate of the amount of money required for the twelve months i.e. for the following financial year for the purposes of its own establishments and as may be required to carry out its functions and duties under the scheme.

39. The Board shall on or before 15th of October forward such detailed estimate to the Government of India, Ministry of Water Resources and the Chief Secretary of all the three riparian States.

40. The Central Government shall pay to the Board the amount for the purpose indicated above before or by the last date of February of the ensuing year.

41. The Central Government will get reimbursement of the expenditure incurred by it on the Board from the three States i.e. the State of Maharashtra, the State of Karnataka and the State of Andhra Pradesh in equal shares or it may, if so, think fit realize the estimated amount in advance from the aforesaid three States.

42. The Board shall maintain detailed and accurate accounts of all the receipts and disbursement and shall after the close of each financial year prepare an annual statement of accounts and shall send the copies thereof to the Comptroller & Auditor-General of Government of India (CAG), Accountant-Generals as well as the concerned Chief Secretaries of the three riparian

States. The form of the annual statements of the accounts shall be such as may be prescribed by the Rules framed by the Board. The accounts maintained by the Board shall be open for inspection at all reasonable time by the Central government and the governments of the party States through their authorized representatives. The Board shall make disbursement from its funds only in such manner as may be prescribed under Rules framed by it. It may, however, incur such expenditure as it may think fit to meet any emergency in the discharge of its function.

43. The Board shall get its accounts audited every year by the Comptroller & Auditor-General of Government of India (CAG) or through any other agency as may be nominated by CAG.

44. The Board shall prepare its Annual Report covering the activities of the Board including the audited Account Report for the preceding year and submit the same to each party State. After approval of the Board in its meeting it will also be submitted to the Central government.

45. The Board or its any other duly authorized representative shall have power to enter upon any land and property upon which any project or development of any project, or any work of gauging, evaporation or other hydrological station or measuring device has been or is being constructed, operated or maintained by any state for the use of Krishna water. Each state through its appropriate department shall render all cooperation and assistance to the Board and its authorized representative in this behalf.

(JUSTICE D.K. SETH)	(JUSTICE B.P. DAS)	(JUSTICE BRIJESH KUMAR)
MEMBER	MEMBER	CHAIRMAN

Dated this the 29th day of November, 2013.

CHAPTER-15 – Trans Basin Diversions

This chapter deals with Inter Basin Diversions identified at National level and State level. The intra-basin transfer of water within Krishna Sub Basin is also assessed.

15.1 The rainfall over the country is primarily associated with tropical depressions originating in the Arabian Sea and the Bay of Bengal. The monsoon accounts for more than 85 per cent of the precipitation. The uncertainty of occurrence of rainfall marked by prolonged dry spells and fluctuations in seasonal and annual rainfall is a serious problem for the country. Large parts of Maharashtra, are not only in deficit in rainfall but also subject to large variations, resulting in frequent droughts and causing immense hardship to the population and enormous loss to the nation. The water availability even for drinking purposes becomes critical, particularly in the summer months as the rivers dry up and the ground water recedes.

Irrigation using river water and ground water has been the prime factor for raising the food grain production in our country

15.2 One of the most effective ways to increase the irrigation potential for increasing the food grain production, mitigate floods and droughts and reduce regional imbalance in the availability of water is the Inter Basin Water Transfer (IBWT) from the surplus rivers to deficit areas. Rivers originating from the Western Ghats are found to be surplus in water resources.

This is with subject to general guidelines that will be laid down by KWDT –II, once it is implemented.

15.3 IMPORT–

Import in the upper Bhima sub basin (k-5) comprises of two types, viz. (a) Import from other Basins (other than Krishna Basin) and (b) Import within the Krishna basin from other sub basins.

15.3.(a) Import from other Basins (other than Krishna Basin)

Water is diverted in Upper Bhima Sub basin for specific purposes like irrigation, domestic water supply, industrial water supply etc.

In future, approx. 101 Mcum (3.00 TMC) is proposed to be diverted from westward flowing rivers from Kokan region into this sub basin and is called ‘EASTWARD DIVERSION’.

Also, Ahmednagar city situated on the banks of Sina river has it’s city water supply scheme from Mula reservoir at Rahuri. This is part of Godavari basin. So, from Godavari basin Ahmednagar & industrial area domestic water supply (57.97 Mcum) and industrial water supply to MIDC at Ahmednagar (5.80 Mcum) are listed under import from other basins.

15.3.(b) Import within the Krishna basin from other sub basins.

Within the basin, there are sub basins from where the water is diverted in Upper Bhima Sub basin for specific purposes like irrigation, domestic water supply, industrial water supply etc.

Water from Upper Krishna sub basin (K-1) from 6 projects is imported to this sub basin. The total quantum is **669 Mcum**. It is proposed for irrigation use.

15.4 EXPORT –

Export from the upper Bhima sub basin (k-5) comprises of two types, viz. (a) Export to other Basins (other than Krishna Basin) and (b) Export to other sub basins within the Krishna basin.

15.4.(a) Export to other Basins (other than Krishna Basin)

Water is diverted from Upper Bhima Sub basin for specific purposes like irrigation, domestic water supply, industrial water supply , hydro power generation etc.

For TATA hydro generation units, 1274.00 Mcum quantum of water is annually exported from Upper Bhima Sub basin (K-5). This diversion is trans-basin diversion and the water flows intto Westward flowing rivers and is called **WWD** (Westward Diversion).

15.4.(b) Export to other sub basins within the Krishna basin.

Within the basin, there are sub basins where the water is diverted from Upper Bhima Sub basin for specific purposes like irrigation, domestic water supply, industrial water supply etc.

Water to Lower Bhima sub basin (K-6) is proposed from two projects of Upper Bhima Sub basin (K-5) is proposed.. The total quantum is 128.01 Mcum. It is proposed for irrigation use.

Table No. 15.4.1 Upper Bhima & Sub Basin - Import & Export – K-5

Sr no	**Basin**	**Project**	**Export From K-5**	**Import To K-5**	**Purpose**
			Mcum	**Mcum**	
1	K-1	1.Dhom Balkawadi	---	77.00	Irriagtion
		2. Jihe Katapur	---	22.00	Irriagtion
		3. Urmodi	---	97.00	Irriagtion
		4. Tarali	---	48.00	Irriagtion
		5. Tembhu LIS	---	280.00	Irriagtion
		6. Mhaisal LIS	---	145.00	Irriagtion
		TOTAL	**---**	**669**	
2	K-2	----------	---	----------	
3	K-3	----------	---	----------	
4	From Kokan Region-	Eastward Diversion	----	101.00	Multi-purpose

5	From Godavari Basin	Ahmednagar city water supply and MIDC	----	58.00	Domestic & Industry
	Total Import In K-5			**828.00**	
6	K-6	Krishna-Marathwada LIS	**57.00**	---------	Irriagtion
		Ekrukh LIS	71.00	----------	Irriagtion
	Total Export to K-6		**128.00**		
7	Out of Krishna basin	WWD- To-TATA-	1274.00	---------	Hydro–power Generation
	Export Grand Total (6+7)		**1402.00**		
	NET TOTAL	**(+ 828.00 - 1402.00)= (-) 574.00 - OUTFLOW**			

Note –Inter basin transfer is not allowed As per KWDT – II report .

Chapter16 - Other Special Requirements:

General:-

The K-5 water basin comprises of the main River Bhima and its tributories viz. Neera, Mula, Mutha, Pawana, Kukadi, Ghod .. etc.There are number of Dams in this basin. However the mainare 1) Ujjani 2) Neera Deodhar, Veer-Bhatagar Dams 3) Panshet , Varasgaon & Khadakwasala 4) Kukadi projects, 5) Ghod Dam .. etc.

There is large scope for social development required for community through these man made water bodies. The development is possible through Navigation & Tourism. The Possible routs of development are summarized as below

16.1 Ujjani Dam :-

The river Bhima starts from Bhimashankar, Sahyadri mountain & flows through Pune and Solapur districts of Maharashtra State. This river is a main tributary of Krishna river. Ujjani Dam was constructed on river Bhima @ village Ujjani Tal. Madha, Dist. Solapur. About 51 villages are partly or fully affected due to this project. These affected villages are resettled on the periphery of the reservoir. A green revolution was experienced by Pune, Solapur & Ahmednagar districts. Due to green revolution large no. of Agro Industries were established in this area enhancing to socio-economic living standards of population in Pune & Solapur Districts, through self employment.

The Ujjani dam provides on wide range the economic, environmental and social benefits. Also dam provides facility of limited flood control, drinking as well as industrial water supply, hydro-electricity etc.

16.1.1 Navigation :

Navigation Through Ujjani Dam Reservoir

Before completion of Dam the villagers along the bank of Bhima river have a market place at Indapur. They used to approach / reach this market place easily before completion of Dam . Due to large mass of water in reservoir the communication between either side of river these villages was nearly snapped. The villagers found their way of communication through reservoir by manually operated launches (Hodi /motor boats). Now mechanically operated launches / Hodi’s transport passengers through reservoir.

Trough detailed survey & oral inquiry it is found that at seven places the mechanically operated launches / motor boots serve the people. Now these launches have became essential need for their communication between these peripheral villages.

At the time , when reservoir is at FRL the water spread area is @ 29000 Ha. The gross capacity of Dam is 117.24 TMC. Also reservoir has dead storage of 63.538 TMC at RL 491.03m. and water spread area at MDDL is @ 19700 Ha . This shows that even if water is at its lowest level in year 54% of water remains balance. Hence there is scope for Navigation throughout the year.

Total 10 routes through Ujjani Reservair are approved by Govt. Of Maharashtra in Govt. Gazatte on 01/04/1993. These routes are referred /proposed by Commissioner of Pune. (Revenue)

1) Kondharchincholi to Kumbhargaon. 2) Kondharchincholi to Dalaj no 3. 3) Takali to Palasdeo 4) Kugaon to Kalthan. 5) Kugaon to Shirasodi. 6) Kugaon to Gangavalan. 7) Dhahigaon to Padastal 8) Dhokari to Shaha. 9) Chikhalthan to Padasthal . 10) Kugaon to Kalashi .

Out of above 10 routes approved by Govt. through gazette on 01/04/1993 following 8 routes ore popular & necessary.

Table 16.1.1 Existing water ways-route

Sr No	Water Way	Distance by road way	Distance by water way	Benefitted villages	Probable Cost (in Rs.Lakas)	Remark
1	Dhokari &Bitargaon, Tal. Karmala to Kandalgaon. Shaha, Tal. Indapur.	via wangi, karmala-Tembhurni State highway to Indapur is @ 45 K.M	11 K.M. (Water way 3 Km & Road way 8 km)	wangi, Bhiwarwadi, Bitargaon & Dhokori, Tal.Karmala & Shaha, Kandalgon Tal Indapur.	6.00	
2	Chikhalthan (Shri Kotaling Temple) to Padasthal.	Chikhalthan-Jeur-Tembhurani-Indapur 50 km.	Chikhalthan-Padasthal-Indapur 12 km. (Water way 3 Km & Road way 9 km)	Kugaon, Chikalthan no.1 & 2, Shetphal.	6.00	
3	Kugaon-Shirsodi.	Kugaon, Chikhalthan, Jeur-Tembhurni-Indapur-70 k.m.	Kugaon, Shirsodi-Indapur- 12 k.m. (Water way 3 Km & Road way 9 km	Kugaon route Between-Indapur & south Port of karmala Taluka.	5.00	
4	1) Kugaon-Kalthan no.1-Indapur.	Kugaon, Chikhalthan No.1, Jeur- Tembhurni-Indapur- 70 k.m.	Kugaon, Kalthan No.1, Gagorgaon-Indapur- 20 k.m.		10.00	Existing approach rood from kugaon to Reservoir-1 k.m. & Kalthan No.1 to Reservoir requires modification.

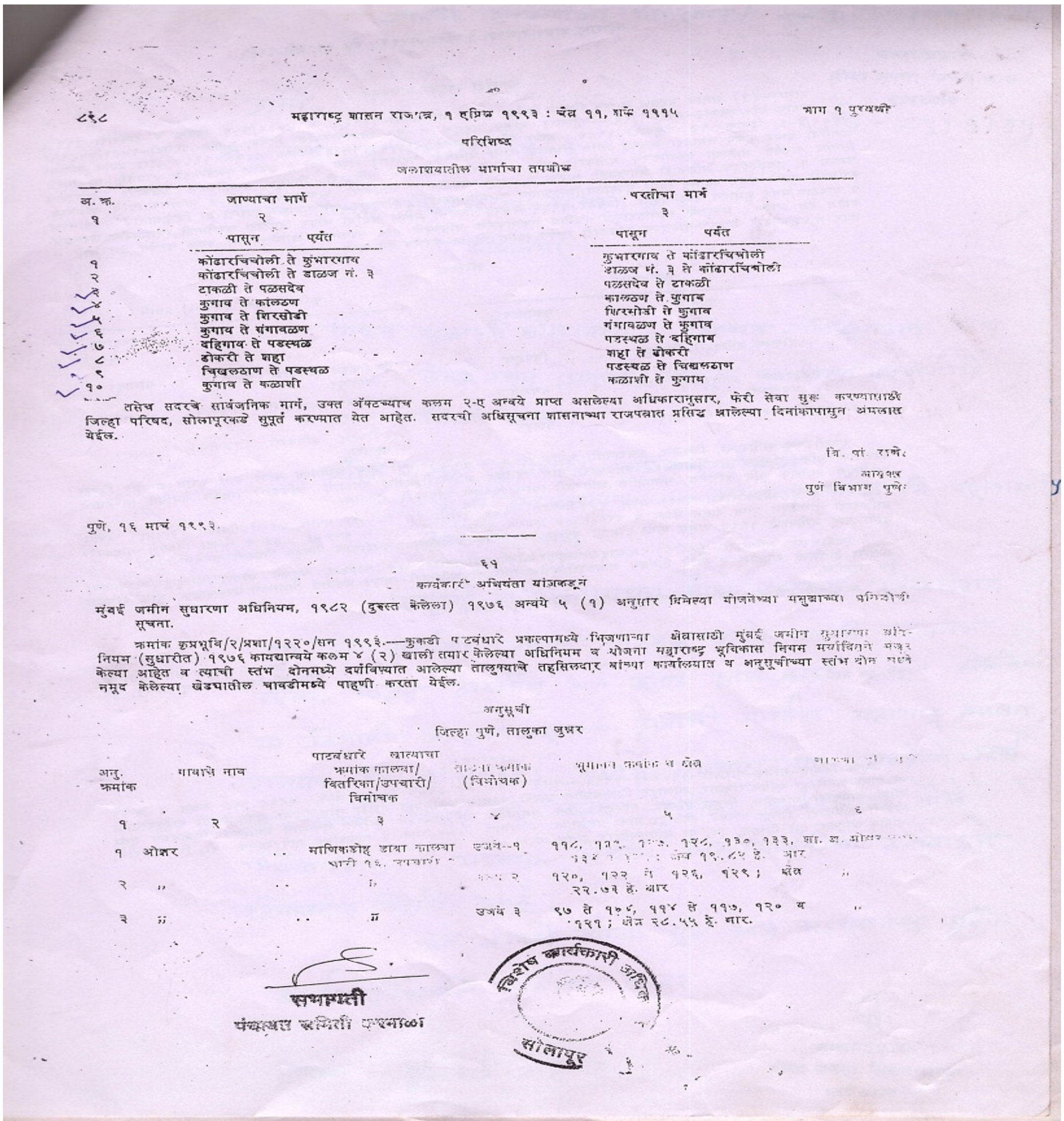
Sr No	Water Way	Distance by road way	Distance by water way	Benefitted villages	Probable Cost (in Rs.Lakas)	Remark
5	Kugaon. Tal karmala to Kalashi Tal indapur.	Kugaon, Chikhalthan shetphal. Jeur-Tembhurni-Indapur-70 k.m.	Kugaon, Kalashi, kalthan No.1, Gagorgaon-National highway to Indhapur- 25 k.m. (Water way 3 Km & Road way 22km)		10.00	Existing approach road from nearby villages to reservoir @ 1 k.m. on both side of reservoir requires modification.
6	Sogaon(Washimbe) Tal karmala to Gangavalan Tal indapur.	Sogaon, Umarad. Jeur- Tembhurni-Indapur- 80 k.m.	Sogaon, Gangavalan, Kalashi, kalthan No.1, Gagorgaon-National highway to Indhapur- 30 k.m. (Water way 3 Km & Road way 27km)		10 .00 .	Existing approach road from nearby villages to reservoir @ 1 k.m. on both side of reservoir requires modification.
7	Chandagaon to ketur Parewadi.	Ketur-Diksal,-Bhigawan to Loni (Natinal Highway) 60 k.m.	Ketur-Chandagaon to Loni (Natinal Highway) 8 k.m.		10.00	Existing approach roads from ketur (Parewadh Station) to Reservoir and Chandgaon to Reservoir requires modification.
8	Takali, Tal.Karmala to Palasdeo, Tal. Indapur	Takali – Dikasal. Bhigawan to Palasdeo via National Highway 45 k.m.	Takali – Dikasal to Palasdeo 6 k.m. (Water way 4 Km & Road way 2 km		5.00	Seasonal passenger transportation is going on this route.
9	Kondhar Chincholi Tal. Karmala to Dalaj.	35 k.m.	5 k.m. (Water way 3 Km & Road way 2 km)		5.00	Here also seasonable transportation is going on this route.
	TOTAL				**67.00**	

16.1.2 Summery of above water ways

From the above one to five and seventh routes are necessary and intensity of communication is maximum on this route throughout the year. The route no Six, eight and nine are seasonal and intensity of communication is less.

Though the Dahigaon to Padasthal & Kugaon to Gangavalan routes are approved, are not necessary as per site conditions. However, Sogaon to Gangavalan additional rout is necessary as mentioned at sr No 6

All above water ways are shown serially on index map.



८६८ महाराष्ट्र शासन राजपत्र, १ एप्रिल १९९३ : चैत्र ११, शके १९१५ भाग १ पुरवणी

परिशिष्ट

जलाशयातील मार्गांचा तपशील

अ. क्र.	जाण्याचा मार्ग	परतीचा मार्ग
१	२	३
	पासून पर्यंत	पासून पर्यंत
१	कोंढारचिंचोली ते कुंभारगाव	कुंभारगाव ते कोंढारचिंचोली
२	कोंढारचिंचोली ते डाळज नं. ३	डाळज नं. ३ ते कोंढारचिंचोली
३	टाकळी ते पळसदेव	पळसदेव ते टाकळी
४	कुगाव ते कालठण	कालठण ते कुगाव
५	कुगाव ते शिरसोडी	शिरसोडी ते कुगाव
६	कुगाव ते गंगावळण	गंगावळण ते कुगाव
७	दहिगाव ते पडस्थळ	पडस्थळ ते दहिगाव
८	डोकरी ते शहा	शहा ते डोकरी
९	चिखलठाण ते पडस्थळ	पडस्थळ ते चिखलठाण
१०	कुगाव ते कळाशी	कळाशी ते कुगाव

तसेच सदरचे सार्वजनिक मार्ग, उक्त ॲक्टच्याच कलम २-ए अन्वये प्राप्त असलेल्या अधिकारानुसार, फेरी सेवा सुरू करण्यासाठी जिल्हा परिषद, सोलापूरकडे सुपूर्त करण्यात येत आहेत. सदरची अधिसूचना शासनाच्या राजपत्रात प्रसिद्ध झालेल्या दिनांकापासुन अंमलात येईल.

वि. पां. राणे,
आयुक्त
पुणे विभाग पुणे.

पुणे, १६ मार्च १९९३.

६१

कार्यकारी अभियंता यांजकडून

मुंबई जमीन सुधारणा अधिनियम, १९८२ (दुरुस्त केलेला) १९७६ अन्वये ५ (१) अनुसार मिळालेल्या योजनेच्या मसुद्याच्या प्रसिद्धीची सूचना.

क्रमांक कृप्रभूवि/२/प्रशा/१२२०/सन १९९३.—कुकडी पाटबंधारे प्रकल्पामध्ये भिजणाऱ्या क्षेत्रासाठी मुंबई जमीन सुधारणा अधिनियम (सुधारीत) १९७६ कायद्यान्वये कलम ४ (२) खाली तयार केलेल्या अधिनियम व योजना महाराष्ट्र भूविकास निगम मर्यादितने मंजूर केल्या आहेत व त्याची स्तंभ दोनमध्ये दर्शविण्यात आलेल्या तालुक्याचे तहसिलदार यांच्या कार्यालयात व अनुसूचीच्या स्तंभ दोन मध्ये नमूद केलेल्या खेड्यातील चावडीमध्ये पाहणी करता येईल.

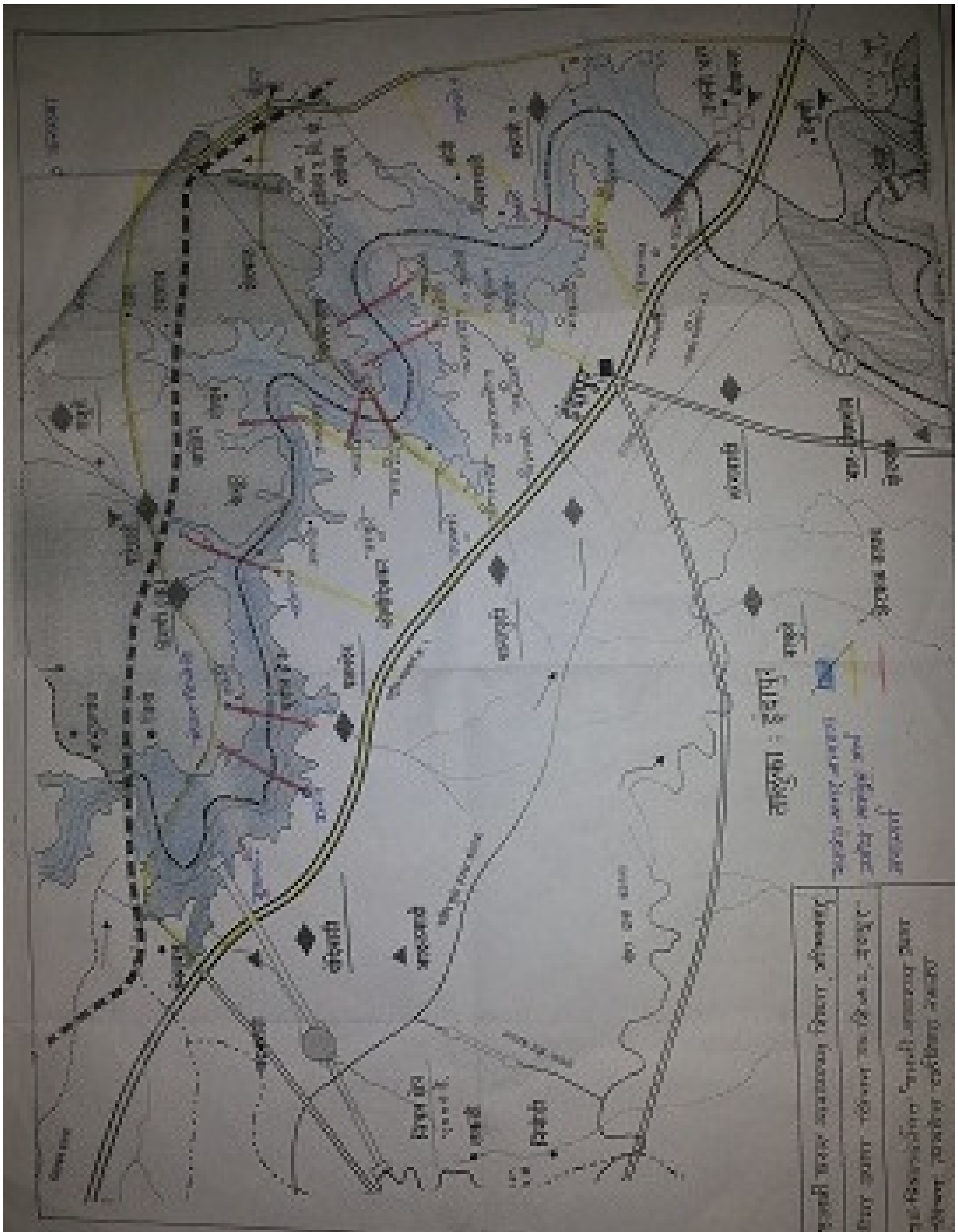
अनुसूची

जिल्हा पुणे, तालुका जुन्नर

अनु. क्रमांक	गावाचे नाव	पाटबंधारे खात्याचा क्रमांक कालवा/ वितरिका/उपचारी/ विमोचक	[illegible] (विमोचक)	भूमापन क्रमांक व क्षेत्र	[illegible]
१	२	३	४	५	६
१	ओझर	माणिकडोह डावा कालवा चारी १६, उपचारी	उजवे-१	११८, ११९, [illegible], १२८, १३०, १३३, [illegible] ; क्षेत्र १९.८५ हे. आर	[illegible]
२	"	"	उजवे २	१२०, १२२ ते १२६, १२९ ; क्षेत्र २२.७१ हे. आर	"
३	"	"	उजवे ३	९७ ते १०४, ११४ ते ११७, १२० व १२१ ; क्षेत्र २८.५५ हे. आर.	"

सभापती
पंचायत समिती [illegible]

सोलापूर



16.1.3 Tourism.

This reservoir is easily approachable from Mumbai-Hydrabad National highway as it runs parallel to reservoir spread & Ahmednagar Vijapur state highway.

There is large scope for development of Tourism centers.

A) Ujjani Dam foot Garden – Provision for very excellent & advanced garden is already made in original project report of Ujjani Project in 1965 Keeping the view of Tourism development. There is about 110 Ha. of land already acquired on Right bank of river. This place is just d/s of Dam and adjacent to National highway. This Place is already full of natural beauty.

It was already proposed to develop this garden on the basis of Vrindavan garden @ Mysore & other famous gardens in India.

There is scope for Horticulture, flower beds, Lawns, musical fountains, medical plants and so on which was already planned.

This natural beauty place can be converted in to a excellent garden through BOT facilities without economical load on public funds.

If we offer the proposal under PPP to reputed companies like TATA, Reliance, Bajaj etc, this place can enhance the beauty of Maharashtra.

Ujani Dam & Proposed Udyan area

B) Khanota Island – This area is near to Bhigawan, Tal. Indapur and totally surrounded by Ujjani reservoir water and remain open above the reservoir water when it is at FRL.- Here is scope for Boating, Garden with lawns, flowers beds, Rest House & Swimming tank. Birds from all over world migrate here in winter season.

Khanota Island traped in Ujjani Reservoir

Flemingo Birds migrated at Ujjani Reservoir

C) **Religious / Worship Places**

1) **Shri Kotaling Temple @ Chikhalthan Tal. Karmala.**

Pilgrims visit this place throughout the year. There is festival / Yatra in the month of Chaitra. (March/April) This place is also surrounded by reservoir water on all three sides & easily approachable. Acquired land above the FRL is also available. The place is already developed by Devasthan committee. Still there is scope for development.

2) **Shree Palasnath Temple at Palasdeo Tal Indapur D-Pune**

Palasnath Temple(New Resettled) Submerged Temple

3) Ganapati Temple at Siddhatek Tal Karjat D- Ahmednagar

This is a one of Ashtavinayakas famous in Maharashtra

4) **Nrusinh Mandir at Narasingapur Tal Indapur D-Pune**

Nrusinh Mandir at Narasingapur

This is a famous worship place situated at confuence (Sangam) of Bhima & Nira Rivers at D/S of Ujjani Dam @ 20Km by road. This place is rich in natural beauty.

5) ***Shri* Vitthal Mandir at Pandharpur**

This is a famous worship place situated on the bank of Bhima (Chandrabhaga River)at D/S of Ujjani Dam @ 60Km by road. On every Ekadashi Lakhs of pilgrims visit this warship place and take blessing from God Vitthala.

View of Chandrabhaga River at Shri VitthalTemple

All these temples are situated on the bank of Bhima river. Here is large scope for tourism development.

16.2 Ghod Project :-

The river Ghod rises in sahyadri hills near Bhimashankar, & flows through Pune and boundary of Ahmednagar districts of Maharashtra State and meets to Bhima River about 32 km d /s of ghod dam site. This ghod river is a main tributary of river Bhima.The principle tributaries, namely Mina and kukadi meet it u/s near villages Pargaon and Shirur repectively. Ghod Dam is constructed on river Ghod at village Chinchani Tal-Shirur Dist-Pune 30 km d/s of shirur. Seven villages are partly or fully affected due to this project. These affected villages are resettled on the periphery of the reservoir. A green revolution has been experienced by Pune, & Ahmednagar districts. Due to green revolution no. of Agro Industries are established in this area enhancing socio-economic developments of the population in Shirur and Shrigonda talukas of Pune & ahmednagar Districts, through self employment.

The Ghod dam supplies irrigation water to shrigonda, karjat talukas of ahmednagr dist and shirur taluka of pune district ,drinking water supply to shrigonda nagar parishad and villages in shrigonda and shirur talukas. Also it provides industrial water supply to MIDC, ranjangaon, Ghodganga sugar factory, shrigonda co-op sugar factory etc.

16.2.1 Navigation on ghod Dam Reservoir

Before completion of Dam the villagers along the bank of Ghod River have a market place at Shirur. They used to approach / reach this market place easily before completion of Dam. Due to large reservoir the communication between either sides of river these villages were nearly snapped. The villagers found their way of communication through reservoir by manually operated launches (Hodi).

At the time, when reservoir is at FRL the water spread area is 3092 Ha. The gross capacity of Dam is 7.638 TMC. Also reservoir has dead storage of 2.172 TMC at RL 541.02 m. and water spread area at MDDL is @ 1172 Ha. This shows that when water is at its lowest level in year 28% of water remains balance. Hence there is less scope for Navigation throughout the year.

Table 16.2.1 Existing private water ways-route

Sr. No	Water Way	Distance by road way	Distance by water way	Benefitted villages	Probable Expenditure (in Rs.Lakas)	Remark
1	Wadgaon Tal. Shrigonda to Shindodi Tal.Shirur	via Chinchani=20 km	3.00 km	Wadgaon, Shindodi, Nomhon, Gunat	6.00	

Sr. No	Water Way	Distance by road way	Distance by water way	Benefitted villages	Probable Expenditure (in Rs.Lakas)	Remark
2	Danewadi on Shirur side to Rajapur on shrigonda side	Via Shirur =25 km	2.50 km	Danewadi, Tardobachiwadi,Chavanwadi, Rajapur-1,2 and mhase.	6.00	
	Total				**12.00**	

16.2.2 Tourism.

This reservoir is easily approachable from Pune-Aurangabad state highway from shirur. There is a scope for development of Tourism centers.

One private navigation route at Tardobachiwadi near town Shirur is under consideration for tourism purpose.

16.3 Kukadi Project :-

The river Kukadi starts from Kukadeshwar, Sahyadri mountain & flows through Pune district of Maharashtra State. This river is a main tributary of Krishna river. Yedgaon & ,Manikdoh on Kukadi river Pimpalgaon Joge on Ar river Dimbhe Dam on Ghod river and Wadaj dam on Meena river was constructed. About 51 villages are partly or fully affected due to this project. These affected villages are resettled on the periphery of the reservoir. A green revolution was experienced by Pune, Solapur & Ahmednagar districts. Due to green revolution large no. of Agro Industries were established in this area enhancing to socio-economic living standards of population in Pune & Solapur, Ahmednagar Districts, through self employment.

The Kukadi complex provides on wide range the economic, environmental and social benefits. Also dam provides facility of limited flood control, drinking as well as industrial water supply, hydro-electricity etc.

16.3.1 Tourism. This Kukadi complex is easily approachable from Pune-Nashik & Nagar-Kalyan National highway as it runs parallel to Kukadi complex spread.There is large scope for development of Tourism centers.

16.3.1.A Dam foot Garden @ Dimbhe dam – Provision for very excellent & advanced garden is already made. There is about 16 Ha. of land already acquired on Right bank of river. This place is just d/s of Dam and adjacent to Pune-Bhimashankar State highway. This Place is already full of natural beauty.

It was already proposed to develop this garden on the basis of Vrindavan garden @ Mysore & other famous gardens in India.

There is scope for Horticulture, flower beds, Lawns, musical fountains, medical plants and so on which was already planned.

This natural beauty place can be converted in to a excellent garden through BOT facilities without economical load on public funds.

The development work of garden handed over to B & C Department for BOT Purpose.

16.3.1.B Yashwantrao Chavan Memorial & Garden – The Project is proposed near Yedgaon dam Tal-Junnar Dist-Pune. To develop 60 Ha of land already acquired for Yedgaon Project. The total expenditure of the project Rs.96.93 Crores which Government part is Rs. 70.41 Crores and Private developer on BOT is for Rs. 26.52 Crores. The proposal of this project is submitted to Tourism Department of Government of Maharashtra in the year 2010. The approach road for this project from Pune-Nashik highway to Yedgaon dam was taken in hand in the year 2011 and Rs.1.50 Crores expenditure has been done. The further process is in progress.

16.3.2 Religious / Worship Places

1) The Ozar & Lanayadri both the temples of Ashtvinayaka is near Junnar city

   Pilgrims visit this place throughout the year. There is festival / Yatra in the month of Bhardapad. (August/Sept) Ozar is also surrounded by reservoir water on all three sides & easily approachable. The place is already developed by Devasthan committee. Still there is scope for development.

2) The birth place of Ch.Shivaji i.e. fort Shivneri is near Wadaj dam Tal Junnar, Dist-Pune. 19th February the birth date of Ch.Shivaji is celebrated by Government of Maharashtra.

3) One of the 12th Joytirlangas the Bhimashankar Temple at Bhimashakr Tal Ambegaon D- Pune near Dimbhe dam.

4) G.M.R.T. Project is at Khodad Tal Junnar D-Pune under Government of India

   Here is large scope for tourism development.

16.4 Bhama Askhed, Andra, Wadivale, Jadhavwadi, Diwale, Thitewadi and Hadshl Dam

Dams provide a range of economic, environmental, and social benefits, including recreation, flood control, water supply, hydroelectric power, waste management, and wildlife habitat. Apart from all that following benefits should also to be consider on the dams in the K5 basin.

16.4.1 NAVIGATION :- At present rivers in the K5 basin are not perennial, but the facility for navigation is regulated on the back water of reservoirs from September to may end. Therefore there is facility available for transportation in many dams by Navigation.

16.4.2 RECREATION:-Other recreational activities such as boating, swimming, fishing etc. are also available on dams in K5 basin.

Amby Vally Ltd. Ambavane is developing Hill station near Lonavala over about 5000 Acre area. Presently they have constructed three small water bodies and running the boating activities in the created water bodies.

Boating proposals for commercial boating activities in the reservoir of Bhama Askhed, Andra, Wadivale, Jadhavwadi, Diwale, Thitewadi and Hadshi etc. are under consideration.

Dams in the K5basin are also famous for film shootings, many films are done in many other languages such as Marathi, Hindi, English , Bhojpuri and Tamil.

16.4.3 FUTURE PLANNING:-

The proposal of sea plane landing in the reservoir of Bhama Askhed is under consideration, hence the transportation facility by air may also available to the public in future. The N.O.C. for sea plane operations from Mumbai to Bhama Askhed reservoir in respect of Maritime Energy Heli Air services Pvt. Ltd. Mumbai is under consideration.

16.5 Khadakwasla Panshet, Warasgaon, Pawana & Chaskaman -Dams provide a range of economic, environmental, and social benefits, including recreation, flood control, water supply, hydroelectric power, waste management, and wildlife habitat. Apart from all that following benefits should also to be consider on the dams in the K5 basin.

16.5.1 NAVIGATION :- At present rivers in the K5 basin are not perennial, but the facility for navigation is regulated on the back water of reservoirs from September to may end. Therefore there is facility available for transportation in dams by Navigation. But Dams within the jurisdiction of this Division viz. Panshet, Warasgaon, Pawana & Chaskaman are Hydro Power Projects hence as per Government Resolution dated 08/12/2003 navigation/ boating on Hydro Power Projects is not allowed. Water body rights of the Khadakwasla Dam are with the National Defense Academy hence navigation in Khadakwasla Reservoir is not allowed.

16.5.2 RECREATION:-Other recreational activities such as boating, swimming, fishing etc. are also available on dams in K5 basin.

16.6 LAWASA PROJECT - Govt of Maharashtra Urban Development Department vide Notification on dated 01-06-2001 has declared the following villages in Mulshi & Velhe Tahasil of Pune district as Tourisum area & these villages are on both the flanks of Warasgaon dam of Khadakwasla Major project. These villages are as follows.

a) Mulshi Tahasil: Village Bhonde, Patharshet, Bembatmal, Palase, Admal, Padalghar, Dasave, Wadawali, Sakhari, Bhoenee, Mugaon, Ugawali, Koloshi, Dhamanohol, Gadale.

b) Velhe Tahasil : Village Mose (Bk), Saiv (Bk), Warasgaon

The area declared under these villages is except forest land

To develop the tourisum area as declared above & with demand from Lavasa Company's letter on dtd 29-10-2001 the MKVDC vide letter on dtd 29-05-2002, the 8 Nos of bandharas are sanctioned to construct in submergence and in catchments area of Warasgaon major project. The storage capacity of these 8 bandharas is 871 mcft. out of 8 Bandharas, 2 Bandharas are sanctioned to construct in submergence of Warasgaon dam & the designed storage of these 2 bandharas is 284 mcft. 2 Bandhara in submergence i. e. @ village Dasawe & Gadale are completed and todays tentative storage of these 2 bandharas is 205 mcft. Being storage in submergence of 2 banadharas, these storage's are released in submergence of Warasgaon dam as per directive's of MKVDC.

The acquired land of 141.15 hectors is leased by MKVDC to Lawasa Company & the agreement is executed during Sept. 2002 with period of 30 years. The 128.79 Hect. land out of 141.15 is under submergence of Warasagon & remaining land of 12.36 Hect is near the submergence but out of submergence. The annual rent of these land is Rs. 2,75,250 / Per year. The land rent upto April 2015 amounting to Rs. 34,63,630/- is paid by Lawasa to Govt. / MKVDC.

CHAPTER 17 - Environment Management and Ecology

17.1.0 Introduction

Ecosystem protection and poverty alleviation are of utmost importance in achieving the Millennium Development Goals. In most developing countries, the two are closely interlinked. But, due to unsustainable anthropogenic pressures, the carrying capacity of ecosystems is severely jeopardized, thus affecting ecosystem goods and services on which the rural poor depend directly. Attempts at focusing on one of these aspects without working on the other have proven to be unsustainable. An approach focused entirely on ecosystems, that does not perceive the local communities as a part of ecosystems or conversely, an approach focused entirely on communities and livelihoods that does not prioritize the urgent need for preservation and restoration of degrading ecosystems have shown to have limited relevance in tackling ground realities. In the two options mentioned above, the approaches have been developed by well-meaning external organizations or governments that seek to 'manage' their projects from a distance, while the vision, wisdom or problems of the local community are seldom seen as the building blocks for developing the approach further.

The rate of growth of urban development in the recent years has been exponential whereas the city infrastructure growth has not been able to match this pace. This has led to enormous pressures on the existing ecological resources, surface water body being one of the most affected. The conventional philosophy of human habitat settlements have always been inspired around the banks of river and thus the dependency on these surface waters for consumption and waste discharges kept on increasing day by day. Though the city governments and local bodies have been trying to cope up with the infrastructure fulfillment, the fact that natural resources have been over exploited shall remain true in times to come.

Water has remained as one of the most demanded commodity for humans. The problem of water is twofold, one that surface water is exploited for domestic & industrial consumption and most of the treated and untreated sewage & industrial wastewater are released back into the surrounding surface water bodies. The problem is further aggravated when these water bodies are perennial and ultimately become sewage of wastewater conveyance systems rather than rivulets. Not only is the sewage a major culprit but many industrial setups around river have been discharging their waste into these rivers and have resulted in total disruption of the existing ecological balance in these water bodies. Thus, the carrying capacity of these ecological resources have been saturated in the recent past which means these river bodies do not have any further natural healing process & if the wastewater discharges continue at this pace, the rivers shall be dead in no time. Many such examples have been quoted in the past and several attempts have been made to rejuvenate / remediate such waste courses like Ganga, Yamuna and many others. One such river that has been in discussion in the recent past is **Bhima** river and this report attempts at delineating discussions to understand the potential environmental damage that has occurred in this surface water body, its reasons to certain extent and prioritize conservation action plan in order to rescue it from further degradation to the extent possible for sustainability.

17.2.0 Upper Bhima Sub-Basin (K-5)

The Bhima River is one of the main tributaries of river Krishna, which forms a large river basin in the southern peninsula of the Indian subcontinent. The river rises from the Bhimashankar hills near Karjat on the western side of the Western Ghats at an altitude of about 945 m above the sea level. The Bhima River has a vast basin comprising of about six million hectares, and flows from west to east passing through the states of Maharashtra and Karnataka, before meeting the river Krishna, which flows further south to the state of Andhra Pradesh. The banks of the Bhima River are densely populated and form a fertile agriculture land. The river also causes floods due to heavy rainfall it receives during the monsoon. In the course of journey it meets many small rivers. The major tributaries of this river are Kukadi, Ghod, Bhama, Indrayani, Mula, Mutha and Pawana. The Indrayani, Mula, Mutha and Pawana flows through Pune & Pimpri Chinchwad city.

Kukadi River (rises Yedgaon Dam and after travelling 61 Km) meets Ghod River (rises from Dimbe Dam at 67 km) at Mhase Shirur. Ghod River then meets Bhima River at Daund. Indrayani River rises from Walwan Dam and meets Bhima River at Lonikand. The Pawana river (rises from Pawana Dam) meets Mula River (rises from Mulshi Dam) near Dapodi, Pimpri Chinchwad. The Mula River meets Mutha River (rises from Khadakwasala Dam) at Sangam Bridge near the Pune railway station. Mutha River meets Bhima River at Rahu. The Bhima River meets the Nira River in Narsingpur in Malshiras taluka in Solapur district. The last 298 km of its course is in Karnataka where it merges with Krishna River near Kudlu in Raichur district. Ujani dam is constructed on the river Bhima, nearly 160 kilometers downstream of Pune city. Built on a relatively flat land surface, the submergence area stretches nearly 40 kilometers from the dam wall. The environmental impacts at Ujjani are an indication of the increasing water pollution in Pune and the cities upstream of the dam. Sina originates in Parner Tehsil flowing through Ahemdnagar and Solapur District and finally meets to Bhima River in Karnataka State. There is no River from Latur and Osmanadabd district meets to Krishna River in Basin K-5.

Bhima flows southeast for long journey of 725 km. The total basin area is 45335 km^2. The population residing along the banks of Bhima is approximately 16.76 million people (2011) with 30.90 million people expected by 2030. Seventy-five percent of the basin lies in the state of Maharashtra.

17.3.0 Probable Sources of Water Pollution in Bhima River and Tributaries

This section describes the most probable reasons of water pollution in the Bhima river basin and its tributaries. This shall not be considered as only limited to these but may be thought as the major sources of pollution.

17.3.1 Urban Development

With the development of Pune city and its industrial growth especially in IT sector causing in-migration and leading to exponential growth of population, demand for water supply has increased exponentially. About 70-80% of this water is disposed as wastewater (sewage). Part of this wastewater is treated whereas partly it is being disposed as it is in rivers causing great potential for river pollution.

17.3.2 Industrial wastewater

There are 12 industrial areas in Pune District, 5 Industrial Areas in Solapur District, and 1 Industrial Area in Ahemadnagar District. Almost all of them are located near the river basins. Most of the industries consume the surface water in process and for domestic use and though most of these industrial areas and industries within are equipped with wastewater treatment plants, it cannot be ruled out that there may be several incidences that this wastewater may form one of the reasons for water pollution. Maharashtra Pollution Control Board does not give permission to any industry of Industrial Area for disposal of treated industrial effluent into the River or water body.

17.3.3 Leachate from Solid Waste

Several of the cities & villages are located near the river basins and most of them have open dumping facilities for solid waste that are inevitably non-scientific. These sites form one of the most critical sources of water pollution due to leachate formation during precipitation

17.3.4 Agricultural Practices

Almost all of the Upper Bhima Sub-basin is fertile and agricultural activities prevail in these areas. Due to the present practices of chemical based agriculture (enormous use of chemical fertilizers and pesticides), runoffs from these areas also forms one of the major reasons of river water pollution

17.3.5 Sand Dredging

Bloom of construction industry in the recent past has led to over exploitation of river resources especially sand. Dredging in Upper Bhima Sub-basin is common practice that is supposed to lead to changes in bathymetry of the river basin (due to creation of huge voids). These voids tend to accumulate excessive water and reduces natural percolation rate ultimately affecting ground water level in surrounding areas and also leading to ingression of minerals in connected water bodies leading to higher hardness. Ultimately these man-made interference slowdowns the natural water purification process of river.

17.3.6 Lack of maintaining Minimum Water Level in River

Excessive construction of Check Dams across the river beds restricts minimal flow of water throughout the river bed thereby affecting the ecological balance of the river. The bigger picture suggests that except for the perennial flow of rain water, these rivers tend to carry sewage due to reduced dilution potential. Furthermore, stagnation of sewage waters in the river due to minimal flow also leads to percolation of this polluted water into aquifers further aggravating the situation and extending pollution from surface water to other sources

17.3.7 Algal Growth

Stagnation of water on one hand & continuous sewage flow on the other enhances the growth of algae and other similar organisms that further deteriorate the quality of river water

17.3.8 Siltation

Soil erosion due to runoffs and compounding of water due to changes in the river beds lead to possibility of increased siltation. The detritus effect of algae and other organisms at high siltation spots further leads to septic conditions adding to the pollution problems

17.3.9 Miscellaneous Sources

Religious events at several of the places located in and around river basins such as Alandi, Dehu, Pandharpur, etc. gathering several thousands of pilgrims are dependent on these rivers for their daily activities and may also form event based acute source of water pollution

17.4.0 Sewage Generation Potential

Upper Bhima Sub-basin and its tributaries have been receiving enormous amount of discharges from treated and untreated sewage generated from various Municipal Corporations, Councils, Villages and few industries. The details of the same are represented in **Annexure-17.1** It is clearly evident that Pune Municipal Corporation, Pimpri Chinchwad Municipal Corporation and Ahemadnagar Municipal Corporation are the most important source of contributory pollution factors to Mula, Mutha, Indrayani & Pawana rivers ultimately joining Bhima River that are finding their way to these rivers via about 21 & 11 nallahs respectively.

The details of Water Consumption, Wastewater Generation and Treatment capacity of local bodies in Upper Bhima Sub-Basin are enclosed as Annexure-17.1.

Thus, it could be estimated that out of the total 1307 MLD sewage generated, almost 62% i.e. 818 MLD of it is treated whereas the remaining 489 MLD is discharged into the river. Out of these untreated discharges, Pune city contributes about 177 MLD, PCMC contributes 67 MLD, Councils contribute 66.58 MLD & Cantonment Boards contribute 31.1 MLD.

17.5.0 Industrial effluent potential

As per the stipulated norms of the State Pollution Regulatory Authority, there is no any industry allowed to discharge treated/untreated effluent into the water body directly.

The details of individual industries & industrial estates on the near bank of rivers of Upper Bhima Sub-Basin are enclosed as Annexure-17.2.

All industries have provided their own Effluent Treatment facilities and treated effluent is used for gardening/irrigation in their own premises. Maharashtra Pollution Control Board does not give permission to any industry of Industrial Area for disposal of treated industrial effluent into the River or water body.

17.6.0 Water Sampling and Quality Monitoring Stations

As it has been stated in various sections of this report that wastewater from different habitations enters into the river in untreated form and thereby there is a potential for environmental degradation of same. In view of the above and to understand this potential, Maharashtra Pollution Control Board office at Pune has been carrying out monitoring of various stretches of Bhima River since past several years (MINARS lately termed as NWMP programme).

Samples are collected from 35 locations of Upper Bhima Sub-basin every month & quarterly samples for 3 locations is collected and analyzed for 26 representative parameters. Accordingly, the most important indicators that has been used in this study to represent the strength & potential of organic load in the river in terms of BOD, DO and coliform contamination are represented in **Table 17.1**. Furthermore, Trend analysis over the past 4 years i.e. from 2011 to 2014 for all parameters analyzed are presented in the later section of this report for a more elaborate & objective view of environmental status of river.

Table 17.1 Characteristics of Different Stretches of Bhima River Basin

Location	DO (mg/lit)	BOD (mg/lit)	Total Coliform/100ml	Fecal Coliform/100ml	Remarks
I] Mutha River					
Near Khadakwasla Dam	5 – 7	4 – 8	200 – 900	10 – 200	Potable after proper treatment
Near Vittalwadi	1 – 2	8 – 25	1600 – 1800	25 – 275	Non-potable even after treatment
Near Deccan	2 – 7	10 – 70	180 – 1800	200 – 450	Non-potable even after treatment
Near Veer Savarkar Bhavan	2.5 – 4	15 – 85	180 – 1800	275 – 450	Non-potable even after treatment
II] Mula River					
Near Aundh	1.5 – 4.5	10 – 90	800 – 1800	140 – 425	Non-potable even after treatment
Near Sanghvi	0.5 – 2.5	15 – 130	800 – 1800	125 – 350	Non-potable even after treatment
III] Mula Pawana River					
Near Harrison Bridge	0 – 3.5	10 – 55	1600 – 1800	200 – 425	Non-potable even after treatment
Near Dapodi	0.5 – 3.0	15 – 45	180 – 1800	275 – 425	Non-potable even after treatment
IV] Pawana River					
Near Ravet Check Dam	6 – 7	4 – 10	225 – 1600	40 – 200	Potable after proper treatment / Need for disinfection must
Near Chinchwad Village	1.5 – 5.0	8 – 25	1600 – 1800	100 – 1000	Non-potable even after treatment
Near Pimpri	0.5 – 3.0	10 – 60	180 – 1800	170 – 425	Non-potable even after treatment

Location	DO (mg/lit)	BOD (mg/lit)	Total Coliform/100ml	Fecal Coliform/100ml	Remarks
Village					
Near Kasarwadi	0.5 – 6.5	5.5 – 40	900 – 1800	140 – 550	Non-potable even after treatment
V] Indrayani River					
Near Moshi Village (U.S)	1.5 – 7.0	3.5 – 30	900 – 1800	115 – 200	Potable after treatment in rainy season
Near Moshi Village (D.S)	0.5 – 6.0	4.5 – 70	900 – 1800	90 – 275	Potable after treatment in rainy season / Need for disinfection must
Alandi Village	2 – 8	5 – 17	900 – 1800	100 – 350	Potable after treatment in rainy season / Need for disinfection must. Additionally, stop sewage entering from Moshi Nalla
VI] Mula - Mutha River					
Near Sangam Bridge	0 – 3	20 – 70	180 – 1800	350 – 425	Non-potable even after treatment
Near Band Garden	1 – 3	15 – 30	180 – 1800	275 – 425	Non-potable even after treatment
Near Mundwa Bridge	0.5 – 2.5	20 – 80	180 – 1800	275 – 425	Non-potable even after treatment
Near Theur	1 – 5	9 – 35	900 – 1800	100 – 350	Non-potable even after treatment
VII] Vel River					
Near Shikhrapur	5.5 – 6.5	3 – 11	500 – 1800	10 – 300	Potable after treatment in rainy season / Need for disinfection must
VIII] Ghod River					
Near Shirur	2.5 – 7	4 – 19	500 – 1800	10 – 300	Potable after treatment in rainy season / Need for disinfection must. Need to control sewage from Shirur Municipal Council
Nira River					
U/s of Jubiliant	2.80-7.11	3.00-11.20	425-1800	35-275	Potable after treatment in rainy season / Need for disinfection must. Need to control sewage from Shirur Municipal Council
D/s of Jubiliant	1.40-7.25	4.5-16.8	550-1800	70-425	Potable after treatment in rainy season / Need for disinfection must. Need to control sewage from Shirur Municipal Council
@Sarola Bridge, Pune Bangalore Highway	1.08-7.21	1.80-11.20	260.82-1800	45-275	Potable after treatment in rainy season / Need for disinfection must. Need to control sewage from Shirur Municipal Council

Location	DO (mg/lit)	BOD (mg/lit)	Total Coliform/100ml	Fecal Coliform/100ml	Remarks
IX] Bhima River					
Near Koregaon Bridge	2.6 – 6.5	3.4 – 18	800 – 1800	100 – 300	Potable after treatment in rainy season / Need for disinfection must
Near Pargaon	3.0 – 6.5	6 – 15	900 – 1600	180 – 225	Potable after treatment in rainy season / Need for disinfection must
Near Daund	4.5 – 6.5	6 – 15	900 – 1600	100 – 225	Potable after treatment in rainy season / Need for disinfection must
Ujjani Backwater	5.5 – 6.5	4 – 10.5	200 – 1800	10 – 400	Potable after treatment in rainy season / Need for disinfection must
Narsingpur	0 – 7.2	3-26	95-1800	4-425	Potable after treatment in rainy season / Need for disinfection must
Takli	3.86–7.18	1.6-11	350-1800	40-425	Potable after treatment in rainy season / Need for disinfection must
Aklai Devi Mandir	0-9.8	4.6-24.5	425-1800	110-550	Potable after treatment in rainy season / Need for disinfection must
Pandharpur (U.S)	0-7.19	2.8-26	350-1800	40-350	Potable after treatment in rainy season / Need for disinfection must
Pandharpur (D.S)	1.02-7.84	3.5-16.5	438-1800	55-425	Potable after treatment in rainy season / Need for disinfection must
IX] Sina River					
Burudgaon (Ahemadnagar)	1.4-5.1	2.8-58	80-500	22-350	Potable after treatment in rainy season / Need for disinfection must
Lambothi	3.9-7.2	2.8-12.2	350-1800	25-350	Potable after treatment in rainy season / Need for disinfection must

17.7.0 Hydraulic & Organic Load

As discussed in the earlier section of this report, it has been essential to understand the extent of water usage and wastewater disposal in the treated and untreated form that has been happening in the course of this river in order to determine the present environmental status & future carrying capacity of the same. This could be achieved by calculating the theoretical organic and hydraulic loads entering the river on one hand, whereas a more systematic approach that has been used by several of the agencies has been to take up extensive monitoring and analysis of the representative sections for environmental parameterization. The scope of the present study is to theoretically calculate such hydraulic and organic load & further delineate options for its management.

The rate of urban and rural settlements around the Upper Bhima Sub-Basin has been projected to be 31 Million by 2030 & thereby revealing that the present population shall be around 19 Million (*Wikipedia*). The hard fact of Upper Bhima Sub-Basin has been that these settlements possess limited access to sanitation infrastructure. Infact, through India, the urban sanitation has been limited to not more than 50% in Class I cities and in rural areas it doesn't even exists. The scenario is threatening when the hydraulic loads from these settlements around Upper Bhima Sub-Basin is calculated revealing water consumption in the range of 1725 Million Liters per Day (MLD).

On the other hand, it is also necessary to understand that urban water supply and sanitation are important basic needs for the improvement of the quality of life and enhancement of productive efficiency of the people. In urban areas, water is tapped for domestic and industrial uses from rivers, streams, wells and lakes. Almost 80% of the water supplied for domestic use, comes out as wastewater.

With the enhancement of drinking water supply to urban areas, the wastewater generation is increasing. If such wastewater is not collected, treated and disposed properly, it will create directly contribution to the locally available freshwater supplies. Additionally, the cumulative results of untreated wastewater can have broad degenerative effects on both public health and ecosystem in downstream areas.

Municipal sewage may be defined as "waste (mostly liquid) originating from a community; may be composed of domestic wastewaters and/or industrial discharges". It is major source of water pollution in Upper Bhima Sub-Basin, particularly in and around large urban centers. In Upper Bhima Sub-Basin about 78% of the urban population has access to safe drinking water and about 38% of the urban population has access to sanitation services.

17.7.1 Load Estimations for Sewage

Thus, taking an average of 80 – 85% of the water consumed to be wasted as domestic sewage, the total hydraulic load adding into the river sums up to be about 1304.43 MLD.

However, Upper Bhima Sub-Basin entails about 484.53 MLD of untreated raw sewage throughout its journey.

It is essential to understand that the organic loading or strength of the sewage and/or pollution potential of the sewage is determined by a chemical parameter known as Biochemical / Biological Oxygen Demand (BOD). Based on the past experience from sewage organic loading, the total amount of BOD load as expressed in mg/Lit is found to be in the range of 200 to 250. Thus, considering the worst case scenario and assuming the BOD to be 250 Mg/Lit, the total organic load from sewage into the river body accumulates to be about 121.13 tons/day.

Simultaneously, approximately 819.9MLD of treated sewage expected to be having BOD of about <100 and most of Municipal Corporations achieving <30 BOD and below being discharged into the river water body leading to a dilution of 1:2. Thereby the effective BOD load seems to be amounting to about 25 tons/day. Thereby, the total BOD load added to Upper Bhima Sub-Basin is about 146.13 tons/day.

Thus, in order to remove this entire BOD, theoretically 730 tons/day of air shall be required to be replenished into the river stretch (considering 20% O_2 in air) assuming 100% diffusivity in order to neutralize the organic load entering the system.

17.7.2 Load Estimations for Industries

As per the stipulated norms of the State Pollution Regulatory Authority, only 2 industry is allowed to discharge their treated wastewater into the surface water body as presented earlier. Out which only one industry is discharging treated effluent into the River after meeting the Standards prescribed in the consent. Analysis results of the effluent quality are enclosed in as Annexure.

17.8.0 River Water Quality of Upper Bhima Sub-Basin

Physico-chemical and biological characterization of Upper Bhima Sub-Basin through sampling and analysis of various indicator parameters are carried out in order to assess the overall environmental status of surface water. Characterization forms one of the first steps towards formulating management plan. Furthermore, in order to evaluate periodic changes (positive/negative) and effectivity of management measures adopted over a period of 4 years, a comparative account of specific subsets of representative parameters are clubbed together for each of the 35 sampling locations in Upper Bhima Sub-Basin as presented in subsequent part of this report along with a brief interpretation including those compared with Indian Drinking Water Standards.

For the said study, the entire stretch of Upper Bhima Sub-Basin from Pune, Solapur and Ahemadnagar has been divided into 10 stretches to ease out the analysis and interpretation. The 10 stretches are viz. Pawna, indrayani, Mula, Mutha, Mula-Mutha-Bhima, Bhima river flowing in Solapur district, Bhima flowing in Pune district, Ghod river and Nira river and Sina River Ahemadnagar to Solpaur. Each of the stretch contains various sampling locations which are detailed in following Table 17.2 For each of the location, samples are drawn for consecutive four years, starting from 2011 to 2014.

Table 17.2 Sampling locations along with station codes

River Name	Station code	Identification of loaction
Bhima River in Solapur	2789	Nallah at D/s. of Aklai Mandir, Akluj, Malshiras, Solapur
	1188	Bhima River at Narsinghpur, (D/s., A/c. with Nira River)
	1911	Chandrabhaga, U/s of Pandharpur Town, Solapur
	1912	Chandrabhaga, D/s of Pandharpur Town, Solapur
	28	Bhima River, Takali Village, Solapur
Bhima River in Pune	2655	Bhima River at Koregaon near Koregaon Bridge, Shirur, Pune
	2656	Bhima River Back water of Ujani Dam, near Raw Water pump house, Kumbhargaon, indapur, Pune
	1192	Bhima after Conf. with Dound, Pune
Ghod River	2665	Ghod River, At-Shirur , Pune
	2715	Vel River at Shikhrapur
Nira River	2682	Nira River at U/s of Jubilant Organosis, Datta Ghat, Baramati, Pune.
	2195	Nira River at D/s of Jubilant Organosis, Bhigwan, Pune
	1463	Nira at River, Sarola on Pune Bangalore Highway
Indrayani	2669	Indrayani River at U/s of Moshigaon, Haveli, Pune
	2668	Indrayani River at D/s of Moshigaon Haveli Pune
	2197	Indrayani River at D/s of Alandigaon, Pune
Mula-Mutha-Bhima	1190	Bhima at D/s of Bund Garden, Haveli, Pune

River Name	Station code	Identification of Ioaction
	2192	Mula Mutha River at Mundhawa Bridge, Pune
	1191	Bhima at Pargaon, (A/c. with Mula)
	2677	Mula Mutha River at D/s. of Theur Haveli, Pune
Mula	2193	Mula River at Aundh Bridge, Aundh gaon , Pune
	2194	Mula River at Harrison Bridge, Near Mula-Pawana Sangam, Pune
Mutha	2680	Mutha River at Khadakwasla Dam, Khadakwasala, Haveli, Pune
	1189	Bhima at Pune U/s of Vithhalwadi, Haveli, Pune
	2678	Mutha River at Veer Sawarkar Bhavan, Pune
	2679	Mutha Rive at Deccan Bridge, Deccan, Pune
	2191	Mutha River at Sangam Bridge, Near Ganpati GhaT, Pune
Pawna	2692	Pawana River at Rawet weir, Ravet, Haveli, Pune.
	2693	Pawna River at Chinchwadgaon, Haveli, Pune
	2694	Pawana River at Pimprigaon, Haveli, Pune
	2690	Pawana River at Kasarwadi, Haveli, Pune
	2691	Pawana River at Dapodibridge, at Pawna-Mula Sangam, Dapodi, Haveli, Pune.
	2196	Pawana River at Sangavigaon, Pune
Sina River	195	Burudgaon in Ahemadnagar District
	2705	Sina River at Lamboti Toll naka, Lamoti, Mohol, Solapur

17.8.1 Mutha River

Mutha river being large stretch; samples were collected from five different locations within the stretch viz. Mutha River at khadakwasla dam(2680), Mutha at upstream of Vithhalwadi(1189), Mutha at Deccan Brige(2679) Deccan, Mutha at Veer Savarkar Bhavan(2678) Pune, & Mutha at Sangam Bridge near Ganpati Ghat(2191), Pune. The result observed of the analysis are represented in the **Table 17.3**

Table 17.3 Summary of river quality for four years at Mutha River

Parameters	Max	Min	Avg	SD
pH	9.07	6.57	7.91	0.03
Dissolved Oxygen mg/l.	8.50	0.00	2.40	0.29
B. O. D. 27° C (3 days) mg/l.	23.50	1.40	12.01	1.26
COD	64.00	8.00	34.70	3.17
COD/BOD	9.00	0.73	3.14	0.48
Conductivity µmhos/cm.	806.40	59.00	371.10	45.64
Total Dissolved Solids	645.00	40.00	256.65	36.65
Total Fixed Solids	516.00	32.00	215.28	29.04
Total Suspended Solids	9.07	6.57	7.91	0.03
Turbidity	8.50	0.00	2.40	0.29
Hardness	23.50	1.40	12.01	1.26
Nitrate-N mg/l.	8.20	0.02	1.27	0.38
Ammonia mg/l.	23.40	0.02	2.32	2.34
TKN	28.00	0.00	3.82	2.26
Total Coliform (MPN) / 100 ml.	1800.00	40.00	1467.79	112.75
Faecal Coliform / 100 ml.	900.00	6.00	267.62	34.66
Chlorides	180.00	3.00	51.91	28.46
Sulphates	272.00	0.90	23.15	23.50
Calcium	144.00	2.00	59.08	32.03
Magnesium	192.00	2.90	52.67	31.27
Fluorides	4.00	0.00	0.91	0.57

Table 17.3 shows the combined analysis results of five locations studied monthly for four consecutive years within Mutha river stretch. It is depicted from the table that maximum pH is 9.07 which is alkaline similar to Mula-Mutha river & it is observed at location 1189 whereas average pH is observed to be 7.91 showing the neutral concentration.

BOD concentration is observed to be maximum at location 2678 with a concentration of 23.50mg/l whereas it is minimum at location 2680 showing concentration of 1.40mg/l. COD is maximum at location 2191 with concentration of 64mg/l crossing the potable water standards limits whereas it is observed to be minimum at location #2680 having concentration of 8mg/l.

The average ratio of COD/BOD observed throughout the stream is 3.14mg/l which shows more polluted region.

Maximum dissolved solids were observed at location #2680 with concentration of 645mg/l whereas minimum concentration of 40mg/l is observed at same location during rainy season due to dilution of water. Average of total fixed solids was observed to be 215.28mg/l in this river stretch.

Maximum hardness is observed at location #2680 with a concentration of 288mg/l. The average concentration of hardness observed throughout the stream is 123.71mg/l.

It is depicted from the table that nutrients are maximum at location #2191 while minimum concentration of 0.02mg/l is observed at location 2680. The average concentration of nitrate is 1.27mg/l, ammonia is 2.32mg/l & TKN is 3.82.

Chlorides in Mutha river ranges from 3mg/L to 180mg/L. Average value for sulphates is observed to be 23.15mg/L whereas the average value for calcium is found to be 59.08mg/L. Calcium has minimum concentration of 2mg/L and reaches to maximum of 144mg/L. Magnesium has minimum concentration of 2.90mg/L and maximum of 192mg/L. In Mutha river, Fluoride concentration ranges between 0 to 4mg/L averaging to about 0.91mg/L

Maximum total coliform count is observed to be 1800 MPN/100ml whereas minimum is observed at a concentration of 900 MPN/100ml.

Table 17.4 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Mutha River

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	88.41
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	0.43

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	99.14
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	86.27
15	Total Hardness	Upto 300	100
16	Chlorides	Upto 250	100
17	Sulphates	Upto 200	99.57
18	Calcium	Upto 75	71.24
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	100

Table 17.4 reflects that for all the sample along Mutha river, 88.41% of the samples have pH within the permissible limits of 6.5-8.5 whereas all of the samples show Nitrates concentration well below the limits. About 0.43% of the sample indicate the Total Colifirms in the range of 10.

For Total dissolved solids, the required limits are upto 500mg/L and about 99% samples are within the standards; only 0.86% crosses the concentration of TDS but falling within the standards of permissible limits defined as 2000mg/L. It can be seen that all of the samples have fallen in the limit of standards defined for Hardness as upto 300mg/L however, 86.27% of the samples are falling in the range of concentration upto 5% defined for Turbidity. 13.73% of the samples are exceeding the prescribed standards for Turbidity.

The limits prescribed for Chlorides is 250mg/L and it is observed that all of the samples have Chloride concentrations well below 250mg/L complying 100% to the standards. About 71% of the samples show Calcium concentrations within limits, i.e. below 75mg/L and about 99.57% samples are showing Sulphates concentrations within limits. For all of the samples, the Fluoride values are not crossing the standard limits of 10mg/L which makes it safe for drinking.

17.8.2 Mula River

Samples were collected at two locations in this river stretch viz. Mula at Aundh bridge (2193) Aundh gaon, & at Harrison Bridge near Mula – Pawana Sangam(2194) Pune. The observations of samples analyzed is represented in **Table 17.5**

Table 17.5 Summary of river quality for four years at Mula River

Parameters	Max	Min	Avg	Stdev
pH	8.92	6.94	7.97	0.01
Dissolved Oxygen mg/l.	7.21	0.00	2.86	0.08
B. O. D. 27° C (3 days) mg/l.	29.80	3.20	11.77	1.16
COD	60.00	12.00	33.59	1.12
COD/BOD	6.32	0.40	3.04	0.15
Conductivity µmhos/cm.	843.20	13.20	473.18	0.25
Total Dissolved Solids	610.00	98.00	328.95	12.15
Total Fixed Solids	550.00	84.00	277.28	12.71
Total Suspended Solids	64.00	0.00	20.93	3.73
Turbidity	174.00	0.08	9.24	0.39
Hardness	270.00	46.00	165.57	7.35
Nitrate-N mg/l.	15.00	0.18	1.94	1.32
Ammonia mg/l.	17.80	0.06	2.58	0.94
TKN	20.72	0.00	4.38	0.76
Total Coliform (MPN) / 100 ml.	1800.00	900.00	1729.35	112.68
Faecal Coliform / 100 ml.	550.00	14.00	283.02	26.09
Chlorides	128.00	12.00	64.3	27.5
Sulphates	84.40	3.8	34.3	18.1
Calcium	152.0	19.2	79.7	35.3
Magnesium	168.0	1.9	71.6	35.6
Fluoride	2.30	0.0	1.0	0.5

Table 17.5 shows the combined analysis results of two locations studied within Mula river stretch. It is depicted from the table that maximum pH is 8.92 which is alkaline similar to Mula-Mutha river & it is observed at location #2193 whereas average pH is observed to be 7.97 showing the neutral concentration.

BOD concentration is observed to be maximum at location 2194 with a concentration of 29.80mg/l whereas it is minimum at location 2193 showing concentration of 3.20mg/l. COD is maximum at location 2194 with concentration of 60mg/l crossing the potable water standards limits whereas it is observed to be minimum at both location having similar concentration of 12mg/l. The average ratio of COD/BOD observed throughout the stream is 3.04mg/l.

Maximum dissolved solids were observed at location #2193 with concentration of 610mg/l whereas minimum concentration is 98mg/l. Water is observed to be turbid throughout the stretch. Average of total fixed solids was observed to be 277.28mg/l in the said river stretch.

Maximum hardness is observed at location #2193 with a concentration of 270mg/l. The average concentration of hardness observed throughout the stream is 165.57mg/l.

It is depicted from the table that nutrients are maximum at location #2193 while minimum concentration of 0.06mg/l is observed. The average concentration of nitrate is 1.94mg/l, ammonia is 2.58mg/l & TKN is 4.38.

Maximum total coliform count is observed to be 1800 MPN/100ml whereas minimum is observed at a concentration of 900 MPN/100ml.

Along the stretch of Mula river, the chlorides vary frm 12mg/L to 128mg/L averaging to about 64.3mg/L. The minimum concentration observed for sulphates is 3.8mg/L which reaches to maximum value of 84.40mg/L. the average concentration of calcium and Magnesium are 79.7mg/L and 71.6mg/L resp. Fluorides are absent at some locations whereas the maximum concentration reaches to 2.30mg/l

Table 17.6 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Mula River

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	84.87
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	61.67
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	98.75
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	96.67
15	Total Hardness	Upto 300	100
16	Chlorides	Upto 250	100
17	Sulphates	Upto 200	100
18	Calcium	Upto 75	43.48
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	100

Table 17.6 shows that in Mula river, about 84.87% of the samples are having pH within the required limits of 6.5-8.5 whereas 13.13% of the samples are exceeding. It is observed that no sample exceeds the limits prescribed for Nitrates, 45mg/L. For about 61.67% , Total coliform ranges upto 10 whereas rest of the samples have total coliforms more that 10.

For Total dissolved solids, about 98.75% samples are within the standards; only 1.75% samples are crossing the concentration of TDS but falling within the standards of permissible limits defined as 2000mg/L. It is observed that all of the samples are in the limit of standards defined for Hardness as upto 300mg/L however, only 3.33% of the samples are exceeding concentration upto 5% defined for Turbidity. All of the collected samples have hardness well within the limits of 300mg/L.

It can be depicted that all of the samples collected along Mula river shows the chloride, fluorides and sulphates concentrations within prescribed limits whereas only 43.48% of the samples show Calcium concentrations within the standards of 75mg/L.

17.8.3 Mula Mutha Bhima

Sample were collected from four locations at this river stretch for analysis viz. Bhima at downstream of Bund Garden(1190) Haveli, at Mundhwa bridge(2192) Pune, Bhima at Pargaon(1191) & at downstream of Theur(2677), Haveli, Pune. The observation of the samples analysis is represented in **Table 17.7**.

Table 17.7 Summary of river quality for four years at Mula – Mutha/ Bhima River

Parameters	Max	Min	Avg	Stdev
pH	9.02	6.97	7.96	0.04
Dissolved Oxygen mg/l.	7.28	0.00	2.78	0.31
B. O. D. 27° C (3 days) mg/l.	24.00	2.80	12.12	0.74
COD	68.00	8.00	34.70	1.94
COD/BOD	5.16	0.63	2.98	0.08
Conductivity µmhos/cm.	1997.00	90.80	534.94	149.12
Total Dissolved Solids	1406.00	0.00	371.64	104.36
Total Fixed Solids	1196.00	0.00	310.32	80.10
Total Suspended Solids	84.00	0.00	24.02	1.21
Turbidity	444.00	0.35	8.92	43.28
Hardness	432.00	38.00	162.26	22.10
Nitrate-N mg/l.	10.00	0.09	1.63	0.28
Ammonia mg/l.	23.00	0.04	1.88	1.75
TKN	19.60	0.00	3.43	0.99
Total Coliform (MPN) / 100 ml.	1800.00	350.00	1735.90	93.47
Faecal Coliform / 100 ml.	900.00	25.00	315.34	43.77
Chlorides	260.0	11.5	73.3	40.3
Sulphates	501.6	3.6	60.6	78.2
Calcium	266.0	12.0	76.6	40.2
Magnesium	236.0	4.0	71.7	43.0
Fluoride	56.0	0.0	1.4	4.2

Table 17.7 shows the combined analysis results of four locations studied within Mula-Mutha River stretch. It is depicted from the table that maximum pH is 9.02 which is slightly alkaline is observed at location1191 whereas average pH is observed to be 7.96 showing the neutral concentration.

Maximum BOD concentration of 24mg/l is observed at location 2192 whereas it is minimum at location 1191 showing concentration of 2.80mg/l. COD is maximum at location 1190 with concentration of 68mg/l crossing the potable water standards limits whereas it is observed to be minimum at location 1191 having concentration of 8mg/l. Ratio of COD/BOD is observed maximum at location 2677 while it is minimum at location 1190. The average ratio of COD/BOD observed throughout the stream is 2.98mg/l.

Maximum dissolved solids were observed at location 1191 with concentration of 1406mg/l whereas minimum concentration is below detectable limit. The average concentration of total suspended solids was observed at 24.02mg/l throughout the stretch.

Chlorides concentration ranges from 11.5mg/L to 260mg/L and Sulphates ranges from 3.6mg/L to about 501.6mg/L. The average concentration for calcium and Magnesium are found to be 76.6mg/L and 71.7mg/L resp. Fluorides have average value of 1.4mg/L along the stretch.

Maximum hardness is observed at location 2677 whereas it is observed to be minimum at location 2192 with a concentration of 38mg/l. The average concentration of hardness observed throughout the stream is 162.26mg/l.

It is depicted from the table that nutrients are maximum at 2192 while it is observed to be minimum at location 1190 with a very less concentration of 0.09mg/l. The average concentration of nitrate is 1.63mg/l, ammonia is 1.88mg/l & TKN is 3.43.

Maximum total coliform count is observed to be 1800 MPN/100ml whereas minimum is observed at a concentration of 350 MPN/100ml.

Table 17.8 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Mula-Mutha/Bhima River

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	85.80
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	0
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	84.66
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	90.91
15	Total Hardness	Upto 300	95.45
16	Chlorides	Upto 250	99.43
17	Sulphates	Upto 200	94.32
18	Calcium	Upto 75	50.00
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	99.43

Table 17.8 shows that in Mula-Mutha/ Bhima river, about 85.80% of the samples are having pH within the required limits of 6.5-8.5 whereas 14% of the samples are exceeding. It is observed that no sample exceeds the limits prescribed for Nitrates, 45mg/L. All samples are having higher values for Total Coliforms crossing the required limits of 10.

For Total dissolved solids, about 84.66% samples are within the standards while 15.34% samples are crossing the concentration of TDS but falling within the standards of permissible limits defined as 2000mg/L. It is seen that all of the samples are in the limit of standards defined for Hardness as upto 300mg/L and about 95.45% of the samples are within the limits. Around 90% samples show turbidity upto 5NTU whereas about 10% showed higher concentrations of turbidity exceeding the limits.

About 50% of the samples complied with the standards prescribed for calcium as their concentrations are falling within the limits of 75mg/L. Almost all of the samples showed concentrations of Chlorides and fluorides upto the standards while about 94% samples have sulphates concentration upto 200mg/L.

17.8.4 Indrayani River

Three locations within this river were analyzed for the staudy viz. at upsetream of Moshigaon(2669), downstream of Moshigaon(2668), Haveli, & downstream of Alandigaon 2197), Pune. The results observed are represented in **Table 17.9**

Table 17.9 Summary of river quality for four years at Indrayani River

Parameters	Max	Min	Avg	Stdev
pH	9.00	6.85	7.97	0.02
Dissolved Oxygen mg/l.	7.32	1.30	4.66	0.17
B. O. D. 27° C (3 days) mg/l.	16.00	3.00	7.57	0.47
COD	56.00	8.00	24.70	1.34
COD/BOD	5.83	1.74	3.34	0.04
Conductivity µmhos/cm.	1126.00	138.00	406.55	23.25
Total Dissolved Solids	872.00	94.00	289.28	8.69
Total Fixed Solids	808.00	59.00	245.33	29.38
Total Suspended Solids	164.00	4.00	22.35	12.17
Turbidity	74.90	0.28	4.63	1.93
Hardness	746.00	40.00	147.96	28.61
Nitrate-N mg/l.	8.40	0.02	1.32	0.32
Ammonia mg/l.	6.92	0.04	0.81	0.24
TKN	7.68	0.00	2.16	0.16
Total Coliform (MPN) / 100 ml.	1800.00	350.00	1626.04	83.74
Faecal Coliform / 100 ml.	550.00	40.00	252.71	10.03
Chlorides	215.00	12.00	58.81	34.94
Sulphates	87.50	2.10	26.98	16.02
Calcium	194.00	10.00	69.05	38.80
Magnesium	250.00	3.90	61.40	36.88
Fluoride	20.00	0.00	1.04	1.68

Table 17.9 shows the combined analysis results of three locations studied within Indrayani River. Maximum pH is observed at location 2668 which is again getting to neutral in its flow stream.

Maximum BOD concentration of 16mg/l is observed at location # 2197 whereas it is minimum at location 2669 showing concentration of 3mg/l. COD is maximum at location #2668 with concentration of 56mg/l; which is crossing the potable water standards whereas it is observed to be minimum at location #2669. Ratio of COD/BOD is observed maximum at location # 2668 while it is minimum at location #2669. The average ratio of COD/BOD observed throughout the stream is 3.34.

Maximum dissolved solids were observed at location #2197 with concentration of 872mg/l whereas minimum were observed at location #2668 with concentration of 94mg/l. Maximum concentration of total fixed solids is observed to be 808 mg/l at location #2669. Water is observed to be turbid throughout the stretch.

Maximum hardness is observed at location #2197 whereas it is observed to be minimum at the same location compared to other two locations. The average concentration of hardness observed throughout the stream is 147.96mg/l.

It is depicted from the table that nutrients are maximum at #2668 while it is observed to be minimum at location #2669. The average concentration of nitrate is 1.32mg/l, ammonia is 0.81mg/l & TKN is 2.16.

Maximum total coliform count is observed to be 1800 MPN/100ml whereas minimum is observed at a concentration of 350 MPN/100ml.

Maximum concentration for Chlorides and Suphates in Indrayani are observed to be about 215mg/L and 88mg/L resp. whereas the average values are 2mg/L and 10mg/L resp. Calcium ranges from 10mg/L to 194mg/L. Average concentration of Magnesium throughout the stretch is found to be about 61.40mg/L. Fluoride in water is absent at some locations whereas is found to be maximum of 20mg/L.

Table 17.10 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Indrayani River

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	86.81
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	0
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	95.14
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	92.36
15	Total Hardness	Upto 300	97.92
15	Total Hardness	Upto 300	98.40
16	Chlorides	Upto 250	100
17	Sulphates	Upto 200	100
18	Calcium	Upto 75	61.81
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	99.31

Table 17.10 delineates that about 86.81% of the samples taken along Indrayani river are having pH within the required limits of 6.5-8.5 whereas rest of the samples are exceeding pH concentrations. It is observed that the entire set of samples is within the required limits of Nitrates, 45mg/L and All samples are having higher values for Total Coliforms crossing the required limits of 10.

For Total dissolved solids, about 95.14% samples are within the standards while remaining samples are crossing the concentration of TDS but falling within the standards of permissible limits defined as 2000mg/L. about 97.92% of the samples are having hardness upto 300mg/L and around 92.36% of the samples show turbidity upto 5NTU whereas about 8% samples are having turbidity higher turbidity, exceeding the limits.

All of the samples collected along Indrayani river have concentration of Chlorides and sulphates inline with the prescribed standards complying 100% with the standards. However, 62% of the samples show Calcium concentrations within 75mg/L and rest of the 38% of the samples are exceeding the concentration of 75mg/L. 99.31% of the samples have fluoride levels upto 10mg/L falling well within the standards.

17.8.5 Pawna River

Samples were collected from six different locations from Pawna river stretch viz. Pawna at Pimprigaon (2694) Haveli, Pawna at Kasarwadi Haveli(2690), Pawna at Dapodi Bridge at Pawna-Mula Sangam(2691) Dapodi, Haveli, Pawna at Ravet weir, Ravet(2692), Pawna at Chinchwadgaon(2693) & Pawna at Sangvi gaon, Pune(2196).The summary of the analysis is represented in **Table 17.11**.

Table 17.11 Summary of river quality for four years at Pawna River

Parameters	Max	Min	Avg	Stdev
pH	9.00	6.80	7.89	0.03
Dissolved Oxygen mg/l.	7.42	0.00	3.17	0.55
B. O. D. 27° C (3 days) mg/l.	20.00	1.40	10.98	0.62
COD	60.00	0.00	29.58	4.59
COD/BOD	6.67	0.00	2.90	0.42
Conductivity µmhos/cm.	836.40	0.00	401.12	20.91
Total Dissolved Solids	610.00	0.00	247.28	27.43
Total Fixed Solids	540.00	0.00	178.76	44.21
Total Suspended Solids	399.00	0.00	34.79	43.02
Turbidity	234.00	0.21	4.52	15.59
Hardness	248.00	0.00	88.66	11.76
Nitrate-N mg/l.	7.80	0.04	1.33	0.22
Ammonia mg/l.	6.00	0.00	1.08	0.28
TKN	7.28	0.00	2.57	0.22
Total Coliform (MPN) / 100 ml.	1800.00	0.00	1527.25	180.74
Faecal Coliform / 100 ml.	550.00	0.00	263.92	13.36
Chlorides	240.00	0.00	56.91	34.87

Parameters	Max	Min	Avg	Stdev
Sulphates	17.90	1.60	31.55	23.92
Calcium	144.00	0.00	49.62	42.00
Magnesium	124.00	0.00	31.51	30.98
Fluoride	146.00	0.09	1.94	10.31

Table 17.11 shows the combined analysis results of six locations studied monthly for four consecutive years within Pawna river stretch. It is depicted from the table that maximum pH of 9.0 is observed at location #2196 whereas average pH is observed to be 7.89 showing the neutral concentration.

BOD concentration is observed to be maximum at location 2196 with a concentration of 20mg/l whereas it is minimum at location #2692 showing concentration of 1.40mg/l. COD is maximum at location #2694 with concentration of 7.80mg/l whereas it is observed to be minimum at location 2692. The average ratio of COD/BOD observed throughout the stream is 1.33mg/l.

Along the stretch, at few of the locations chlorides, calcium and magnesium are found to be absent. However, the maxium concentrations for the same are observed to be 240mg/L, 144mg/L and 124mg/L resp. Average concentration of Sulphates is about 31.55mg/L and that of for fluorides is about 1.94mg/L

Maximum dissolved solids were observed at location #2694 with concentration of 610mg/l whereas minimum concentration is observed to be below detectable limit at many locations during rainy season due to dilution of water. Average of total fixed solids was observed to be 247.28mg/l in this river stretch.

Maximum hardness is observed at location #2690 with a concentration of 248mg/l. The average concentration of hardness observed throughout the stream is 88.66mg/l.

It is depicted from the table that nutrients are maximum at location #2196. The average concentration of nitrate is 1.33mg/l, ammonia is 1.08mg/l & TKN is 2.57.Maximum total coliform count is observed to be 1800 MPN/100ml whereas minimum is observed at a concentration of 1527 MPN/100ml.

Table 17.12 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Pawna River

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	90.80
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	0
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	1.20
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	99.20
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	92.36
15	Total Hardness	Upto 300	98.40
16	Chlorides	Upto 250	100
17	Sulphates	Upto 200	100
18	Calcium	Upto 75	76.80
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	98.80

It is seen from the **Table 17.12** that 100% of the samples comply with the prescribed standards for Cholrides and Sulphates. The standards defined for Calcium are upto 75mg/L and about 76.8% of the samples have Calcium concentrations within limits. About 98.8% of the samples have Fluoride concentration within 10mg/L and only about 1.2% samples are exceeding the standard limits in Pawna river.

Table 17.12 reflects that about 91% of the samples taken along Pawna river are having pH within the required limits of 6.5-8.5 whereas rest of the samples are exceeding pH concentrations. It is seen that the entire set of samples is within the required limits of Nitrates, 45mg/L and only 1.20% of the samples are having values for Total Coliforms within the required limits of 10. About 98% of the samples have higher coliform values making the river water unfit for potable use.

For Total dissolved solids, about 99% samples are within the standards while remaining samples are crossing the concentration of TDS but falling within the standards of permissible limits defined as 2000mg/L. About 98.40% of the samples are having hardness upto 300mg/L and around 92.36% of the samples show turbidity upto 5NTU whereas about 8% samples are having turbidity higher turbidity, exceeding the limits.

17.8.6 Bhima in Pune

Three locations were sasmpled for four years along the course of Bhima flowing through Pune city. These locations include the river at Koregaon Bridge in Shirur, Bhima river back water at Ujjani dam near Raw Water pump house, Kumbhargaon in Indapur along with the third location at Bhima river in Daund area of Pune.

Table 17.13 indicates the values of different parameters analysed for the samples along above mentioned locations.

Table 17.13 Summary of analysis at 6 locations along Bhima River in Pune

Parameters	Max	Min	Avg	Stdev
pH	8.99	7.10	8.08	0.02
Dissolved Oxygen mg/l.	7.26	1.40	4.76	0.41
B. O. D. 27° C (3 days) mg/l.	48.00	2.00	7.97	2.07
COD	56.00	8.00	23.36	0.65
COD/BOD	6.32	0.59	3.25	0.08
Conductivity µmhos/cm.	1861.00	131.90	596.60	87.05
Total Dissolved Solids	1346.00	0.00	428.89	61.51
Total Fixed Solids	1122.00	0.00	358.16	41.54
Total Suspended Solids	82.00	0.00	21.03	1.51
Turbidity	192.00	0.00	3.62	15.87
Hardness	344.00	0.00	171.50	6.94
Nitrate-N mg/l.	7.80	0.04	1.40	0.25

Parameters	Max	Min	Avg	Stdev
Ammonia mg/l.	17.40	0.04	1.06	0.89
TKN	12.80	0.00	2.45	0.58
Total Coliform (MPN) / 100 ml.	1800.00	95.00	1406.58	166.94
Faecal Coliform / 100 ml.	550.00	10.00	194.01	34.84
Chlorides	435.00	12.00	81.25	24.09
Sulphates	561.60	4.30	86.75	45.76
Calcium	192.00	12.00	82.14	1.79
Magnesium	232.00	5.80	78.72	11.16
Fluoride	2.40	0.00	0.96	0.01

It is observed that the pH has maximum concentration of 8.99 and minimum of 7.10 along the river. Average pH value measured is about 8.08.

BOD concentration is ranging between minimum at location 2656 which is 2.00mg/L and the maximum concentration for the same is observed at same location, measured to be 48mg/L whereas along the river average value of BOD falls around 7.96mg/L. COD of the river water ranges from minimum concentration of 8.00mg/L to maximum of 56.00mg/L averaging about 23.36mg/L along the river stretch. These values of COD are well within the limits. COD to BOD ratio has minimum value of 0 and reaches to maximum value of 5.71 at location 2655 which indicates that the river water at this location is highly polluted. Average value of Dissolved Oxygen is about 4.76mg/L which is just crossing the limits for DO in river water of 4mg/L.

The chloride concentration ranges between 12 to 435mg/L and Sulphates vary from 4.30 to 561.60mg/L. The average concentration for Calcium is observed to be 82.14mg/L and that of Magnesium is 78.72mg/L. Few of the samples show Fluoride content absent and the maximum of the same is about 2.40mg/L.

Solids concentration in the river is found to be ranging between 1000mg/L to about 1800mg/L. maximum concentrations of total solids is found at 1192 being 1800mg/L which has minimum of 95mg/L at location 2656. Suspended solids in water have average value of 21.03mg/L making water potable. Hardness and turbidity levels are ranging upto 344.00mg/L and 19.022mg/L respectively and are absent at few locations.

The Nitarte concentrations are ranging from 0.04mg/L to about 7.80mg/L. Average concentration of Nitrates is measured to be 1.40mg/L along the river. Total kjeldahl nitrogen in river shows to be absent at some of locations whereas it has maximum concentration of 12.80mg/L. Ammonia has maximum concentration of 17.40mg/L and minimum is 0.04mg/L averaging to 1.06mg/L.

Coliforms present in the river water shows the maximum values of 1800 for total coliforms and minimum of 95. Faecal coliforms are having average value of 194.01 along the river. The anions, Chlorides and sulphates in river water are having maximum concentration of 435mg/L and 561mg/L respectively with the average values of about 81.25mg/L and 86.75mg/L resp. Calcium and Magnesium contributing towards hardness in water has maximum concentrations of 192mg/L and 232mg/L resp. Minimum values of the same are about 12mg/L and 5.80mg/L. Fluoride content of the water ranges between 0 to 2.40mg/L with average value of 0.96mg/L.

Table 17.14 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Bhima River in Pune

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	80.45
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	0
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	71.43
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	91.73
15	Total Hardness	Upto 300	93.98

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
16	Chlorides	Upto 250	96.99
17	Sulphates	Upto 200	89.47
18	Calcium	Upto 75	45.86
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	100

From **Table 17.14** it is seen that about 80.45% of the samples taken along Bhima river flowing through Pune are having pH within the required limits of 6.5-8.5 whereas rest of the samples are shown to be exceeding pH concentrations. It is seen that the entire set of samples is within the required limits of Nitrates, 45mg/L and all of the samples have higher coliforms.

For Total dissolved solids, about 71.43% samples are within the standards while remaining samples are crossing the concentration of TDS but falling within the standards of permissible limits defined as 2000mg/L. About 94% of the samples are having hardness upto 300mg/L and around 91.73% of the samples show turbidity upto 5NTU whereas about 8% samples are having turbidity higher turbidity, exceeding the limits.

It is seen that about 97% of the samples show chloride concentrations upto 250mg/L. about 89.47% of the samples are falling within the standards of 200mg/L and about 11% of the samples are exceeding the limits. About 45.86% of the samples of Bhima river in Pune are showing the concentration of calcium upto 75mg/L whereas about 55% of the samples have calium concentrations higher than 75mg/L which leads to the hardness of water. It is observed that all of the samples have fluoride levels below limits complying 100% with the standards.

17.8.7 Ghod River

Ghod river at Shirur along with the river at Shhikhrapur, known as Velu River have been selected to study the characters of Ghod River. At these two locations, samples were collected and analysed accordingly that describes the environmental status of Ghod river. Results of the analysis are summarized in **Table17** below.

Table 17.15 Summary of analysis at 6 locations along Ghod River

Parameters	Max	Min	Avg	Stdev
pH	9.2	6.89	8.15	0.09
Dissolved Oxygen mg/l.	7.16	1.75	5.05	0.07
B. O. D. 27° C (3 days) mg/l.	18	3.5	7.07	0.17
COD	50	0	22.6	0.42
COD/BOD	5.333	0	3.32	0.24
Conductivity µmhos/cm.	1835	182.1	672	33.4
Total Dissolved Solids	1468	0	475	6.84
Total Fixed Solids	1174	0	400	15.5
Total Suspended Solids	84	0	19.9	0.74
Turbidity	8.13	0	1.23	0.33
Hardness	344.00	0.00	171.50	6.94
Nitrate-N mg/l.	8.4	0.04	1.45	0.37
Ammonia mg/l.	6.2	0.02	0.93	0.53
TKN	5.88	0	1.97	0.05
Total Coliform (MPN) / 100 ml.	1800	275	1255	117
Faecal Coliform / 100 ml.	425	0	161	0.55
Chlorides	270	10	36	16
Sulphates	443	3	86	12
Calcium	335	12	80	14
Magnesium	256	8.2	88	0.3
Fluoride	2.3	0.3	0.8	0

pH along the Ghod river ranges from minimum of 6.89 at location 2715 and shows maximum of 9.2 at location 2665. Average pH along the river stretch is found to be about 8.15.

BOD concentration has minimum concentration of 7.07mg/L at location 2715 and the maximum concentration for the same is observed to be 18mg/L whereas along the river average value of BOD falls around 7.97mg/L. COD of the river water is absent at the location 2715 whereas the maximum of 50.00mg/L is observed at the same location within the study period of 4 years. COD to BOD ratio has minimum value of 0 and reaches to maximum value of 5.33 at location 2715 which indicates that the river water is being polluted tremendously. Average value of Dissolved Oxygen is about 5.05mg/L and ranging between 1.75mg/L to maximum of 7.16mg/L

Maximum concentrations of total solids are about 1468mg/L which absent at another locations showing the minimum concentration. Suspended solids in water has average value of 19.9mg/L making water potable. Hardness and turbidity levels are observed to be 515 mg/L and 8.13mg/L respectively and are showing minimum concentration of 0mg/L.

Coliforms present in the river water shows the maximum values of 1800 for total coliforms and minimum of 275 which shows the increase in the confluence of polluted water in the river. Faecal coliforms are having average value of 161 along the river.

The Nitarte concentrations are ranging from 0.04mg/L to about 8.40mg/L. Average concentration of Nitrates is measured to be 1.45mg/L along the river. Total kjeldahl nitrogen in river shows to be absent at some of locations whereas it has maximum concentration of 5.88mg/L. Ammonia has maximum concentration of 6.2mg/L and minimum is 0.02mg/L averaging to 0.93mg/L.

Chlorides and Sulphates have maximum values of 270mg/L and 443mg/L resp. whereas the minimum concentrations observed are 10mg/L and 3mg/L resp. Calcium and magnesium have average concentrations of 80mg/L and 88mg/L resp. Fluoride content has maximum concentration of 2.3mg/L to minimum of 0.3mg/L.

Table 17.16 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Ghod River

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	74.65
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	9.86
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	53.52

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	95.77
15	Total Hardness	Upto 300	83.10
16	Chlorides	Upto 250	98.59
17	Sulphates	Upto 200	85.92
18	Calcium	Upto 75	53.52
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	100

From **Table 17.16,** it is indicated that about 74.65% of the samples taken along Ghod river are having pH within the required limits of 6.5-8.5 whereas rest of the samples are shown to be exceeding pH concentrations. It is seen that the entire set of samples is within the required limits of Nitrates, 45mg/L whereas only 9.86% of the samples show total coliforms within the required limits of 10..

In Ghod river, all of the samples have FLuotide content less than 10mg/L and about 98.59% of the samples have chlorides within 250mg/L. 85% of the samples are complying with the standards defined for sulphates. With the maximum desirable limits for Calcium being 75mg/L, about 53% of the samples are well within those standards however rest of the samples are exceeding the levels of 75mg/L.

For Total dissolved solids, about 53.52% samples have concentrations within standards while remaining samples are crossing the concentration of TDS but falling within the standards of permissible limits defined as 2000mg/L. About 83.10% of the samples are having hardness upto 300mg/L and around 95.77% of the samples show turbidity upto 5NTU whereas about 4.23% samples are having turbidity higher turbidity, exceeding the limits.

17.8.8 Nira River

Three locations were identified along the stretch of Nira River that included NIra river at the U/s of Jubiliant Organosis at Datta wadi in Baramati, Nira at the D/s of Jubiliant Organosis at Bhigwan area in Pune and Nira river at Sarola on Pune-Banglore Highway.

The variations observed in the analysis results of samples collected along Nira river are summarized in **Table 17.17**

Table 17.17 Summary of analysis at 6 locations along Nira River

Parameters	Max	Min	Avg	Stdev
pH	9.18	7.46	8.14	0.02
Dissolved Oxygen mg/l.	7.25	1.08	5.35	0.30
B. O. D. 27° C (3 days) mg/l.	16.80	1.80	6.47	0.34
COD	40.00	7.07	21.25	0.95
COD/BOD	6.25	0.65	3.37	0.11
Conductivity µmhos/cm.	1388.00	22.50	472.19	72.51
Total Dissolved Solids	960.00	44.00	330.67	53.50
Total Fixed Solids	2110.00	36.00	293.88	87.66
Total Suspended Solids	67.00	2.00	16.61	1.43
Turbidity	11.60	0.11	1.38	0.18
Hardness	360.00	0.54	119.27	10.34
Nitrate-N mg/l.	8.4	0.04	1.45	0.37
Ammonia mg/l.	6.2	0.02	0.93	0.53
TKN	4.00	0.02	0.99	0.08
Total Coliform (MPN) / 100 ml.	1800.00	260.82	1428.01	85.45
Faecal Coliform / 100 ml.	425.00	35.00	194.94	12.14
Chlorides	215.00	7.50	65.53	8.82
Sulphates	405.00	0.36	43.85	26.86
Calcium	164.00	2.00	53.49	4.48
Magnesium	196.00	5.30	53.55	7.37
Fluoride	10.00	0.10	1.02	0.58

Nira river shows the variation in pH with the maximum value of 9.18 at location 2682 and goes down to the minimum of 7.46 at location 1463.

The concentration of BOD has minimum concentration of 1.80mg/L and the maximum concentration for the same is observed to be 16.80mg/L whereas along the river average value of BOD falls around 6.47mg/L. COD of the river water is maximum being 40mg/L whereas the minimum of 7.07mg/L. COD to BOD ratio has minimum value of 0.65 and reaches to maximum value of 6.25 indicating the higher pollution levels along the course of river. Dissolved oxygen in river water ranges between 1.08mg/L to 7.25mg/L

Maximum concentrations of total solids are about 960mg/L which reaches to minimum concentration of 44mg/L. Suspended solids in water has average value of 16.61mg/L. Fixed solids in water are exceeding the concentration limits being the maximum concentration of about 2110mg/L Hardness and turbidity levels are observed to be 360mg/L and 11.60mg/L respectively and are showing minimum concentration of 0.54mg/L and 0.11mg/L resp.

Coliforms present in the river water shows the maximum values of 1800 for total coliforms and minimum of 261 whereas Faecal coliforms are having average value of 194.94 along the river with maximum concentration of 425 and minimum of 35.

The Nitarte concentrations are ranging from 0.02mg/L to about 4.00mg/L. Average concentration of Nitrates is measured to be 0.99mg/L along the river. Total kjeldahl nitrogen in river shows to be absent at some of locations and has maximum concentration of 11.2mg/L. analysis of Ammonia shows the 10.56mg/L and minimum of 0.04mg/L.

Chlorides show concentration ranging from 7.50mg/L to 215mg/L averaging to about 65.53mg/L. Sulphates are in the range of 0.36mg/L to about 405mg/L. Calcium and Magnesium concentrations are in the range of 2 to 164mg/L and 5.30 to 196mg/L. Average concentrations of Fluoride is about 1.02mg/L along the river stretch of Nira.

Table 17.18 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Nira River

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	79.10
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	0
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	76.87
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	94.78
15	Total Hardness	Upto 300	98.51
16	Chlorides	Upto 250	100
17	Sulphates	Upto 200	98.51
18	Calcium	Upto 75	100
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	100

From **Table 17.18,** it is clear that in Nira river, 79.10% of the samples are having pH within the required limits of 6.5-8.5 whereas rest of the 21% samples have exceeding pH concentrations. It is seen that the entire set of samples is within the required limits of Nitrates, 45mg/L whereas all of the samples show total coliforms higher than the required limits of 10..

About 76.87% of the samples have Total dissolved solids within standards while remaining samples are crossing the concentration of TDS but maintaining the standards of permissible limits defined as 2000mg/L. About 94.87% of the samples are having turbitidy less that 5NTU whereas about 98.51% samples have hardness upto 300mg/L

Considering the standards defined for Chlorides, Calcium and fluorides, all of the samples are complying 100% whereas about 98% of the samples are within the limits of 200mg/L defined for calcium.

17.8.9 Bhima in Solapur

For the River BHima, flowing through Solapur district, samples are collected from 6 locations viz. Nallah at D/s. of Aklai Mandir, Akluj, Bhima River at Narsinghpur, (D/s., A/c. with Nira River), Chandrabhaga, U/s of Pandharpur Town, Chandrabhaga, D/s of Pandharpur Town, Bhima River in Takali Village and Sina River at Laboti Toll naka, Lamoti, Mohol. The analysis results of samples collected from these locations, over the period of 4 years are summarized in **Table 17.19**

Table 17.19 Summary of analysis at 6 locations along Bhima River in Solapur

Parameters	Max	Min	Avg	Stdev
pH	9.00	7.40	8.19	0.32
Dissolved Oxygen mg/l.	9.80	0.00	5.01	0.65
B. O. D. 27° C (3 days) mg/l.	26.00	1.60	7.66	1.24
COD	92.00	8.00	24.09	3.73
COD/BOD	6.32	0.59	3.25	0.08
Conductivity µmhos/cm.	4334.00	0.94	1198.76	140.35
Total Dissolved Solids	2610.00	78.00	839.56	74.88
Total Fixed Solids	2247.00	12.00	706.99	70.04
Total Suspended Solids	140.00	0.10	22.61	8.54
Turbidity	234.00	0.21	4.52	15.59
Hardness	1096.00	26.00	302.19	33.96
Nitrate-N mg/l.	7.20	0.02	1.11	0.15
Ammonia mg/l.	17.40	0.03	1.07	1.06
TKN	19.40	0.00	2.27	0.67
Total Coliform (MPN) / 100 ml.	1800.00	95.00	1369.99	45.90
Faecal Coliform / 100 ml.	550.00	4.00	222.29	13.03
Chlorides	760.00	10.50	147.53	87.58
Sulphates	1000.00	0.10	124.58	111.25
Calcium	616.00	20.00	107.07	87.62
Magnesium	442.00	13.00	85.66	76.08
Fluoride	126.05	0.30	1.40	8.65

It is depicted from table that the pH values range from very negligible at 7.40 observed at location 1912 whereas it increases to 9.00 at location 2789. The average value of pH along the river is observed to be 8.19 which is within the standards prescribed for inland water surfaces.

Organics in river show that the concentration of BOD is minimum at location 28 which is 1.60mg/L and the maximum concentration for the same is observed at location 1188 measured to be 26mg/L whereas along the river average value of BOD falls around 7.66mg/L. Dissolved Oxygen in river ranges from being absent at some location and maximum of 9.80mg/L. COD of the river water lies within minimum concentration of 8.00mg/L to maximum of 92mg/L averaging about 24.09mg/L along the river stretch. One of the major indicators of pollution, COD to BOD ratio falls in the scale of 0.59 to 6.32 showing fluctuations in pollution levels in the stretch.

It is observed from the table that the solids in river water have higher concentration than the standards prescribed. Total dissolved solids and fixed solids have maximum concentrations ranging around 2000mg/L whereas the suspended solids have mnaximum concentrations of 104mg/L. Average concentration of TDS is observed to be 839.56mg/L and same for fixed solids is about 707mg/L. Because of the highe contents of solids, the water has become turbid in river which measures about 190NTU at location 2789 and is minimum measuring to be 0.25NTU at location 1188. Table depicts that the average concentration for hardness is about 302mg/L. maximum hardness of water is analysed at location 2789 and has minimum concentration of 26mg/L at location 28.

Analysis of coliforms indicate that the levels are beyond the standard limits and the water is unfit for drinking purpose. Maximum value of faecal coliform is observed to be 550 at location 2789 and is minimum at 1188 being 4. For the Total coliforms, the value ranges from maximum of 1800 to minimum of 95.

The levels of nutrients in the river water are very low. The Nitarte content of river lies within the range of 0.02mg/L to about 7.20mg/L. Average concentration of Nitrates is measured to be 1.11mg/L along the river. Along with the Nitrates, total kjeldahl nitrogen in river water has minimum concentration of 0.00 and maximum of 19.40mg/L. Ammonia has maximum concentration of 17.40mg/L and minimum is 0.03mg/L

Chlorides in Bhima river flowing through solapur are ranging between 10.5mg/L to 760mg/L whereas sulphates concentrations range between 0.10mg/L to about 1000mg/L. Average concentrations for Calcium and Magnesium are found to be about 107.07mg/L and 85.66mg/L resp. Fluoride content in river has varies between 0.30mg/L to 126.05mg/L

Table 17.20 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Bhima River in Solapur

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	71.79
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	19.05
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	19.78
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--
14	Turbidity	Upto 5	91.21
15	Total Hardness	Upto 300	54.58
16	Chlorides	Upto 250	92.31
17	Sulphates	Upto 200	82.05
18	Calcium	Upto 75	48.35
19	Magnesium	Not Specified	--
20	Fluorides	Upto 10	99.27

From **Table 17.20,** it is clear that for the samples collected in Bhima river flowing through Solapur, 71.79% of the samples have pH concentrations less than required limits of 6.5-8.5 whereas rest of the 29% samples have exceeding pH concentrations. It is seen that the entire set of samples is within the required limits of Nitrates, 45mg/L whereas about 19.78% of the samples show total coliforms within the required limits of 10..

About 19.78% of the samples have Total dissolved solids within standards while remaining samples are crossing the concentration of TDS but maintaining the standards of permissible limits defined as 2000mg/L. About 91.21% of the samples are having turbitidy less that 5NTU whereas about 54.58% samples have hardness upto 300mg/L

From about 273 samples collected across the river, about 92% of the samples have chloride content within the limits of 250mg/L whereas about 82.050% of the samples have sulphates concentration upto 200mg/L. 48% of the samples are falling within the standards of 75mg/L for calcium and about 99% of the samples comply with the standards.

17.8.10 Sina River in Ahemadnagar and Solapur

For the River Sina, flowing through Ahemadnagar and Solapur district, samples are collected from 2 locations viz. Sina River at Burudgaon Tal.& Dist.Ahemadnagar and Sina River at Lamboti Toll naka, Lamoti, Mohol. The analysis results of samples collected from these locations, over the period of 4 years are summarized in **Table 17.21**

Table 17.21 Summary of analysis at 2 locations along Sina River in Ahmednagar & Solapur

Parameters	Max	Min	Avg	Stdev
pH	7.11	8.92	8.05	0.60
Dissolved Oxygen mg/l.	0.00	7.20	4.90	1.78
B. O. D. 27° C (3 days) mg/l.	0.85	90.00	14.39	21.32
COD	12.00	272.00	48.56	57.79
COD/BOD	1.10	32.94	6.51	7.97
Conductivity µmhos/cm.	96.10	3694.00	1246.26	848.88
Total Dissolved Solids	140.00	2306.00	905.56	504.33
Total Fixed Solids	48.00	1185.00	605.12	298.16
Total Suspended Solids	6.00	72.00	24.53	15.49

Parameters	Max	Min	Avg	Stdev
Turbidity	0.38	16.60	3.31	4.09
Hardness	100.00	570.00	311.29	121.89
Nitrate-N mg/l.	0.02	7.00	2.15	1.93
Ammonia mg/l.	0.088	87.52	4.84	19.20
TKN	2.2	5.88	1.36	1.89
Total Coliform (MPN) / 100 ml.	80.00	1800.00	749.05	704.87
Faecal Coliform / 100 ml.	22.00	350.00	120.63	112.20
Chlorides	23.00	650.00	187.61	152.66
Sulphates	11.00	574.00	112.91	125.51
Calcium	23.20	340.00	156.05	85.43
Magnesium	9.70	330.00	109.51	80.77
Fluoride	0.30	1.20	0.40	0.41

It is depicted from table that the pH values range from at 7.11 observed at location 193 whereas it increases to 8.92 at location 2705. The average value of pH along the river is observed to be 8.05 which is within the standards prescribed for inland water surfaces.

Organics in river show that the concentration of BOD is minimum at location 2705 which is 0.85 mg/L and the maximum concentration for the same is observed at location 193 measured to be 90 mg/L whereas along the river average value of BOD falls around 14.39 mg/L. Dissolved Oxygen in river ranges from being absent at some location and maximum of 7.20 mg/L. COD of the river water lies within minimum concentration of 12.00mg/L to maximum of 272 mg/L averaging about 48.56 mg/L along the river stretch. One of the major indicators of pollution, COD to BOD ratio falls in the scale of 1.10 to 32.94 showing fluctuations in pollution levels in the stretch.

It is observed from the table that the solids in river water have higher concentration than the standards prescribed. Total dissolved solids have maximum concentrations ranging around 2000mg/L whereas the suspended solids have maximum concentrations of 72 mg/L. Average concentration of TDS is observed to be 905.56 mg/L and same for fixed solids is about 605.12 mg/L. Because of the highe contents of solids, the water has become turbid in river which measures about 16.60 NTU at location 193 and is minimum measuring to be 0.38 NTU at location 2705. Table depicts that the average concentration for hardness is about 311.29 mg/L.

maximum hardness of water is analysed at location 2705 and has minimum concentration of 100 mg/L at location 193.

Analysis of coliforms indicate that the levels are beyond the standard limits and the water is unfit for drinking purpose. Maximum value of faecal coliform is observed to be 350.0 at location 193 and is minimum at 193 being 22.0. For the Total coliforms, the value ranges from maximum of 1800 to minimum of 80.

The levels of nutrients in the river water are very low. The Nitarte content of river lies within the range of 0.02mg/L to about 7.0 mg/L. Average concentration of Nitrates is measured to be 2.15 mg/L along the river. Along with the Nitrates, total kjeldahl nitrogen in river water has minimum concentration of 2.2 and maximum of 5.88 mg/L. Ammonia has maximum concentration of 87.52 mg/L and minimum is 0.088 mg/L

Chlorides in Sina river flowing through Ahemadnagar and solapur are ranging between 23.0 mg/L to 650.0 mg/L whereas sulphates concentrations range between 11.0 mg/L to about 574.0 mg/L. Average concentrations for Calcium and Magnesium are found to be about 156.05 mg/L and 109.51 mg/L resp. Fluoride content in river has varies between 0.3 mg/L to 1.20 mg/L

Table 17.22 Comparison of Surface Quality with Indian Drinking Water Standards (MPCB) for Bhima River in Solapur

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
1	pH	6.5-8.5	76.74
2	Dissolved Oxygen	Not Specified	--
3	BOD	Not Specified	--
4	COD	Not Specified	--
5	Nitrate, N mg/L	Upto 45	100
6	Ammonia, mg/L	Not Specified	--
7	TKN	Not Specified	--
8	Total Coliform	Upto 10	0.00
9	Fecal Coliform	Not Specified	--
10	Conductivity	Not Specified	--
11	TDS	Upto 500	16.27
12	Total Fixed Solids	Not Specified	--
13	Total Suspended Solids	Not Specified	--

Sr. no.	Parameters	Indian Standards (Permissible Drinking water limits)	% Compliance
14	Turbidity	Upto 5	86.04
15	Total Hardness	Upto 300	39.53
16	Chlorides	Upto 250	86.04
17	Sulphates	Upto 200	86.04
18	Calcium	Upto 75	16.27
19	Magnesium	Upto 30	18.60
20	Fluorides	Upto 1	88.88

From **Table 17.22,** it is clear that for the samples collected in Sina river flowing through Ahemdnagar & Solapur, 76.74% of the samples have pH concentrations less than required limits of 6.5-8.5 whereas rest of the 23.26% samples have exceeding pH concentrations. It is seen that the entire set of samples is within the required limits of Nitrates, 45mg/L whereas total coliforms observed at two locations & which above the required limits of 10.

About 16.27 % of the samples have Total dissolved solids within standards while remaining samples are crossing the concentration of TDS but maintaining the standards of permissible limits defined as 2000mg/L. About 86.24 % of the samples are having turbitidy less that 5NTU whereas about 39.53% samples have hardness upto 300mg/L

About 86.04% of the samples have chloride & sulphate content within the limits of 250mg/L & 200mg/L resp. 16.27% of the samples are falling within the standards of 75mg/L for calcium, 18.60 % of the samples are falling within the standards of 30 mg/L for magnesium and about 88.88 % of the samples comply with the standards of fluoride.

17.9.0 Environment Management

Management of ecological resources is an emerging field of environmental systems development. Riverine systems have been in discussions since long but with the increasing pressures due to resource exploitation & vast development in and around the water bodies with its limited infrastructure for domestic sewage disposal have augmented the problems. Though there have been several other issues related to waste disposal, augmenting the organic as well as solids load in the riverine system, the present report outlines an integrated approach for wastewater management as discussed in the following sections.

17.9.1 Control of Pollution at the Source

As the name indicates, measures shall be taken at the source itself that are leading to pollution in the water body. This is normally achieved either by optimizing the water supply in these areas as well as decentralized wastewater treatment system development. Though this option seem to be workable in long run, a detailed technical and financial feasibility of the same needs to be undertaken.

17.9.2 Sewage Treatment Plants

In other words implementing control measures to avoid the discharge of the pollutants into the river. The most widely used method is the planning of Sewage Treatment Plant, where the domestic effluent shall be treated followed by discharge of treated water into the nearby water body or reused as and when applicable / required. This shall serve two fold management options. On one hand it shall serve as treatment facility for effective environmental up-gradation and on the other hand it shall also render huge amounts of dilution in the receiving water body leading to its healthy behavior.

Though sounding very easy, the evaluation of various parameters for STP is a difficult task and shall require time as well as resources including huge financial aid and thereby this option shall be considered to be a LONG TERM one. Total of about 1098.9MLD sewage is generated from centers like Municipal Corporation, Council and villages. Though finances are available for major Municipal Corporations through schemes such as JNNURM and others, availability of land, wastewater conveyance systems, construction time, etc shall be a major task in itself. Secondly, from the scientific perspective, selection of technology is another such issue in construction of STP. Some of the common technologies such as Activated Sludge Process (ASP), Sequential Batch Reactor (SBR), Upflow Anaerobic Sludge Blanket (UASB), DWATS and others, require huge amount of electricity, extreme maintenance & sensible operation blended with skilled manpower to handle the plant.

17.9.3 Sewage Irrigation (Short Term Temporary Relief)

Another such option at the source management is that instead of constructing full-fledged STP, the wastewater may be primarily treated for removal of solids and pathogens (settling of solids & disinfection) & oxygenated through low cost mechanisms such as creation of turbulence through traversing wastewater in open channel restricting the flows using bunds, fountains, and/or oxidation ditch etc to be further used for irrigation purposes.

Many studies have been carried out on the same nationally as well as internationally. Similar type of sewage based irrigation are practiced successfully in the Dharwad district of Karnataka, India as well as many other places include Greece, Pakistan, Israel, etc.

17.9.4 Control of Pollution In the Path (Short & Long Term Relief)

Many streams, nallah's and such other water bodies converge into the river & many of them in the present case of Bhima carry sewage wastewater, though detailed assessment of the loads needs to be done before undertaking any such measures. This particular section delineates conceptual option for In the Path treatment.

These streams account for the indirect source of pollution for the river. Hence there is need of mitigation measures for the pollution of these sources. Phytoremediation is one such technology that can be used to curb the pollution of the water bodies, both static and flowing.

17.9.5 Nallah Treatment using In-situ Phytoremediation

Phytorid technology comprises of constructed phyto-filtration system which is functionally similar to the natural wetlands. This technology is based on the principle of working root systems of plants combined with the natural attenuation process. It can be used for pollution control and waste management of municipal or industrial effluents from rural as well as urban areas. Various species of aquatic plants have been utilized to attain maximum efficiency in the treatment of domestic wastes. These include species like *Phramites australis, Phalaris arundinacea, Glyceria maxima, Typha spp., Scirpus spp.*, other common grasses etc.

17.9.6 Control of Pollution at End of Pipe

End of the pipe treatment is the most resource consuming and tedious process. This shall be taken up only in case of extreme pollution and deterioration of the river when none of the above mentioned options are available or feasible. Most of this process is physical, mechanical and biological and may be required at regular time intervals.

17.9.7 De-silting

One of the best possible options for immediate overturn of the existing problems is de-silting with the use of mechanical devices also termed as Dredging. Though highly cost intensive, such methods have been conventionally utilized for immediate relief from pollution and increasing the carrying capacity of the river bodies all across the globe. Such examples can be taken up from lakes like Pashan in Pune, Powai in Mumbai, Kacharali in Thane and many others. As far as rivers are concerned the greatest example to be quoted for the same is Mithi River wherein every year de-silting has been carried out since past several decades. This de-silting also helps rejuvenate the existing ecosystem and diffuse air through mechanical turbulence caused during this process. Though not a very sustainable practice, but this seems to be an immediate and short terms remedy for most tedious issues of environmental degradation of rivers.

17.9.8 Mechanical Aeration

As it has been calculated in the earlier sections, the total air requirement for neutralizing the BOD in entire stretch of Bhima River is about 767.4tons of air/day. This system shall be the least rated option since mechanical aeration would require enormous amount of energy which itself is a scare resource as of now in the areas where it is intended to be used.

This can be mainly achieved by implementation of mechanical aerators. The aerators will help in providing the excess oxygen required to reduce the BOD of the waste water. From the calculations mentioned earlier in the report, each site along the Bhima river basin will have a different oxygen demand.

17.9.9 Marina Adaptation or Biological Rejuvenation

Establishing the lost ecological balance is the most effective way of rejuvenation of any water body. Though a sensitive and time consuming process, it shall still form the basis of sustainability which is the prime goal desired out of all this studies and action plans.

Use of balanced blend of eco flora and fauna along with symbiotic microbial cultures has been very effective in restoring lakes and rivers. It shall be again borne in mind that such systems are usually effective in steady state conditions which are difficult to achieve in rivers but a detailed feasibility of such systems along with an integrated approach of mechanical and natural process may render most suitable options of all.

17.9.10 Physical Cleaning & Beautification

Human perception about clean water is more of an psychological preference than chemical nature. Thus, it is very important to have cleanliness especially related to the removal / eradication of weeds such as hyacinth and others that have been long considered to be aesthetic and environmental nuisance. Similarly, aesthetic improvement in the form of beautification along the banks of canals as well as along the river wherever possible shall be done.

17.9.11 Minimum Flow in the River

It is very essential that there is constant flow maintained in the river. It has been an experience in the past that stagnation or low flow velocities leads to anaerobic or septic conditions in water bodies leading to foul smell due to release of anaerobic end products such as methane and hydrogen sulphide. This also leads to change over of the whole aquatic flora which otherwise is aerobic in nature and ultimately increasing the BOD requirements. Hence it is very essential to maintain a minimum optimum flow in the river that shall be sufficient enough to flush the riverine system. Though the concept of optimum or minimal flow is not scientifically unclear but it shall be sufficient enough to have certain amount of turbulence and flowing so as to avoid anaerobic conditions in any stretch of the river.

17.9.12 Conservation & Best Possible Options for Improvement

It shall be important that decisions regarding selection of technology for treatment of wastewater along all the identified sources shall include the end use of treated water which in most of the cases shall be for agricultural use in and geographical area of these sources.

1) **Small Villages –** Septic tank followed by soak pit
2) **Municipal Councils –** Collection system through underground network with technologies such as Trickling Filter, Phytoremediation, Facultative Lagoon or Aerated Lagoons.
3) **Municipal Corporations –** Collection system through underground network for decentralized treatment using technologies such as ASP, SBR, MBBR or UASB

Annexure-17.1

Water Consumption, Wastewater Generation and Treatment capacity of local body

Name	District	River	Sewage Generation MLD	Sewage Treatment MLD	Percentage Treatment	Disposal	Type of Treatment
Municipal Corporation							
Pimpri-Chinchwad	Pune	Mula, Pawana and Indrayani	291	224	76.97	Pawana River	SBR
Pune	Pune	Ram, Mula, Mutha	744	567	76.21	Ram, Mula, Mutha	ASP, SBR
Solapur	Solapur	Seena	88	0	0	Nalla to Seena River	---
Ahemadnagar	Ahemadnagar	Seena	60	0	0	Nalla to Seena River	----
Municipal Council							
Indapur	Pune	---	2.4	0	0		---
Daund	Pune	Bhima	4.2	0	0	Open Space	---
Jejuri	Pune	---	3	0	0		---
Saswad	Pune	Karha	4	0	0	Karha River	---
Baramati	Pune	---	4.2	0	0	Open Space	---
Bhor	Pune	Nira	2	0	0	Open Space	---
Lonavala	Pune	Indrayani	16	3.69	23.06	Indrayani	ASP
Shirur	Pune	Ghod	3.5	6	100	Ghod	ASP
Alandi	Pune	Indrayani	3	0	0	Indrayani	---
Junnar	Pune	Meena	2.2	0	0	Meena	---

Name	District	River	Sewage Generation MLD	Sewage Treatment MLD	Percentage Treatment	Disposal	Type of Treatment
Talegaon Dabhade	Pune	Pawana	6.7	0	0	Pawana	---
Shrigonda	Ahemad nagar	Sina	1.90	0.0	0.0	Into local Nalla	----
Pathardi	Ahemad nagar	Sina	2.00	0.0	0.0	Into local Nalla	----
Cantonment Board							
Pune	Pune	Mutha	22.8	0	0	Mula- Mutha River	---
Dehu Road	Pune	Pawana	8.33	0	0	Pawana	---
Kirkee	Pune	Indrayani	6	9.2	100	Indrayani	ASP
Nagar Parishad / Panchayat							
Malkapur	Satara	Koyana	6.75	0	0	Koyana	---
Pandharpur	Solapur	Bhima	12	8	66	Bhima River	MBBR
Maindargi	Solapur	----	0.77	0	0	Natural Nala	---
Kurduwadi	Solapur	----	1.45	0	0	Natural Nala	---
Sangola	Solapur	----	1.79	0	0	Natural Nala	---
Barshi	Solapur	----	6.7	0	0	Natural Nala	---
Mangalwedha	Solapur	----	1.25	0	0	Natural Nala	---
Akkalkot	Solapur	----	0.4	0	0	Natural Nala	---
Dudhani	Solapur	----	0.56	0	0	Natural Nala	---
Karmala	Solapur	----	1.4	0	0	Natural Nala	---
Total			**1307**	**818.09**			

Annexure-17.2

Details of individual industries & industrial estates on the near bank of rivers of Upper Bhima Sub-Basin

Sr. No.	Name	Address	Category	Nearest River		Effluent Quantity MLD	ETP Status	Disposal of treated effluent
				Name	distance in Km			
A	**Industrial Estate**							
1	MIDC Chakan Only 01 unit namely M/s. Mahindra Vehicle Mfg. Ltd nearest to River Indrayani	MIDC Chakan, Phase- III, Tal- Khed, Dist- Pune	MIDC Area	Indrayani	0.75km	Domestic Effluent- 371 CMD,Industrial 1110 CMD	Industry has provided 02 nos.of STP havin capacity 200 CMD of each provided up to tert ETP having capacity 1500 CMD,Primery,Secondary & tertiary, RO followe by MEE.	Recycle about & remainin use for HRTS havin area 6.5 acrs.
2	Pimpri Chinchwad MIDC	Pimpri Chinchwad	MIDC Area	Pawana	2 to 3	80	Individual industry has provided their own ETP & treated effluent is being utilized for gardening on their own land.	On land for irrigation purpose
3	Talawade MIDC (Software Park)	Talwade i	MIDC Area	Indryani	0.5 to 0.7	Domastic effluent 17.0 MLD,	Individual industry has provided their own STP & treated effluent is being utilized for gardening on their own land.	On land for irrigation purpose
4	Ahemednagar MIDC	Ahmednagar	MIDC Area	Sina	1	2.0	Individual industry has provided their own ETP & treated effluent is being utilized for gardening on their own land.	On land for irrigation purpose

5	Supa MIDC	Ahmednagar	MIDC Area	Sina	20.0	0.65	Individual industries has provided their own ETP	Individual industries has provided their own ETP and treated effluent being used for gardening on their own land.
6	Chincholi	Chincholi, Tal-Mohol, Dist. Solapur	MIDC Area	Sina	7	0.6	Individual industries has provided their own ETP	Common Effluent Treatment Plant (CETP) is having capacity 1.5 MLD & Treated effluent utilized for on land irrigation in HRTS.
7	Akkalkoat Road	MIDC Akkalkoat Road, Solapur.	MIDC Area	Sina	10	1.5	Individual industry has provided their own ETP	Common Effluent Treatment Plant (CETP) is having capacity 3 MLD & treated effluent is discharge into local nala.
B	**Individual Industries**							

1	Ammunition Factory	Khadaki	Red	Mula	0.5	81 CMD	05 nos.of ETP & 01 no.of STP provided up to tertiary	On land for gardening purpose
2	High Explosive factory	Khadki	Red	Mula	0.5	Industrial Effluent - 350 CMD, Domestic Effluent 0.4 MLD	Industry has provied ETP 5 MLD capacity , its consist of inlet effluent sump, equalization tank, alum dosing tank, clarifloculator, SDB, cascae ,sand beds, treated effluent stored in a pond within premises , further it is used for gardening purpose. STP of capacity 0.4 MLD its consist of screen chamber ,grit chamber, aeration tank, clarifier, chlorine dosing tank, sludge drying bed, sand bed having sand of different sizes.	On land for gardening purpose
3	M/s. Venkteshwara Hatechris,A/P-Bebe dohal, Tal- Maval, Dist- Pune	A/p- Bebedohal, Tal- Maval, Dist- Sangli	Red	Pawana	0.5km	Inustrial Effluent-600 CMD	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier,filter press,multigrae filter,ACF,Softener,Ozonization, etc.	Recycle about 40% &remainin use for agiculture purpose.
4	M/s. Ganga Paper Mill,	A/P- Bebe Dohal, Tal- Maval,Dist- Pune	Red	Pawana	1.6 km	Industrial Effluent-232 CMD	Industry has provided ETP comprising of primary treatment followed by secondary based on ASP	90% reuse in process & remainng used On land for irrigation purpose.
5	M/s. Rama krishi Rasayan	A/P-Loni Kalbhor, Tal- Haveli, Dist-	Red	Mula-Mutha	1.0km	103.5 CMD,	Industry has provided ETP which comprising the units Collection	Industrial effluent

		Pune					tank,Neutralizationstorage tank & againe reused in process activity.STP comprising of Collection tank,Reaction tank included neutralization,Aeration,Settling tank,Carbon & Sand Filter.	Reused in process activity.& Domestic treated effluent use for on land for gardening.
6	M/s.Cadboury India Pvt.Ltd.	A/p Induri,Tal-Maval,Dist-Pune	Red	Indrayani	1.6 km	200 CMD	ndustry has provided ETP which comprising the units Fat removal,Equilization tank,unaerobic plant followed by aerobic,Aeration, Sec.clarifier,Treate effluent tank,RO.	On land for gardening purpose
7	Greaves Cotton Ltd., Diesal Engine Unit,	Mumbai Pune Road, Chinchwad, Pune - 19.	Red	Pawana	2	0.004	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
8	PMT Machines Ltd.,	Pune Mumbai Road Behind PCMC Bldg, Pimpri, Pune	Red	Pawana	2	0.030	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
9	Pudumjee Paper & Pulp Mills Ltd,	Thergaon, Chinchwad, Pune - 411 033	Red	Pawana	0.2	5.500	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary	Industry recycled 70% water and dispose about

							Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	2200 CMD treated water in River Pawana.
10	Elantus Beck (India) Ltd.,	147, Mumbai Pune Road, Pimpri Pune -18	Red	Pawana	2	0.370	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
11	M/s. Dai Ichi Karkaria Ltd.,	Mumbai Pune Road	Red	Pawana	0.7	0.250	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
12	Force Motors Ltd.,	Mumbai Pune Road, Akurdi, Pune - 411 035.	Red	Pawana	1.5	0.200	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
13	Bajaj Auto Ltd.,	Survey No. 51A,82,67,86 Mumbai-Pune Road, Akurdi, Pune	Red	Pawana	1.5	0.574	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying	On land for irrigation purpose

							beds, etc.	
14	SKF India limited,	S.No.159 to 162,169,186,Chinchwad,Pune-33	Red	Pawana	0.9	0.120	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
15	Tata Motors Limited ,	Chinchwad, Dist - Pune .	Red	Pawana	0.93	0.380	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
16	Indian Card Clothing Co.Ltd	Mumbai-Pune Rd.Pimpri.	Red	Pawana	0.8	0.012	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
17	Premier Limited,	Mumbai Pune Road,Chinchwad, Pune	Red	Pawana	0.8	0.060	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying	On land for irrigation purpose

							beds, etc.	
18	M/s. Sandvik Asia Pvt. Ltd.,	Mumbai -Pune Road, Dapodi, Pune - 411012	Red	Pawana	0.8	0.700	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Tertiary treatment Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
19	M/s ThyssenKrupp Industries India Pvt. Ltd.,	S. No. 202/1, 206/4, 207/2, Pimpri Pune	Red	Pawana	0.5	0.001	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Tertiary treatment, Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
20	Jubilant Lifesciences Ltd.	Village- Nimbut Nira, Tal- Baramati, Dist-Pune	Red	Nira	0.1	1270	Primary as Biomethanization, Secondary as trickiling filter & tertiary treatment as Reverse Osmosis provided. RO reject used for Bio composting	Wastewater from chemical plant after treatment used on land for plantation
21	M/s. Aurangabad Distillery Pvt. Ltd.	Walchandnagar, Tal-Indapur, Dist-Pune	Red	Nira	3	254	Primary as Biomethanization, Secondary as trickiling filter & tertiary treatment as Reverse Osmosis provided. RO reject used for Bio composting	Recycled for cooling water make up
22	M/s. Chatrapati SSK Ltd.	Bhavaninagar, Tal-	Red	Nira	3	350	Primary & secondary treatment	On land for

		Indapur, Dist-Pune					provided	gardeing & irrigation purpose
23	Someshwar SSK Ltd.	Someshwarnagar, Tal- Baramati, Dist-Pune	Red	Nira	5	1200	Primary & secondary treatment provided	On land for gardeing & irrigation purpose
24	M/s. Indo Afrique Paper Mills Ltd.	Village- Pande, Pune-Satara Road, Tal-Bhor, Pune	Red	Nira	0.2	1165	Primary, secondary & tertiary treatment system provided	Recycled in the process
25	M/s. Bhima SSK Ltd.	Patas, Tal- Daund, Dist-Pune	Red	Bhima	5	2000	Primary, secondary & tertiary treatment system provided	On land for gardeing & irrigation purpose
26	M/s. Daund Sugar Ltd. (Sugar Unit)	Village- Alegaon, Tal-Daund, Pune	Red	Bhima	2	350	Primary, secondary & tertiary treatment system provided	For irrigation purpose to nearby farmers
27	M/s. Sahakar Maharshi Shankarrao Mohite Patil SSK Ltd., (Sugar & Cogen)	A/P-Akluj, Tal Malshiras, Dist. Solapur	Red	Nira	5	0.085	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
28	M/s. Sahakar Maharshi Shankarrao Mohite Patil SSK Ltd., (Distillery)	A/P-Akluj, Tal Malshiras, Dist. Solapur	Red	Nira	5	0.526	Bio Methination followed by composting.	Composting
29	M/s. Shankar SSK Ltd., (Sugar & Cogen)	Sadashivnagar, Tal Malshiras, Dist. Solapur.	Red	Nira	10	0.631	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose

30	M/s. Shankar SSK Ltd., (Disitllery)	Sadashivnagar, Tal Malshiras, Dist. Solapur.	Red	Nira	10	0.082	Bio Methination followed by composting.	Composting
31	M/s. Saswadmali Sugar Factory Ltd., (Sugar & Cogen)	Malinagar, Tal Malshiras, Dist. Solapur	Red	Nira	1.4	0.413	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
32	M/s. Saswadmali Sugar Factory Ltd., (Distillery)	Malinagar, Tal Malshiras, Dist. Solapur	Red	Nira	1.4	0.212	Bio Methination followed by composting.	Composting
33	M/s. Saswadmali Sugar Factory Ltd., (Grain Based Distillery)	Malinagar, Tal Malshiras, Dist. Solapur	Red	Nira	1.4	0.098	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	
34	M/s. Pandurang SSK Ltd., (Sugar & Cogen)	A/P Shripur, Tal-Malshiras, Dist. Solapur.	Red	Bhima	7	0.405	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
35	M/s. Pandurang SSK Ltd., (Distillery)	A/P Shripur, Tal-Malshiras, Dist. Solapur.	Red	Bhima	7	0.175	Bio Methination followed by composting.	Composting
36	M/s. Brima Sagar Maharashtra Distillery Ltd.,	A/P Shripur, Tal-Malshiras, Di.Solap.	Red	Bhima	7	0.479	Bio Methination followed by composting.	Composting
37	M/s. Shetakari SSK Ltd., (Sugar)	Chandapuri, Tal Malshiras, Dist. Solapur	Red	Nira	10	0.270	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
38	M/s. Dhavalpratapsingh Mohite Patil Agro Industries Ltd., (Grain Based Distillery)	A/P Choundashri, Tal Malshiras, Dist. Solapur.	Red	Nira	8	0.308	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose

39	M/s. Vitthal SSK Ltd., (Sugar & Cogen)	A/P Gursale, Tal Pandharpur, Dist. Solapur.	Red	Bhima	3	0.684	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
40	M/s. Vitthal SSK Ltd., (Distillery)	A/P Gursale, Tal Pandharpur, Dist. Solapur.	Red	Bhima	3	0.318	Bio Methination followed by composting.	Composting
41	M/s. Sahakar Shiromani Vasantrao Kale SSK Ltd., (Sugar & Cogen)	A/P Chandrabhaga Nagar, Tal Pandharpur, Dist. Solapur.	Red	Bhima	8	0.270	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
42	M/s. Sahakar Shiromani Vasantrao Kale SSK Ltd., (Distillery)	A/P Chandrabhaga Nagar, Tal Pandharpur, Dist. Solapur.	Red	Bhima	8	0.202	Bio Methination followed by composting.	Composting
43	M/s. Sitaram Maharaj SSK Ltd., (Sugar)	A/P Khardi, Tal Pandharpur, Dist. Solapur.	Red	Bhima	12	0.310	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
44	M/s. Shivratna Udyog Ltd., (Sugar)	A/P Karkamb, Tal-Pandharpur, Dist. Solapur.	Red	Bhima	10	0.435	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
45	M/s. Fabtech Sugar Works Ltd., (Sugar & Cogen)	A/P Nandur, Tal Mangalwedha, Dist. Solapur.	Red	Bhima	10	0.265	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
46	M/s. Bhiravnath Sugar Works Ltd., (Sugar & Cogen)	A/P Lavangi, Tal Mangalwedha, Dist. Solapur.	Red	Bhima	15	0.235	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
47	M/s. Utopian Sugar Ltd.,	A/P Kacharawadi, Tal Mangalwedha, Dist.	Red	Bhima	10	0.370	Industry has provided Primary,	On land for irrigation

	(Sugar & Cogen)	Solapur.					Secondary, Tertiary Treatment ETP.	purpose
48	M/s. Sant Damaji SSK Ltd., (Sugar)	A/P Mangalwedha, Tal Mangalwedha, Dist. Solapur	Red	Bhima	5	0.300	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
49	M/s. Lokmangal Ethanol, Sugar & Cogen Industries Ltd.,	A/P Bhandar Kavathe, Tal S Solapur, Dist. Solapur	Red	Bhima	7	0.290	Industry has provided Primary, Secondary, Tertiary Treatment ETP.	On land for irrigation purpose
50	M/s. Shri Sahakar Mharshi Shivajirao Narayanrao Nagawade SSK (. (Sugar)	A/P-Shrigonda, Tal-Shrigonda, Dist-Ahmednagar	Red	Ghod	10	0.350	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose Only
51	M/s Kukadi S.S.K. Ltd. (Sugar unit)	A/p- Visapur,Tal.-Shrigonda, Dist-Sangli	Red	Ghod	10	0.315	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose
52	M/s.Saikrupa Sugar and Allied Industries Ltd. (Sugar unit and Distillery)	Hirdgaon, Tal-Shrigondan, Dist-Ahmednagar	Red	Ghod	10	0.500	Industry has provided ETP comprising of primary treatment followed by secondary based on ASP	On land for irrigation purpose
53	M/s.Saikrupa Sugar and Allied Industries Ltd. (Sugar unit)	Devdhaithan, Tal-Shrigonda, Dist-Ahmednagar	Red	Ghod	10	0.120	Industry has provided ETP which comprising the units such as Oil & Grease trap, collection tank, primary Clarifier, Aeration tank, Secondary Clarifier, Treated water holding tank, Sludge drying beds, etc.	On land for irrigation purpose

54	M/s. Ambalika Sakhar Karkhana Ltd.	Ambalika Nagar, Tal-Karjat, Dist-Ahmednagar	Red	Sina	08	0.517	Industry has provided ETP comprising the units such as Primary clarifier, Holding tank, Equalization tank, Aeration tank, Secondary Clarifier, Sludge drying beds, etc	On land for irrigation purpose
55	M/s. Jai Shriram Sakhar Agro Products Ltd. (Sugar unit)	A/P-Haladgaon, Tal-Jamkhed, Dist-Ahmednagar	Red	Sina	10	0.150	Industry has provided, primary treatment followed by ASP based secondery treatment	On land for irrigation purpose
56	M/s. Vridheshwar SSK Ltd. Raigaon (Sugar unit)	At-Adinath Nagar, Tal- Pathardi, Dist-Ahmednagar	Red	Godavari	25	0.225	Industry has provided, primary treatment followed by ASP based secondery treatment	On land for irrigation purpose
57	M/s. Piyush Construction and Infrastructure Pvt Ltd. (Sugar unit)	Tal- and Dist-Ahmednagar	Red	Sina	08	0.210	Industry has provided ETP which comprising the units such as Equalization tank, Buffer tank, Digester, Polishing tank, Settler, Sludge drying bed, etc	On land for irrigation purpose

18

19 CHAPTER 18 – INSTITUTIONAL ARRANGEMENTS

18.1 River Basin Agencies

At present, five Irrigation Development Corporations are in operation in the State, river basinwise. As per the provisions in the Acts there are 20 Members in the governing council of the Corporation and it is headed by the Minister for Irrigation as Chairperson. The Members include MLAs, MLCs, Secretaries of different Departments and non-official members. One Officer not below the rank of Secretary to Government from the cadre of the Engineering Services of Water Resources Department is appointed by the State Government as the Member-Secretary to the Corporation who is called Executive Director. There is an Executive Committee to carry out the functions of the Corporation. The Corporation receives part of funds from Government and it can raise balance funds through its own resources and borrowings based on Government Guarantee.

At present these Corporations are mainly involved in developmental activities and not the management. The management of W.R. Projects, assessment and recovery of water charges is looked after by Government. Therefore, these Corporations are not having their own source of earning from the revenue received as water charges. In general, these Corporations are mostly working as one of the wings of Government.

18.2 State Water Policy, 2003

As per Para 2.1.1 “Integrated, multi-sectoral and river basin Approach” of the State Water Policy, the water resources of the States shall be planned, developed, managed with a river basin and sub basin as the unit, adopting multi-sectoral approach and treating surface and sub-surface water with unitary approach. The State Water Policy also stipulates that the river basin agencies shall have the responsibility and authority for the integrated planning, development and management of the water resources and watersheds of their respective river basins; for flood management, drought management and operation and maintenance of water storage and delivery infrastructure. These river basin agencies shall prepare integrated river basin plans with the effective inclusion and participation of representative of all basin water user entities, categories of water users and other stake holders. Such basin plans shall include a development plan, a long-term operation plan, a monitoring plan, a comprehensive watershed management plan, an efficiency improvement and water conservation plan and a waste minimization and water quality management plan.

18.3 The MWRRA Act 2005

Act provides for establishing River Basin Agencies and states that River Basin Agency (RBA) means any one of the five River Basin Development Corporations operating in the river basin and includes the Government Authorities as specified by the Government from time to time.

18.4 Maharashtra Act No. XV of 1996

As per Maharashtra Act No. XV of 1996, the Maharashtra Krishna Valley Development Corporation Act, 1996. (MKVDC) has been established in April 1996 and as per Chapter-IV "Functions and Powers of Corporation", various functions of the Corporation have been defined.

It is felt that after the State Water Policy 2003 was spelt out, the various provisions in the Act of MKVDC (1996Act) should have been modified in accordance with State Water Policy 2003. Similarly, after the MWRRA Act 2005 was enacted, modifications in the Acts of all Irrigation Development Corporations should have been done. The modifications in the MKVDC Act shall be done in accordance with above (1.2). It is also felt that for effective implementation of Water Resources Development Projects with an integrated approach, the act shall also provide for magisterial powers to MKVDC (RBA).

18.5 Present Staffing Pattern of MKVDC

MKVDC is headed by Executive Director (a post equivalent to Secretary from engineering cadre) assisted by Chief Accounts and Finance Officer (CAFO), Accounts Officer, Superintending Engineer, Executive Engineer and a few engineering and Clerical staff e.g. Deputy Engineer, Sectional Engineer, Office Supreintendent, Senior Clerks, etc.

It is obvious that since the planning, implementation and monitoring of MKVDC (River Basin Authority-RBA) has to be done with multi-sectoral approach, experience shows that the present staff of MKVDC can not function with multi-sectoral and integrated approach to water resources. Under MKVDC there are Offices of Chief Engineers, Superintending Engineers and Executive Engineers for implementation of Water Resources Projects. The staff in these Offices is only from engineering cadre. It is observed that the present level of co-ordination of the Offices like MKVDC, Chief Engineer, Superintending Engineer, Executive Engineer with other Departments like Geology (GSDA), Agriculture, Environment and Pollution Control Board, Industries, MJP, Zilla Parishads, Revenue, Co-operative and Banking, Agriculture Universities, Meteorology, Fisheries, Tourism, Marketing, Transportation (PWD), Municipal Corporations/Councils, Forest, MSEB, etc. is not as required for future Integrated State Water Plan. Even though MKVDC is supposed to look after irrigation management of Water Resources Projects, it is observed that at present this function is not being performed by MKVDC and needs to be include under MKVDC immediately.

18.5.1 Present Scenario

The planned utilization to in the sub basin K 5 is 8266.47 Mm^3(against water availability of 16694.00 Mm^3@ 75% Dependibility) whereas actual use of water is Mm^3 far below than planned utilization. Drought prevailing conditions are also occurring frequently in the sub basin. At present One Circle Office fully and (3) circle offices partly and (6) Divisional Offices are looking after water resources development activities partly for the sub basin. Water resources development activities are similarly looked after by other Departments also (like GSDA, Agriculture, etc.). Therefore an inter-disciplinary approach is necessary for strengthening or otherwise combining various Departments for implementation of the proposed plan.

In order to have integrated approach to Water Resources Development and Management, following models of MKVDC (RBA) are suggested.

Model-I –

1) In the office of MKVDC, Senior Officers from the fields of Geology, Agriculture, Engineering, Environment, Hydrology, Soils, Water Supply Department, Industries, Tourism, Revenue, Economy, Co-operative and Banking sector need to be recruited who will plan and monitor the water resources projects with an integrated approach. The MKVDC will prepare and monitor an integrated plan annually as well as a short term plan say for 5 years. A senior level Officer of the rank of Secretary who is competent in administration, management and execution who can deliver the goods may have to be posted if necessary by open advertisement. The structure of Office of MKVDC (RBA) is proposed in general will be as below –

i) Executive Director, to be further called as Commissioner of River Basin as head of RBA. Following Officers from various Departments will work under him who will assist in preparation and monitoring of integrated plan of Water Resources Development and Management with multi-sectoral approach.

a) Chief Finance Officer to look after all financial matters related with water resources projects including credit and finance facilities.

b) Joint Director/Deputy Director of Agricultural to look after all agricultural activities, economical use of water, achieving best efficiency of irrigation projects.

c) Superintending Engineer, Executive Engineer, Deputy Engineer from Water Resources Department.

d) Executive Engineer from Maharashtra Jeevan Pradhikaran.

e) Environmental Engineer.

f) Officer from Co-operative, Fisheries, Tourism, Revenue (for LA and R&R) and Marketing, Industries Department each.

g) Senior Geologist (for Ground Water Management).

h) Socio-economic expert preferably Agricultural Economist.

i) Statistician.

j) Executive Engineer from M S E Dist Co. Ltd. (Old MSEB).

If any assistance from officers of departments other than above is required, it shall be made mandatory for other departments to give such assistance as and when required for preparation and monitoring of the integrated plan.

2) Similar Officers as above from various fields also will have to be recruited in the Office of Chief Engineers, Superintending Engineers, Executive Engineers for implementations and monitoring of the water resources projects as planned by MKVDC as above (1). Officers at appropriate levels from various Departments will also have to be posted in the Offices of Chief Engineers, Superintending Engineers, Executive Engineers, etc. who will implement the plan with respect to their Department.

Model-II –

1) Senior Officers from various fields as mentioned in Para 1 above under head of RBA will prepare and monitor an integrated plan of water resources project. The present structure of Offices of Chief Engineers, Superintending Engineer, Executive Engineer, etc. may continue for implementation of water resources projects. However, the implementation of water resources project with respect to subjects/parameters other than engineering will have to be looked after by the respective Departments like Geology, Agriculture, MJP, Environment, Industries, Co-operative, etc. Departments entrusted with implementation of the above plan will however be accountable and answerable to RBA.

18.6 The proposed organizational structure of River Basin Authority

The proposed organizational structure of River Basin Authorityis as under below–

PROPOSED ORGANISATION STRUCTURE OF RBA

MASTER PLAN – REVIEW COMMITTE

M.D.KVRBA (Chairman)

S.E. KVRBA (Secretary)

M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14

Member Energy Agri. G.W. W.C. MJP MIDC Fisheries MTDC Z.P. Urban MPCB Hydrology Revenue

W.R.D. Centers

M1

WRD

1.DG, MERI

2.DG, Walmi

3.CE, WRDC

4.C.E, Hydro

M5

MJP

Member Secretary MJP

M9

Z.P.

1.C.E.O. Z.P. Pune/Solapur/Sangli/Satara/

M6

MIDC

C.E. MIDC

M10

Urban Centers

1.Commissioner &

M13

Revenue

Commissioner Pune /Nashik/Aurangabad

M2
Agriculture
Director Pune/

M7
Fisheries
Director

M11
MPCB
Regional Manager

M14
Energy
1.C.E.

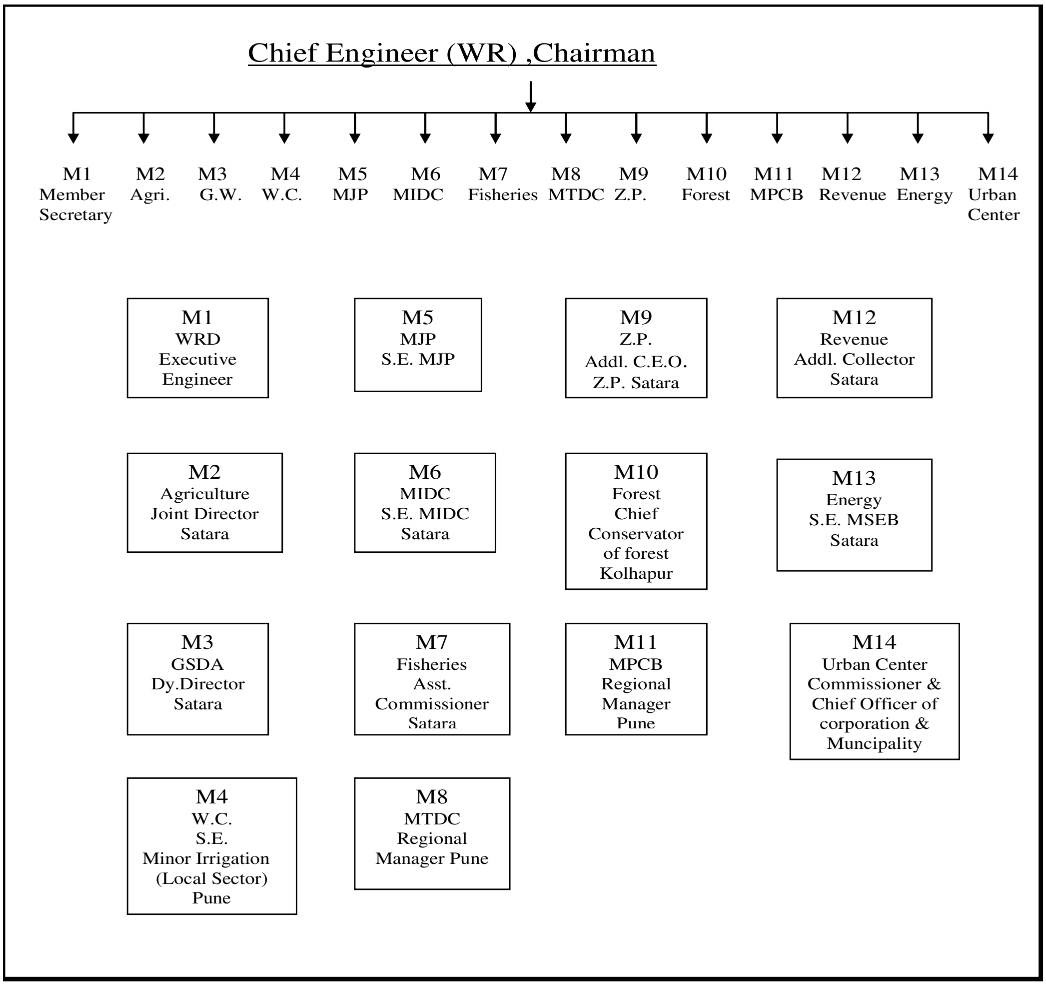
M3
GSDA
Director Pune

M8
MTDC
Regional Manager

M12
Hydrology

M4
W.C.
C.E. W.C.

The Krishna Sub Basins are grouped together are implementation of IDMWR. The implementation of this group will be done by committing as mentioned below



Chief Engineer (WR) ,Chairman

CHAPTER-19 — USE OF MODERN TOOLS

19.1. Remote Sensing, GIS and GPS in Integrated Management of Water Resources

In developing countries like India, with increasing population and living standards, the demand for water is growing exponentially. The optimal management of water resources becomes absolute necessary to meet the growing demand for which basin wise integrated planning and management is required. Remote sensing based inputs have been significantly contributing to the water resources development, planning and management. The major areas of applications in the field of water resource includes Irrigation infrastructure monitoring, Basin-level water resources assessment, Flood forecasting and inundation modeling, Water bodies monitoring, GLOF studies, Irrigation performance assessment, Reservoir capacity loss assessment, River basin planning & development. and Hydrologic modeling.

GIS and remote sensing techniques are effectively used to replace, complement and supplement data collection in various facets of different kinds of water resources projects. This chapter describes the design and implementation of a GIS-based system for water resources management. The system can help water resource manager to appreciate the potential of remote sensing capabilities for application in the management of precious water wealth. The system can dynamically monitor water and provide decision support for precious water management. It has obvious economic, environmental and social benefits.

Water resources are the basis of sustainable development of society and economy. It is recognized from the present situation that the key issue is the management. In fact, Remote Sensing (RS), Geographic Information System (GIS) and Global Positioning System (GPS) can play important role to water resources management, such as surface water, groundwater, investigation, dynamic monitoring of ecology and estimation of water, amount necessary for keeping and recovering ecological environment, existing irrigation area investigation and irrigation planning, soil moisture and drought monitoring, investigation of soil salinization, planning, monitoring and effect evaluation of returning cultivated and to forest or grassland, dynamic monitoring of desertification and soil erosion, variation of river course and sedimentation in lakes and reservoirs, site selection of water project and its planning, design, construction and management. What follows is relatively detail introduction in several aspects.

The rapid development of spatial technologies in recent years has made available new tools and capabilities to Extension services and clientele for management of spatial data. In particular, the evolution of Geographic Information Systems (GIS), the Global Positioning System (GPS), and Remote Sensing (RS) technologies has enabled the collection and analysis of field data in ways that were not possible before the advent of the computer.

GIS applications enable the storage, management, and analysis of large quantities of spatially distributed data. These data are associated with their respective geographic features. For example, water quality data would be associated with a sampling site, represented by a point. Data on crop yields might be associated with fields or experimental plots, represented on a map by polygons. A GIS can manage different data types occupying the same geographic space. For example, a biological control agent and its prey may be distributed in different abundances across a variety of plant types in an experimental plot. The power of a GIS lies in its ability to analyze relationships between features and their associated data (Samson, 1995). This analytical ability results in the generation of new information, as patterns and spatial relationships are revealed.

GIS provides support for our engineering projects which include comprehensive watershed and flood protection planning, design and analysis including complex hydraulics, fluvial geomorphology, river and stream mechanics analysis, hydrologic modeling, design of new and innovative hydraulic facilities, and urban storm water management systems.GIS is a powerful tool for developing solutions for water resources such as assessing water quality and managing water resources on a local or regional scale. Hydrologists use GIS technology to integrate various data and applications into one, manageable system.

GPS technology has provided an indispensable tool for management of water resources and natural resources. GPS is a satellite and ground-based radio navigation and locational system that enable the user to determine very accurate locations on the surface of the Earth. Although GPS is a complex and sophisticated technology, user interfaces have evolved to become very accessible to the non-technical user.

To sustain the Earth's environment while balancing human needs requires better decision making with more up-to-date information. Gathering accurate and timely information has been one of the greatest challenges facing both government and private organizations that must make these decisions. The Global Positioning System (GPS) helps to address that need.

Data collection systems provide decision makers with descriptive information and accurate positional data about items that are spread across many kilometers of terrain. By connecting position information with other types of data, it is possible to analyze many environmental problems from a new perspective. Position data collected through GPS can be imported into geographic information system (G1S) software, allowing spatial aspects to be analyzed with other information to create a far more complete understanding of a particular situation that might be possible through conventional means.

19.2. Role of satellite Remote Sensing for Water Resources Management

Measurements from satellite remote sensing provide a means of observing and quantifying land and hydrological variables over geographic space and support their temporal description. Remote sensing instruments capture up welling electromagnetic radiation from earth surface features which is either reflected or emitted. The former is reflected solar radiation and the latter is in thermal infrared and microwave portions of electro-magnetic spectrum. Active microwave radars obtain reflected/returned microwave signals. The reflected solar energy is used for mapping land & water resources like land use, land cover, forests, snow & glaciers, surface water features, geologic & geomorphologic features, water quality, etc. The thermal emission in the infrared is used for surface temperature, energy fluxes and microwave for soil moisture, snow & glacier, flood. etc.

Remote sensing has several advantages over field measurements. First, measurements derived from remote sensing are objective; they are not based on opinions. Second, the information is collected in a systematic way which allows time series and comparison between schemes. Third, remote sensing covers a wide area such as entire river basin. Ground studies are often confined to a small pilot area because of the expense and logistical constraints. Fourth, information can be aggregated to give a bulk representation, or disaggregated to very fine scales to provide more detailed and explanatory information related to spatial uniformity. Fifth, information can be spatially represented through geographic information systems, revealing information that is often not apparent when information is provided in tabular form.

Towards evolving and supporting comprehensive water management strategies space technology plays a crucial role. Systematic approaches involving judicious combination of conventions ground measurements and remote sensing techniques pave way for achieving optimum planning and operations of water resources projects remote sensing has shown enormous promise for providing wealth of data and information that

Were deficient with the in-situ observations. It has also been a valuable tool in many hydrologic modeling applications due to its capability of providing unrestricted collection of information with wide spatial coverage and temporal revisit.

Earth observation Satellite (EOS) data has been extensively used to map surface water bodies, monitor their spread and estimate the volume of water. The SWIR band of AWIFIS sensor in IRS P6 was found to be useful in better discrimination of snow and could, besides delineating the transition and patch in snow covered area. Snow-melt runoff forecasts are being made using IRS-WiFS/AWiFS and NOAA/AVHRR data. These forecasts enable better planning of water resources by the respective water management boards. Monitoring reservoir spread through seasons has helped to assess the storage loss due to sedimentation, updating of rating curves. Satellite data derived spatial and temporal information on cropping pattern, crop intensity and condition forms basic inputs for developing indicators for agricultural performance of the irrigation systems and bench marking of systems. Satellite data derived geological and hydro-geomorphologic features assist prospecting the ground water resources to plan aquifer recharging, water harvesting and drinking water sources. High resofution satellite data remarkably augmented the remote sensing services extending it to infrastructure planning management.

The overall applications of RS & GIS in water resources sector can be broadly categorized into the following:

• Water Resources Assessment

• Water Resources Management

• Water Resources Development

• Watershed Management

• Flood Disaster Support

• Environmental Impact Assessment & Management

• Water Resources Information & Decision Support Systems

Table 19.1 provides the details of Sensors/satellites data suitable for Water Resources Management.

Table 19.1 Sensors Satellites data suitable for Water Resources Management

Application	**Satellite and Sensor**
• Field/Plot boundaries • Irrigation network/infrastructure • Cartographic information • Micro-scale features	Cartosat-1 & 2 0 PAN Ikonos, QuickBird SPOT(PAN)
• Land use • Land cover • Surface water resources • Crop identification • Crop yield/condition • Soil salinity • Water logging	IRS, Landsat, SPOT, ASTER, CBERS
• Evapotranspiration • Soil moisture	NOAA, Aqua, Terra, Landsat, ASTER, CBERS
• Surface roughness ERS	ERS, Radarsat, RISAT
• Soil moisture	
• Flood inundation • River bank erosion • River control works	IRS, Landsat, SPOT, ERS, Radarsat, JERS, RISAT IRS, Landsat, SPOT, Cartosat01 *2 Cartosat-1&2, Ikonos, Quickbird
• Surface Water • Snow cover • Glaciers	IRS, Landsat, SPOT, ASTER, NOAA, Aqua. Terra

• Snow depth • Snow water equivalent	ERS, Radarsat, JERS, RISAT
• Water quality	IRS, Landsat, SPOT
• Precipitation	TERMM, METEOSAT

Various applications have been developed, since last 3 decades, wherein SRS date is being put into use to provide quantitative and reliable information, there by facilitating improved water resources management.

• Surface water resources
- Water bodies
- Wetlands
• Irrigation water management
- Inventory of Irrigated Agriculture
-Performance Evaluation & Bench Marking
- Monitoring Intervention Schemes
- Near Real- Time Monitoring
- Surface Water Logging
- Soil Salinity/Alkalinity
-Irrigation Infrastructure Mapping
- Assessment of Irrigation Potential creation
- Pre-feasibility studies
-Actual Evapotranspiration estimation (R&D level)
- Irrigation Information System (R &D level)
• Reservoir Sedimentation
- Assessment of Sedimentation
- Updation of Elevation-Area-Capacity Curve
- Estimation of Reservoir Capacity
- Assessment of Rate of Siltation
- Assessment of Life of Reservoir
- Reservoir Catchment Analysis
-impact of Foreshore Cultivation
• Hydro
-Power generation
- Submergence area analysis
- Inputs for pre-feasibility assessment
-Inputs for ranking studies
-EIA studies
• Interlinking of rivers
- Pre-feasibility studies
-Canal alignment studies
-Submergence area analysis
-Land irrigability
- Inputs for Detailed Project Reports
• Flood disaster monitoring and management
-Flood inundation mapping & monitoring
-Flood hazard zonation

-Flood forecasting
- Flood inundation simulation
- Disaster management and support

19.3. Measurement Of Sugar Cane Crop Using Satellite

19.3.1. Remote Sensing And GIS Technique (Case Study of Khadakwasala Project)

The sugarcane crop mapping using remote sensing technique has been carried out by Remote Sensing Division, at MERI Nashik for the command areas of irrigation projects. The surveys based on remote sensing data are faster, economical and it covers large area. The present study covers the sugarcane crop mapping for Khadakwasala project of Upper Bhima Basin. Accordingly the work has been included in the Annual Research Programme of MERI of 2011-2012. The IRS multi date LISS-III images covering the gross command area to identify sugarcane crop acreage are used in this study. These results derived by this method are useful for checking the field crop acerage data collected by management divisions.

19.3.2. Objective

The objective is to identify and measure sugarcane crop in the command area of Khadakwasala Project through satellite remote sensing and to generate Village-wise statistics for the sugarcane crop area.

19.3.3. Command area

Mutha river originates near Western Ghat in Pune District. Khadakwasala dam has been built in 1880 across Mutha River which is located 18 km away from Pune city. It has maximum height of dam is 31.76 metres. The dam site is locateds at latitude 18°-18'N Longitude 73°-47'-11" E. The fields are irrigated through new Mutha right bank canal.The command spreads in four talukas of Pune District viz. haveli with 23 villages, Baramati with 02 villages, Indapur with 64 villages and Daund with 76 villages.

19.3.4. DATA PREPARATION

4.1 Field Data

Following data has been obtained from field authority and other agencies.

i) Index map of project along with the command area for precise geographic location of study area.

ii) Salient Features of the Project.

iii) Toposheet numbers of Khadakwasala command area.

iv) List of villages fall under Khadakwasala command area.

v) The digital Village Maps in vector form for Haveli, Baramati, Indapur and Daund Talukas available with RSGID, MERI

4.2 Selection of Satellite Data

Based on the general practice of sugarcane cultivation prevailing in command area under study, sugarcane crop cycle for different varieties is tabulated as below

Table 19.2: Sugarcane Crop Life Cycle For Different Varieties

Sr.No	Season	Time of planting	Duration (months)	Variety	Delta(cm)
1	Suru	Jan-Feb	12	Co86032,phuleG-265,Sanjvani	250-275 2
2	Pre-seasonal	Oct-Nov	15	Sampada, sanjavani, co-419 co-86032	275-325
3	Adsali	July-Aug	18	Co-746,co-94014	325-350
4	Ratoon /Khodwa	Feb- March	12-15	4Co746,Co86032, etc	250-275

Sugarcane crop life cycle is as below

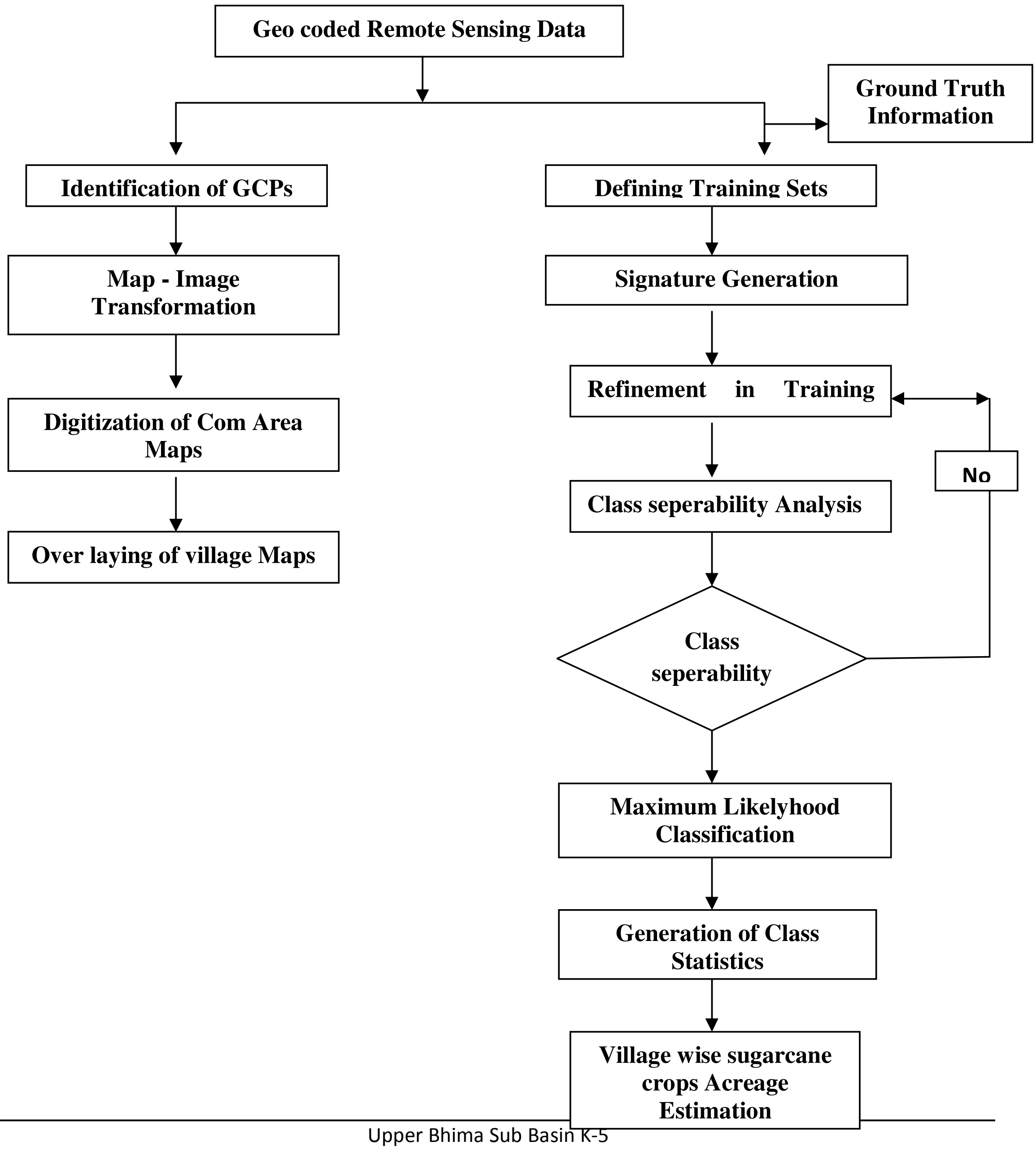
1. Germination phase - planting to 60 days.
2. Formative phase - 60 to130 days.
3. Grand phase - 130 to 250 days.
4. Maturity phase - 250 to365 days. More water is required in phase 2&3.

In the present study it is decided to map the sugarcane crop standing from November 2011 to May 2012. Selection of satellite data is done based on sugarcane crop cycle. First satellite image of initial period of the crop year selected is of the date 8th November 2011, second image of the date 19th January2012 and third image of the date 31st March 2012, of Path 95 Row 59 The adjoining path satellite image of date 13th November 2011, 24th January 2012 and 5th April 2012 of Path 96 Row 60 are used for other half of command area.

19.3.5 METHODOLOGY:

5.1 Flow Chart

It is used for identification, measuring and mapping of Sugarcane Crop using Remote Sensing Technique



5.2 Subseting Area of Interest

Subsets are taken from these Lieo-coded images so as to contain only the study area for the ease of manipulation of data.

5.3 Land Use & Land cover Classification Using Satellite Image

Depending on various shades of colours seen in the False Colour Composite (FCC) of the image classification is carried out. Digital values of pixels of evenly distributing training samples and standard class signatures are used for LU/LC classification in eight classes.

Table 19.3 Signature of Sugarcane Area in Satellite Data

Sr. No	Height of Sugarcane	Period	Variety	Signature in image
1	4' and above	5 months or more fully grown with bright signature	Planted during July to December and ratoon harvested early.	Bright red or magenta
2	2' to 4'	Less than 5 months but more than 3 months	Planted during December to January and / or Khodva of harvested late.	Red or pale red
3	Less than 2'	Less than 3 months	Planted during February to March and / or Khodva of harvested after February	Reddish black or black

Land use / Land cover classes

1) Medium bright red — Crop2 —Confirmed sugarcane

2) Bright red — Crop I —wheat, maize, banana.

3) Faint red and pink — vegetation] —other vegetation 2 and crops

4) Gray white patches — urban land

5) White- sugarcane waste

6) Green —Blackish- empty agricultural lands-Fallow land.

7) Cyan-Greenish-white lands generally away from agricultural lands- Barren land

8) Blue -Water in lakes and river- Blue, Bluish and Black-Water.

The RESOURCESAT-2 LISS-111 image of November 2011 is classified for sugarcane crop. Similarly Satellite image of January 2012 is interpreted for sugarcane crop and other land use classes. Classified data of first image helps in interpreting sugarcane area of second image at higher confidence level.

5.4 Aggregation of Classified Two Date Images

The two-season scenes of command area depicted through two classified images of November 2011 and January 2012 are available. The period of maturity of sugarcane varies from 12 months to 18 months. Sometimes due to delay in harvesting, sugarcane crop may be seen standing for few months although it is ready for harvesting. It is seen that sugarcane is at various stages of growth in field throughout the year. Various types of mixed vegetation have been observed along rivers and nalas where drainage density is more.Some of these vegetation remains green even in summer. Besides sugarcane, some other crops are also grown. It is also observed during field visit that sugarcane and fodder crops are shown on the same field. Due to complexity of the irrigation practice it has been experienced that classification of sugarcane crop in command area with a single date satellite image with reasonable accuracy is difficult.

Logical Decision Rules Used For Aggregation of Two Season Images

Images:1: 8th &] 3`h November 2011 Images:2: 19th & 24th January 2012 Result Crop with less vigour Crop with increased vigour Sugarcane Crop with vigour Crop with vigour Sugarcane Fallow or harvested field Crop with vigour Sugarcane Crop with less vigour Fallow or sugarcane waste field Other crop Crop with vigour Fallow or sugarcane waste field Other crop

To prepare a composite classified image, a MATRIX image is created from the 2 classified images. This matrix image contains 121(1 1 X I I) possible combinations of classes. After applying above described logic, the various class combinations are recoded and reduced to following 8 classes. Class 1- Water, Class 2- Urban/Barren, Class 3- Vegetation, Class 4- Forest, Class 5- Fallow, Class 6- Crop-Waste, Class 7- CropI, Class 8- CropII Sugarcane.

5.5 Use of Third Image For Aggregation

Experience of previous study shows that use of three images of different dates gives good accuracy in sugarcane mapping. Use of only two images may result in under / over estimation of sugarcane crop in small areas where harvesting of sugarcane is delayed with practice of second year sugarcane crop. If harvesting of first year sugarcane crop is delayed in some areas, the preparation of land for second year plant (Khodava) is also delayed. In the second satellite image such lands cannot be identified for any crop as the growth of plants is very low. It is also the case with late new plantation of sugarcane. If the growth is not vigorous, but only moderate or normal, these plants cannot be identified in the field as sugarcane. Fruit gardens such as Sapota, Coconut, Banana, Grape and Pomegranate gardens area resembles with sugarcane resulting in over estimation. Third image helps to separate these fruit gardens from sugarcane. Third image of date 31st March 2012 and 5th April 2012 are used here. Similar procedure is followed for classification, aggregation, etc. The previous recoded image and the third image are used and matrix image is prepared. Classified land use and cover image is shown in Fig 2 and final supervised image showing sugarcane crop is shown in Fig 3 enclosed in annexure.

5.6 Generation of Area Statistics

Recoded composite image showing the land use classes is prepared. Then digital village map in vector form is overlaid on the image. The village-wise statistics of areas of land uses in each village is obtained using SUMMARY module in GIS ANALYSIS. Data is edited in MS Excel to present in a tabular form (Annexure I). 6.00 FIELD VISIT FOR GROUND TRUTH VERIFICATION. A field has been conducted for ground truth data collection on 26th to 31th December 201-2.The locations have been confirmed with the help of Trimble JUNO handheld GPS receiver (details are given in Annexure II). The information about the standing crop on the field has been noted. Photographic record about ground truth points is also maintained. Following personnel from MERE carried out the Ground Truth data Collection. Shri. S.G.Wagh, Asst. Engr. II, Shri. B.F. Nagare, Draftsman Grade - I. Following personnel from Khadakwasala Irrigation Division coordinated the activity. Shri S.M.kale, ShriS.G.Padadhalmal, Shri S.G.Pisal all Sectional Engineers and Canal Inspectors of Khadakwasala Irrigation Division.

19.3.6. RESULTS

The methodology adopted using the remote sensing technique with three season's images of LISS III sensor is used to give fairly accurate results at village level. The village level area of sugarcane in the command area thus mapped is shown in following table no.4.In general the error that may occur in RS based technology is in the range of 10 to 15 %. The village level database then prepared can be used for periodical mapping of sugar cane. The Sugarcane acreage measured works out to 26235.13 ha. Village-wise area statements are attached as annexure- 19.1

Table 19.4 Summary of Results

Sr. No.	District	Taluka	No. of Villages	Area of Village in Ha	Sugarcane by SRS in Ha
1	Pune	Haveli	23	25424.	2842.
2		Baramati	2	4618.	283.
3		Daund	76	93149.	14542.
4		Indapur	64	71657.20	8568.
Total			165	194849.	26235.

19.4.0.:- Real-time data acquisition system:

19.4.1 The Water Resources Department (WRD) of Government of Maharashtra (GoM) is entrusted with the surface water resources planning, development and management. A large number of major, medium and minor water resources development projects (reservoirs and weirs) have been constructed in Maharashtra. Though, the reservoirs in Maharashtra are not specifically provided with flood cushion, they have moderated flood peaks to considerable extent by proper reservoir operations. The reservoirs are multipurpose including hydropower, irrigation, domestic and industrial uses and are operated with rigid schedules as single entities based on the historical hydro-meteorological data and experience gained. These methods are often not adequate for establishing optimal operational decisions, especially where integrated operation of multiple reservoirs for flood management is contemplated. In addition, manual data observation and transmission results in a considerable time lag, between data observed in field and its communication to decision making level which sometime leaves little time, for flood forecasts.

The Ministry of Water Resources (MoWR), Government of India (GoI) has initiated Hydrology Project Phase II (HP-II), which is a follow-on to the concluded Hydrology Project-I (HP-I:1995-2003). During HP-I, the Hydrological Information System (HIS) was developed for the entire state of Maharashtra and the data is monitored manually 1-2 times a day. Validated hydro meteorological data is being made available for planning and management of water resources of the state in scientific manner. Data is also being made available for research activities and other water resources purposes. Under HP-II project, Decision Support System (DSS) for water resources planning and management is developed for Upper Bhima basin as a pilot.

During the Mid-term review taken by World Bank in October 2009 as a part of India Hydrology Project -II, the Real time decision support system comprising of Real Time Stream flow Forecasting and Reservoir Operation System based on real time data acquisition system was proposed for Krishna bhima basin of state.

Fig – 19.1

Fig – 19.2

Automated Reservoir Water Level and Outflow Discharge Stations:

Kadvi (Radar)

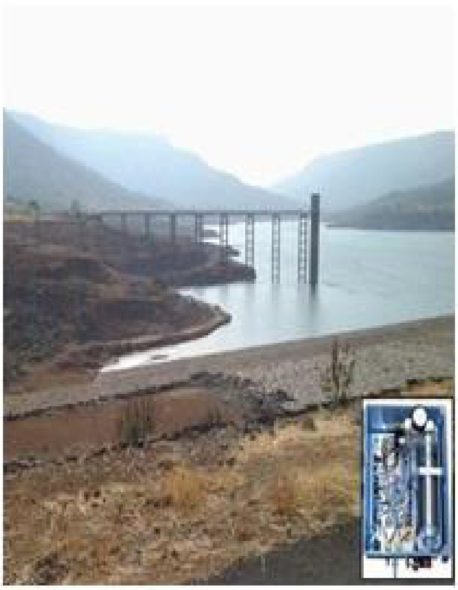
Radhanagari (Radar)

Fig – 19.3

Automated Reservoir Water Level and Outflow discharge station :

Dhom Balkawadi (Bubbler)

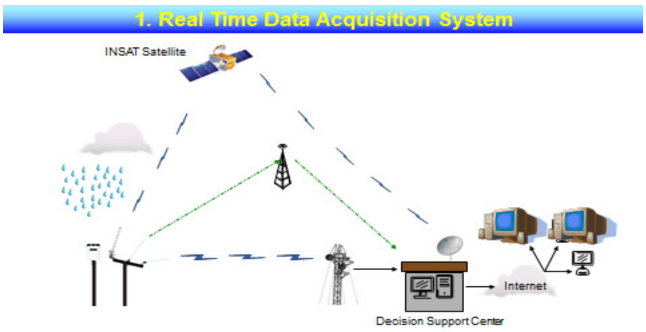
Urmodi (Shaft Encoder)



19.4.2:- Implementation in Krishna Basin :-

In Krishna and Bhima Basins total 249 Real time hydro meteorological data collection stations (RTDAS) are installed and commissioned under HP II (viz. Automated Rainfall Stations, Automated Full Climate Stations, Automated River /canal Water Level (Stage) & Discharge Station, Automated Reservoir Water Level & Outflow Discharge Stations). Also spillway gates of dams are now equipped with gate sensors. The rainfall, climate parameters (viz. max min temperature, relative humidity, wind velocity, wind direction, barometric pressure, solar radiation), water level of reservoir and river gauging sites, gate sensor opening for spillway gates are measured using sensors. The sensors are installed at prominent locations in the basins (rivers, dams, dam catchments, etc.). The data is collected and transmitted in real time through VSAT/GSM mode. The conceptual picture of RTDAS is shown below.

Fig – 19.4



19.5.0. Data collection and Validation by Hydrology Project, Nashik.

19.5.1. Introduction:-

The data like rain fall, river gauge is collected by Hydrology project Nashik. This data is processed and validated at various levels using software called SWDES, HYMOS.

19.5.2. Primary Validation: It is done at Sub divisional level. Observed data is entered in software SWDES ((Surface Water Data Entry System). All observed parameters are checked against maximum, minimum, upper boundary & lower boundary limits.

19.5.3. Secondary Validation: It is done at divisional level. After primary validation data is exported to software HYMOS (Hydrological Modeling system) and using this software secondary validation is carried out.

For rainfall Special homogeneity test is conducted for group of stations having same topography, same altitude. Test station is compared with other stations in the vicinity of 20 to 25 sqkm area. Difference between estimated and observed rainfall is compared with respect to standard deviation. Standard deviation allowed is 20%. Greater than 20% Standard deviation observed values are to be checked.

• Gauge discharge data — Rating curve i.e. stage discharge curve is prepared from observed stage discharge data & it is compared with previous 5 years rating curves.

19.5.4. Hydrological validation: It is done at Hydrometeorological Data Processing Division, Nashik using HYMOS software.

• Average rainfall by Theissen polygon over the catchment of Gauge Discharge station (MPC) is calculated. From rating curve discharge is calculated and from the discharge runoff depth (HRD) is calculated. NIPC > HRD i.e. **Rainfall > Runoff** is the final check.

19.5.5.Interagency Validation: Climatic data sent to IMD and Gauge discharge data sent to CWC for interagency validation.

19.5.6. Procedure of validation: Climatic data validation done on monthly basis and rainfall & gauge discharge data validation done on yearly basis.

19.5.7. Data Storage & Dissemination: After these validation data sent to Data Storage Center for Storage & dissemination. WISDOM (Water information System Data Online Management) software is used for data storage & data dissemination. All information is available on our website www.mahahp.org

Annexure 19.1

Locations of Ground Truth and Field Visit for Sugarcane Mapping in Command of Khadakwasala Dam

S.N	Village	Taluka	Ground truth features (crop/barrenland/fallowl and/ vegetation/etc)	Latitude	Longitude	Size of plot in	Remark
1	Theur	Haveli	Sugarcane	18°31' 18.3"	74°03' 12.5"	5	
2	Theur	Haveli	Guava	T8°31' 18.3"	74°03' 15.3"	4	
3	Naigaon	Haveli	Sugarcan	W	74°04'34.3"		
4	Naigaon	Haveli	e Sugarcan	18°31' 01"	74°04'51.8"	5	
5	Urali Kanchan	Haveli	e Grass	30' 29.5"	74°07'58.5"		
6	Koregaon	Haveli	Sugarcane	18° 31' 40.2"	74° 07'44"	5	
7	Ashtapur	Haveli	Sugarcane	1	74° 08'5.5"		
	Hingangaon	Haveli	Sugarcane	18° 32' 20.4"	74° 09'23.7"	4	
9	Khamgaon Tek	Haveli	Sugarcane	18° 31' 40.2"	74° 10'56"		
10	Khamgaon Tek	Haveli	Sugarcane	18°31' 46.6"	74°10'36.5"		
11	Yawat	Daund	Sugarcane	18°28' 38.8"	74°15' 41.8"	5	
12	Kasurdi	Daund	Sugarcane	18°28' 56.3"	74°14' 18.2"	10	
13	Sahajpur	Daund	Banana	18°29' 14.4"	74° 10' 7.8"	2	

S.N	Village	Taluka	Ground truth features (crop/barrenland/fallowland/ vegetation/etc)	Latitude	Longitude h a	Size of plot in	Remark
14	Yawat Station	Daund	Sugarcane	18° 29' 49.1"	74° 16' 11.4"		
15	Yawat Station	Daund	Wheat	18° 30' 52.4"	74° 16' 41.4"	1.5	
16	Pimpalgaon	Daund	Sugarcane	18°33' 51.1"	74° 16' 45.6"		
17	Nathachiwadi	Daund	S u g a r c a n e	18° 31' 56.7"	74017' 38.7"	4	
18	Khutbav	Daund	Wheat	18° 30' 42.5"	74°18' 55.5,,	1.5	
19	Galandwadi	Daund	Sugarcane	18°31'19.3"	74°20' 2.2"	4	
20	Kedgaon	Daund	Wheat	18° 29'58.5"	74°21' 7.2"	1.5	
21	Warwand	Daund	Harvesting stage Sugarcane	18° 26' 45.7"	74° 25' 7.1"	2	
22	Patas	Daund	Horticulture	18°26' 31.6"	74°28' 36.4"	2	
23	Betwadi	Daund	Sugarcane	18°27' 16.2"	74°30' 42.5"	2	
24	Girim	Daund	Sugarcane	18°27' 27.1"	74° 31' 53.6"	3	
25	Nanwij	Daund	Sugarcane	18°29, 5 4" .	74° 31' 57.2"	4	
26	Deulgaon	Daund	Jawar	17 2 5 ' 46.6"	74° 40' 29.6"	5	
27	Shirapur	Daund	Sugarcane	18° 27'6.1"	74°43' 11.1"	3	
28	Khadaki	Daund	Wheat	18°21'2.5"	74039, 13.7"	1.5	
29	Chincholi Swami	Daund	Jawari	18° 19'31.2"	74°43' 35.9"	2	

S.N	Village	Taluka	Ground truth features (crop/barrenland/fallowland/ vegetation/etc)	Latitude	Longitude h a	Size of plot in	Remark
30	Bhigwan	Indapur	Vegetation	18° 18'16.1"	74° 45' 40.8"	10	
31	Bhigwan	Indapur	Sugarcane	18° 19'20"	74° 46' 36.4"		
32	Rajegaon	Indapur	Sugarcane	18° 19' 41.7" 1	74° 46' 41.8"		
33	Madanwadi	Indapur	Sugarcane	18° 17'3.2"	740 44' 2.6"		
34	Dalaj 2	Indapur	Mix crop	18° 13'38.5"	74° 47' 38.9"	1	
35	Palase-A'	Indapur	Wheat, Sugarcane	18° 12'56.3"	74° 53' 7.9"	1	
36	Loni	Indapur	Jawar	18° 12' 32"	74° 54' 36.8"	5	
37	Varkute (Bk)	Indapur	Pomogranate	18° 11' 15.8"	74° 56' 13.4"		
38	Bijwadi	Indapur	Grapes	18° 09'14.3"	74° 57' 52.9"	10	
39	Konkulwadi	Indapur	Vegetables,Pomogranate	I 8° 07' 48.3"	74° 57' 22.7"	2	
40	Indapur	Indapur	Sugarcane	18° 07' 43.6"	75° 00' 27.7"	3	

RISK MANAGEMENT

1.0 Introduction :

The geographical area of Maharashtra state is 308,000 Km2. Major river basins in the state are the Krishna river (with its major tributary as Bhima), Godavari, Tapi and the West flowing rivers of Konkan strip. Maharashtra receives rainfall from both south-west and north-east monsoon. The state has very highly variable rainfall ranging from 6000 mm in upper catchments to 200 mm in shadow areas of lower catchments. Majority of rainfall mainly occurs in a four months period between June to September with the number of rainy days varying between 40 to 100. The state experiences flash floods particularly in Western Ghats including Krishna basin & Bhima sub Basin. For instance, Pune, Solapur and Ahmednagar districts in Bhima sub Basin experienced severe floods several times during recent decade.

The Water Resources Department (WRD) of Government of Maharashtra (GoM) is entrusted with the surface water resources planning, development and management. A large number of major, medium and minor water resources development projects (reservoirs and weirs) have been constructed in Maharashtra. Though the reservoirs in Maharashtra are not specifically provided with flood cushion, they have moderated flood peaks to considerable extent by proper reservoir operations.

2.0 K5- Bhima Sub Basin :

The Bhima River Basin, covers an area of 45335 sq.km in three large states— Maharashtra , Karnataka & Telangana. The river Bhima, which is one of the major rivers of Maharashtra covering an area of 14856 sq.km is 300 km long in Maharashtra. Bhima originates from Bhimashankar in Pune district and flows through Pune, Ahmednagar and Solapur Districts. It mainly flows from north to south. Main tributaries in Bhima river basin are Man, Bori, Nira, Bhama, Sina, Indrayani, Ghod, Mula-Mutha, flowing from west to east .

3.0 Flood Prone Area of K5- Bhima river basin :

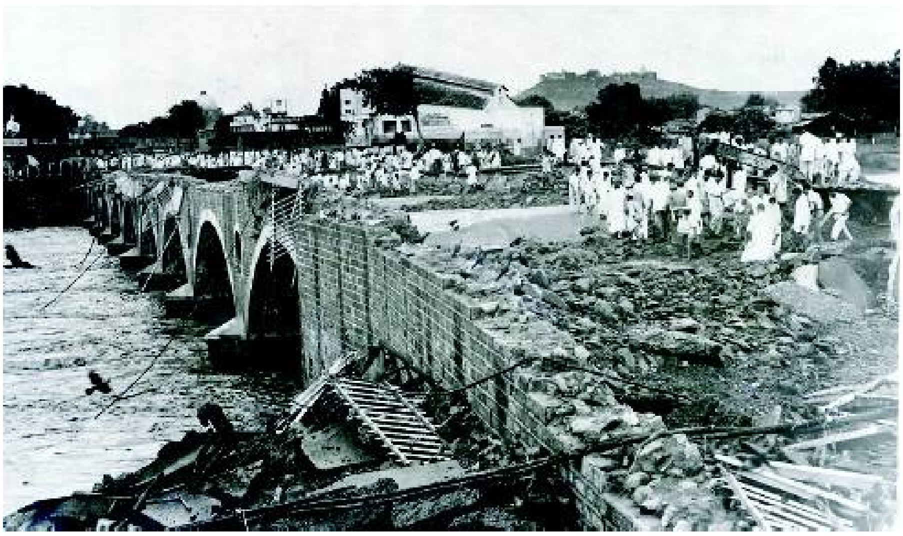
Flood, by definition means an overflow of water that submerges land which is usually dry. It can also be described as a covering by water of land not normally covered by water.

Prominent floods in History –

Panshet -

In the history of Maharashtra state, which came into existence on 1st May 1960, Panshet dam burst causing flood and catastrophic effects on 12th July 1961 is everlasting. It was the worst flood experienced in decades by Pune city.

Panshet Dam, also called Tanajisagar Dam, is a dam on the Mutha River about 50 km southwest of the city of Pune . The dam was constructed in late 1950s for irrigation and, along with three other dams nearby, Varasgaon, Temghar and Khadakwasla, it supplies drinking water to Pune. Panshet Dam burst in its first year of storing water on 12 July 1961.



The Panshet Dam was under construction when the dam had failed. It was zoned at a height of 51 m and having an impervious central core outlet gates located in a trench of the left abutment and hoists were not fully installed when floods occurred at the site of construction. The reservoir had a capacity of 300 million m3 . Between June 18 and July 12, 1961, the recorded rainfall was 1778 mm. The rain caused such a rapid rise of the reservoir water level that the new embankment could not adjust to the new loading condition. The peak flow was estimated at 4870 m3 /s . Water rose at the rate of 9 m per day initially, which rose up to 24 m in 12 days. Due to incomplete rough outlet surface the flow through was unsteady which caused pressure surges. Cracks were formed along the edges of the right angles to the axis of the dam causing a subsidence of 9 m wide. An estimated 1.4 m of subsidence had occurred in 2.5 hours, leaving the crest of the dam 0.6 m above the reservoir level. Failure was neither due to insufficient spillway capacity nor due to foundation effect. It was attributed to inadequate provision of the outlet facility during emergency. This caused collapse of the structure above the outlets.

Some areas of the Bhima river basin suffer from floods. Due to heavy rains in the catchment of Bhima and Nira rivers created flood havocs in Solapur, and Vijapur (Karnataka) districts in July 2005

Pandhapur - It is one of the most flood prone areas in the Bhima sub basin. Notable floods in the recent past were also observed in 1956 and 1984.

A normal day at Pandharpur as above. But when floods havoc, it is like below.

It is reported that about 149 villages in the district of Solapur, Pune & Nagar are prone to floods. The extent of flooding could be so severe that these villages remain cut off from the rest of the area for a week.

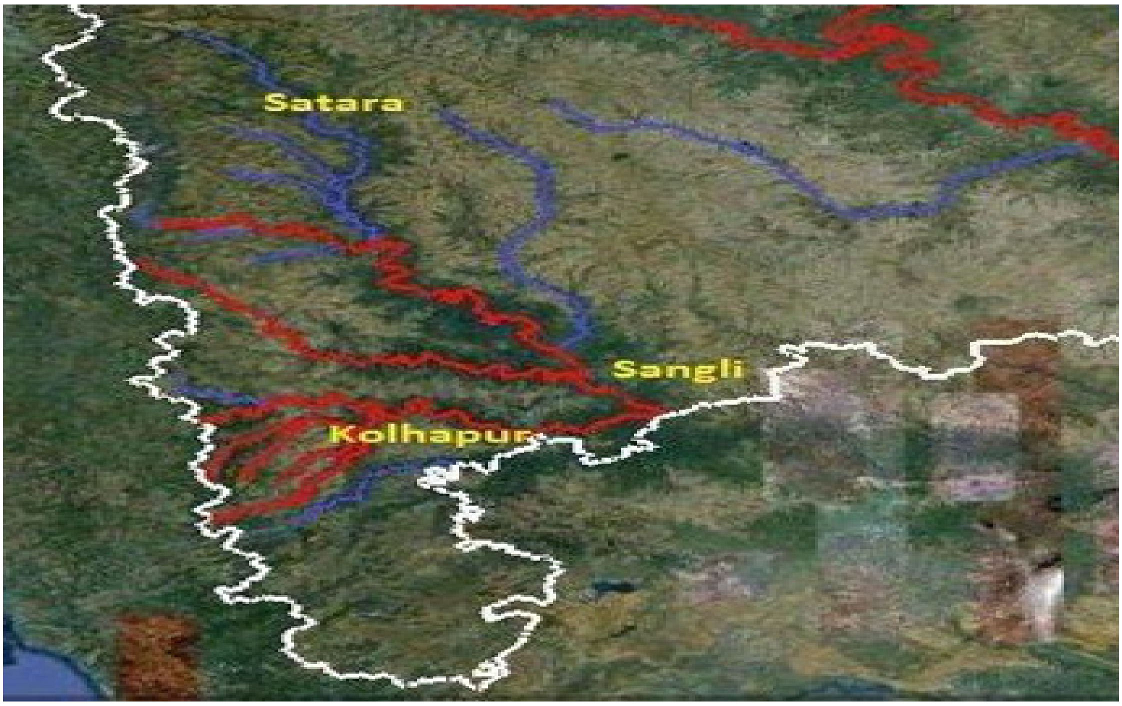


Figure 2- Flood Prone Reaches (in) in K5- Bhima Basin

2.0 Ghod Sub-Basin :

The river Ghod is one of the major tributaries of river Bhima. Ghod originates from Bhimasanker in Pune district and flows through Pune, & Nagar districts. It mainly flows from north to south. Two of its main tributaries are namely, Kukadi and Mina flows from west to east.

3.0 Flood Prone Area of Ghod river Sub-basin :

Some areas of the Ghod river basin suffer from floods. The years 1971, 1973, 1976, 1983 and 1997 observed heavy floods in the sub basin. Due to heavy rains in the catchments of Ghod and Kukadi rivers created flood situation in villages d/s of Ghod dam.

The spillway discharge of Ghod dam during these years was about 1.00 lack cusecs. It is reported that about 4 villagesd/s of Ghod dam in the district of Pune & Nagar are affected by floods from Ghod river.

4.0 Reservoir Operation:

Ghod dam is planned for the conservation purposes for utilization of the stored water for irrigation, industrial use, water supply and /or power generation. Provision of specific flood absorption storage is not considered in the reservoir up till now. It is not planned as flood control reservoir. Dams can moderate the floods through a proper reservoir operation aided by reliable flood forecasting system. ROS will become quite useful for the Reservoir Authorities. During the monsoon period, reservoir operation usually consists of release of water for various uses, considering actual demands and storages available. The release schedules are routinely prepared by the concerned authorities. Flood forecasting operations and reservoir operation are physically carried out during rainy season.

5. Flood Management – Ghod

In Flood Position all dams controlled by this department and communication done by E.E. Kukadi Irrigation DivisionNo-1, Narayangaon and Kukadi Irrigation division No-2, Shrigonda. Central Flood Control Unit on situation of flood in rainy season (June to Oct) in between these month daily rainfall on dam site, Incoming flow, Discharge Passed from Canal & Spill way, important places in river water level & danger level, these above all situation of all dams & all river controlled by these flood control unit.

This Collective information given to collector, corporations, office of police Commissioner, Press (Media), all department of Govt. & also to Mantralaya, Mumbai etc. at 10.00 a.m. daily. The Information of Ghod Project given by S.E. command area development Authority, Pune, Ex engr, Kukadi Irrigation Division No-2, shrigonda. In Flood situation these information updated by every hours and same time dangerous situation advance notice given to department from five years back these information are available on this web site- **www.punefloodcontrol.com**

2. Geographical situation of Rivers & Reservoir in Ghod/Bhima Basin.

2.1 Geographical Situation – Ghod river start from sahyadri about Bhimashankar Hill & flowing through Pune & ahmednagr District and meets Bhima at 32 km d/s of Ghod dam. Rainfall.

Total catchment area of Ghod dam is 3586 sqkm. maximum available Rainfall is 5000 mm at Tamhini & minimum Rainfall noted at Ghod dam taluka is 200 mm.

Important Rivers in Ghod Sub Basin

Sr-No.	River Name	Source	Length K.m.	Linking to other River	Joint Source
1	Ghod	Bhimashankar	125	Bhima	Tandali Sangam
2	Meena	Mankeshwar	80	Ghod	Shingwe Pargaon
9	Kukdi	Kukdeshwar, Tal Junner	95	Ghod	Annapur
10	Aar	Khuni Pargaon	32	Kukdi	Yedgaon Dam (Tilekarwadi)
13	Hanga	Hanga ,Tal-Parner	85	Ghod	Shirsgaon Kata

Important Dam in Ghod Sub Basin -

Sr. No.	Name of Dam	River	Total Water Storage TMC	Proposed Discharged Capacity Qusecs			
				Spillway	Canal	Power House	Total
	Kukdi Sub Basin						
1	Yedgaon	Kukdi	3.30	113149	1840	0	114989
2	Manikdoh	Kukdi	10.88	50808	297	600	51715
3	Dimbhe	Ghod	13.50	74938	1546	550	77034

4	Wadaj	Meena	1.27	52443	1058	0	53501
5	Pimpalgaon Joge	Aar	8.31	25003	245	0	25248
6	Chilhewadi	Pushpawati	1.00	57250	0	0	57250
7	Ghod	Ghod	7.63	261000	685	0	261685

Flood Affected Spots

1.1 Downstream of Ghod Dam

Kashti and Pachpute vasti, Tandali Sangam,Ganegaon,Sangavi– These towns/ villages situated down stream of Ghod dam and the distance is 25-30 k.m. from Ghod dam. The flow coming from Kukdi and Mina basin ends in Ghod Dam and this flow meets Bhima river at Tandali sangam near Daund city.. The flood alert level is 509.62 m and the discharge of this level is 80,000 cusecs and dangerous level is 530.35 m and discharge of this level is 1,20,000 cusecs.

Flood Affected villages under Ghod Sub Basin

Sr. No.	Town	Taluka	Sr. No.	Town	Taluka
1	Kashti	Shrigonda Dis-A'nagar	8	Ganegaon	Shirur Dist-Pine
2	Pachpute vasti	Shrigonda Dis-A'nagar	9	Inamgaon	Shirur Dist-Pine
3	Sangavi	Shrigonda Dis-A'nagar	10	Kalaskarwadi	Shirur Dist-Pine
4	Bori	Shrigonda Dis-A'nagar	11	Pimpalsuti	Shirur Dist-Pine
5	Hangewadi	Shrigonda Dis-A'nagar	12	Chinchani	Shirur Dist-Pine
6	Wangdari	Shrigonda Dis-A'nagar	13	Shirasgaon	Shirur Dist-Pine
7	Tandali	Shirur Dist-Pine			

6.0 Disaster Management Plan:

The Disaster Management Plan prepared for Village/Municipality level has two parts.

Part-1 of the Plan contains information on-

1. Information about Village / Municipality
2. Hazardous, Vulnerable and Risk Areas in the Village / Municipality and Map showing Disaster Prone area
3. Response and Improvement Plan
4. Early Warning and Preparedness Plan
5. Mitigation, Relief and rehabilitation Plan

Part-2 of the Plan includes-

1. Telephone numbers of Government Officials (State/District/Tal./Control Room)
2. List of Members of Disaster Management Committee, Groups, Swimmers etc.
3. Mitigation Measures for Hazardous, Vulnerable and Risk Areas
4. List of Emergency and Important Services
5. List of NGOs, Addresses, Telephone Numbers, Specialization
6. Inventory of available resources and equipment.

It was learnt that some major flood prone rivers are marked with blue lines (for 25 year flood) and red lines (for 100 year floods) by WRD.

7.0 Flood Control Cell :

For Ghod river, the Ghod Flood Control Cell is established, which collects the reservoir levels, rainfall, spillway discharges for each of the reservoirs twice a day (07:00 Hrs and 17:00 Hrs) in normal circumstances and hourly in flood like situation. The data is received by any available means viz. Cell Phones, Wireless, Land Line etc. Flood control cell is under the Executive Engineer, Kukadi Irrigation DivisionNo-2, Shrigonda and during monsoon (from June to October) is operational 24X7 in three shifts. Everyday, at 08:00 Hrs Report is generated and send to The Chief Engineer (S.P.), Water Resources Pune, Divisional Commissioner, Pune and the District Administration. The Disaster Management Cell under District Collector with the help of other departments is prepared for emergency response.

8.0 Rainfall :

Rainfall is the only source of water in the Ghod River. The quantity of inflow and flow forecasts depends on the intensity and timeliness of rainfall data. In the Ghod river basin, the flood forecasting and reservoir operations are based on the guidelines given in "*Dam Safety Manual Chapter 7 : Flood Forecasting, Reservoir Operation and Gate Operation, 1984, Irrigation Department, Government of Maharashtra*". This manual had been prepared mainly based on the circulars issued by the GoM, the literature published by the Central Water Commission, New Delhi and the Central Board of Irrigation and Power, New Delhi and provisions in IS: 7323-1974.

Reservoir Operation Schedule (ROS)

The ROS for Ghod Dam Reservoir for the year 2014 has been approved by the Chief Engineer,S.P. Pune (WRD), Pune is as follows in Table-1.

Table-1 – Reservoir Operation Schedule

ROS OF GHOD DAM

Sr.No.	Date	Upper Guide Curve : 90 % Dependable				Lower Guide Curve : 75 % Dependable			
		R.L.	Storage		%	R.L.	Storage		%
			MCUM.	TMC			MCUM.	TMC	
1	2	3	4	5	6	7	8	9	10
1	15-Jun	547.290	115.783	4.089	74.80	544.239	47.559	1.680	30.72
2	30-Jun	547.290	115.783	4.089	74.80	544.239	47.559	1.680	30.72
3	15-Jul	547.290	115.783	4.089	74.80	544.248	47.748	1.686	30.84
4	31-Jul	547.290	115.933	4.094	74.89	544.958	61.452	2.170	39.70
5	15-Aug	547.470	120.808	4.266	78.04	545.534	73.530	2.597	47.50
6	31-Aug	547.823	130.641	4.614	84.39	546.493	95.579	3.375	61.74
7	15-Sep	548.344	145.810	5.149	94.19	547.339	117.259	4.141	75.75
8	30-Sep	548.533	151.554	5.352	97.90	548.219	142.139	5.020	91.82
9	15-Oct	548.640	154.800	5.467	100.00	548.640	154.800	5.467	100.00

Flood Management – Bhima Basin (Ghod & Kukadi sub-basin)

Importance of Flood Control in Bhima Basin there 20 major & 13 medium projects half of them Ujjani, Sina kolegaon & Ghod Projects are coming under Jurisdiction of Chief Engineer (S.P.) Pune, Khadwasla, Panshet, Varsgaon, Temghar, Bhatgar,, Veer, Kukadi complex consisting Yedgaon,Wadaj,Manikdoh,Pimpalgaon Joge & Dimbhe dam these important project are under Jurisdiction of Chief Engineer, Water Resource Department Pune.

In Flood Position all dams controlled by this department and communication done by E.E. Khadkwasla Irrigation Division, Pune and for Kukadi complex by E.E.Kukadi Irrigation Division No.1, Narayangaon and Central Food Control Unit on situation of flood in rainy season (June to Oct) in between these month daily rainfall on dam site, Incoming flow, Discharge Pass from Canal & Spill way, important places in river water level & danger level, these above all situation of all dams & all river controlled by these flood control unit.

This Collective information given to collector, corporation, office of police Commissioner, Press (Media), all department of Govt. also Mantralaya, Mumbai etc. at 10.00 a.m. daily. The Information of Ujjani Project given by S.E. command area development Authority, Solapur & E.E. Ujjani Dam management division, Bhimanagar. For Kukadi information given by S.E. Command Development Authority Pune & E.E. Kukadi Irrigation Division No.1, Narayangaon. In Flood situation these information updated by every hours and same time dangerous situation advance notice given to department from five years back these information are available on this web site. www.pune flood control.

DISASTER MANAGEMENT (Flood)

FLOOD MANAGEMENT

There are 0 rainguage stations in the catchment area of Kukadi complex Tal-Junnar and Ambegaon Dist-Pune There is rain gauge station on each dam of Kukadi project i.e. Yedgaon, Wadaj, Manikdoh,Pimpalgaon Joge & Dimbhe. The data from the same is used to forecast the flood to be released from Kukadi complex. The details of spillway radial gates are as bellow

Sr.No.	Name of dam	Size of Radial gate	No. Of gates	Spillway discharge
1	Yedgaon dam	12x5.00 m.	11	3844 Cumecs
2	Wadaj dam	12x5.00 m.	05	1426 Cumecs
3	Manikdoh dam	12x5.00 m.	05	1439 Cumecs
4	Pimpalgaon Joge	12x5.00 m.	05	708 Cumecs
5	Dimbhe dam	12x5.00 m.	05	2122 Cumecs

The gates of the dams are operated according to the following schedule.

Reservoir Operation Schedule (ROS)

The ROS for Yedgaon, Wadaj, Manikdoh,Pimpalgaon Joge & Dimbhe Reservoir for the year 2014 has been approved by the Chief Engineer,S.P. Pune (WRD), Pune vide his (Marathi) Letter No. DE5/PB10/1270,1271dated 3.3.2015 and is as follows in Table-1.

Table-1 – Reservoir Operation Schedule for Yedgaon

Sr.No.	Date	As per 75% Yield		As per 90 % Yield		Remarks
		Water Level (m)	% Of Gross Storage	Water Level (m)	% Of Gross Storage	
1	2	3	4	5	6	7
1)	15 June	635.918	10.13	638.292	37.10	
2)	30 June	635.926	10.40	638.293	37.12	
3)	15 July	636.00	10.71	638.293	37.12	
4)	31 July	638.009	32.30	638.602	42.36	
5)	15 Aug	639.859	66.75	640.131	73.61	
6)	31 Aug	640.152	74.26	640.233	76.72	
7)	15 Sep	640.745	92.27	640.781	93.36	
8)	30 Sep	640.933	97.97	640.945	98.33	
9)	15 Oct	641.00	100.00	641.00	100.00	

Table-2 – Reservoir Operation Schedule for Wadaj

Sr. No.	Date	As per 75% Yield		As per 90 % Yield		Remarks
		Water Level (m)	% Of Gross Storage	Water Level (m)	% Of Gross Storage	
1	2	3	4	5	6	7
1)	15 June	712.500	43.34	712.500	43.34	
2)	30 June	712.500	43.34	712.500	43.34	
3)	15 July	712.500	43.34	712.500	43.34	
4)	31 July	712.500	43.34	712.500	43.34	
5)	15 Aug	712.500	43.34	713.389	51.05	
6)	31 Aug	714.084	55.87	714.939	66.16	
7)	15 Sep	716.672	88.55	716.739	89.30	
8)	30 Sep	717.134	95.00	717.232	96.23	
9)	15 Oct	717.530	100.00	717.530	100.000	

Table-3 – Reservoir Operation Schedule for Manikdoh

Sr. No.	Date	As per 75% Yield		As per 90 % Yield		Remarks
		Water Level (m)	% Of Gross Storage	Water Level (m)	% Of Gross Storage	
1	**2**	**3**	**4**	**5**	**6**	**7**
1)	15 June	706.250	70.98	708.237	81.84	
2)	30 June	706.250	70.98	708.237	81.84	
3)	15 July	706.250	70.98	708.316	82.29	
4)	31 July	707.891	79.86	709.147	87.05	
5)	15 Aug	709.748	90.49	710.117	92.60	
6)	31 Aug	710.565	95.49	710.753	96.72	
7)	15 Sep	711.069	98.80	711.130	99.19	
8)	30 Sep	711.217	99.76	711.230	99.85	
9)	15 Oct	711.250	100.00	711.250	100.00	

Table-4 – Reservoir Operation Schedule for Pimpalgaon Joge

Sr. No.	Date	As per 75% Yield		As per 90 % Yield		Remarks
		Water Level (m)	% Of Gross Storage	Water Level (m)	% Of Gross Storage	
1	2	3	4	5	6	7
1)	15 June	684.067	40.39	685.32	66.90	
2)	30 June	684.067	40.39	685.32	66.90	
3)	15 July	684.257	44.36	685.423	69.15	
4)	31 July	684.921	58.24	685.826	77.95	
5)	15 Aug	686.00	81.76	686.356	89.88	
6)	31 Aug	686.421	91.36	686.623	95.97	
7)	15 Sep	686.743	98.71	686.762	99.14	
8)	30 Sep	686.793	99.85	686.793	99.84	
9)	15 Oct	686.800	100.00	686.800	100.00	

Table-5 – Reservoir Operation Schedule for Dimbhe

Sr. No.	Date	As per 75% Yield		As per 90 % Yield		Remarks
		Water Level (m)	% Of Gross Storage	Water Level (m)	% Of Gross Storage	
1	2	3	4	5	6	7
1)	15 June	711.145	64.65	712.943	71.92	
2)	30 June	711.145	64.65	714.147	76.94	
3)	15 July	711.145	64.65	714.147	76.94	
4)	31 July	711.145	64.65	716.26	86.14	
5)	15 Aug	714.641	79.04	717.337	91.15	
6)	31 Aug	716.986	89.49	717.875	93.75	
7)	15 Sep	718.496	96.80	719.145	100.00	
8)	30 Sep	719.112	99.84	719.145	100.00	
9)	15 Oct	719.145	100.00	719.145	100.00	

Gate Operation Schedule (GOS) –

The GOS for Yedgaon, Wadaj, Manikdoh,Pimpalgaon Joge & Dimbhe Dam has been detailed as below in discription as followes –

Gate Operation Schedule

The gate opening should start with 0.25 m head interval and operated as per the stages mentioned in the above Table for releasing the discharge of each dam and similarly for closing the discharge for each dam.

General instruction for gate operation are given by M.E.R.I. Under Letter No. T.C.2/94/5714 dated 27/7/70 specific points stressed by M.E.R.I. In this letter are applicable to any gate operation are as follows.

If individually part nomber of gates are opened dispropotionately higher, ski jump is likely to be formed instead of a roller. This condition may also develop if all gate opening are not kept equal during operation the differential gate opening should not differ 0.25m or 0.5m. At any time in the sequence specified.

By opening the central gates first and keeping the end gates closed the side wall gate subjected to dynamic pressure and return flows are produced due to the flows from central gates expending side ways and causing return flows. This has to be avoided by opening end gates first and others in a symmetrical manner, through gradual increse as explained above.

The sequence of hydraulic operation recommended for approval.

Sr.No.	Name of dam	Size of Radial gate	No. Of gates	Spillway discharge
1	Yedgaon dam	12x5.00 m.	11	3844 Cumecs
2	Wadaj dam	12x5.00 m.	05	1426 Cumecs
3	Manikdoh dam	12x5.00 m.	05	1439 Cumecs
4	Pimpalgaon Joge	12x5.00 m.	05	708 Cumecs
5	Dimbhe dam	12x5.00 m.	05	2122 Cumecs

SEQUENCE OF GATE OPERATION

Following are the general guidelines for the gate operation

if the dam has got stilling basin at two different evaluations, then generaly the gates with stilling basin is lower level need to be operated first.

The end gated should normally be opened first to prevent cross flow striking against guide walls and junctions.

At any time during the operation of different gates, the difference in gate opening for any two consecutive gates should not exceed 0.50m.

After opening the end gates the gate/gates ate the central should be opened in symetrical manner starting from the central towards the end through gradual increse in the opening.

While closing the gates, the gate that was opened last should be closed first. The procedure to be followed for closing the gates would generaly be the reverse of the procedure followed for opening the gates. Complete closure of the gate should be accompalished by gradual lowering of the gates by 0.20m to 0.30m in the proper sequence.

While surpluging the floods when the reservoir is all or near about the F.R.L. Towards the end of mansoon.

The reservoir level should not be allowed to enchrouch upon free board.

No part of conservation storage be allowed to spill towards the later part of the mansoon.

3 Frequency of Flood

The Table showing the water released from Yedgaon, Wadaj, Manikdoh,Pimpalgaon Joge & Dimbhe Dam spillway from 2004-05 to 2013-14 is as below in Table-22.3.

Table-3 – Status of Water Flood from Kukadi complex

Sr.No.	Date	Name of dam	Discharge
1	31.8.2010	Yedgaon	43.40
2	31.8.2010	Wadaj	90.00
3	28.8.2011	Wadaj	210.00
4	7.9.2011	Yedgaon	130.00
5	12.9.2013	Wadaj	70.00
6	31.7.2013	Yedgaon	210.00
7	30.7.2014	Yedgaon	566.00
8	30.7.2014	Wadaj	215.00
9	1.8.2013	Dimbhe	290.00

Above information shows that out of 5 years of operation of Kukadi complex Reservoir, the overflow occurred only in ___ years. The maximum discharge released through spillway is 566 Cumec which is 3% of the design flood discharge. Normal flood carrying capacity of river Ujjani er on downstream side of Project Ujjani site near village is Cumec. No land of any village has been damaged as reported by Revenue Department during discussion.

After maintaining reservoir water levels as per above schedule, excess discharge is released to downstream of Dam as mentioned in above Table. The information regarding the same is communicated immediately to Revenue and Police Authorities by WRD.

4 The list of villages likely to be affected by the flood of Kukadi complex based on the discharge released is given below. The locations of these villages have been marked on the Map No. 22.1 showing a) Blue Zone, b) Green Zone and c) Red Zone.

5) **Blue Zone :** As per the guideline issued by Dam Safety Manual Chapter-7, Page No. 28, these Blue Zone is known as Prohibitive Zone which is 1.5 times river channel capacity. This area may be used only for the open land type of use such as playgrounds, gardens, river side esplanades or cultivation of light crops wherever such riparian rights exists.
6) **Green Zone :** This Zone is also known as restrictive Zone which is of spillway design flood capacity. In the restrictive zone the land use regulation may specify the safe height for the plinth level of the lowest floor level and the type of building method to prevent collapse of the structure during floods.

   Restrictions on the type of uses of buildings in such zones may also be specified. This will take into account the possibility of floods expected in this zone and also necessity of all prompt evacuation of people, cattle and goods at short notice, to avoid costly flood damages and loss of life. While framing constructions in such zones, compulsory insurance may also have to be considered.

7) **Red Zone :** This Zone is also known as Caution Zone and is of Dam break inundation Zone. Flooding in this area may be rare but not altogether impossible. The regulation for land use in this zone should only include a caution about the flood risk and likely flood height in this area and necessary building precautions for safety under such circumstances, wherever a contingency may arise.

Based on this, the villages along with the population (2011), likely to be affected are as below in Table-22.5.

Table- 5 – Status of Population Affected due to Flood

Right Flank				Left Flank			
Sr. No	**Name**	**Taluka**	**Population**	**Sr. No**	**Name**	**Taluka**	**Population**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1)	**Yedgaon dam**						
1)	Kandali	Junnar	802	1	Pimpalwandi	Junnar	681
2)	Shiroli	Junnar	394	2	Bori	Junnar	586
3)	Nimgaon sava	Junnar	542	3	Jadhavwadi	Junnar	359
4)	Pargaon	Junnar	310	4	Sakori	Junnar	401
5)	Jambut	Shirur	620	5	Mangrul	Junnar	252
6)	Wadner Bk	Shirur	348	6	Wadner Kd	Parner	452
7)				7	Renwadi	Parner	227
2)	**Wadaj dam**						
1	Wadaj	Junnar	200	1	Nimgaon	Junnar	100
2	Nimdari	Junnar	100	2	Basti	Junnar	90
3	Savargaon	Junnar	250	3	Vadgaon sahani	Junnar	130
4	Warulwadi	Junnar	350	4	Pimpalgaon	Junnar	210
5	Ranjani	Ambegaon	180	5	Arvi	Junnar	180
6				6	Narayangaon	Junnar	610
7				7	Hivare	Junnar	110
8				8	Khodad	Junnar	98
9				9	Valati	Ambegaon	70
10				10	Shingave	Ambegaon	130
3)	**Manikdoh dam**						
1	Junnar	Junnar	6000	1	Golegaon	Junnar	100
2	Shiroli Bk	Junnar	200	2	Kukshet	Junnar	90
3	Dhalewadi	Junnar	90	3	Shiroli Kd	Junnar	90
4				4	Tejewadi	Junnar	90
5				5	Ozar	Junnar	150
6				6	Hivare Bk	Junnar	100

4)	**Pimpalgaon Joge dam**						
1	Dingore	Junnar	100	1	Pimpalgaon Joge	Junnar	100
2	Netwad	Junnar	70	2	Udapur	Junnar	90
3				3	Thikekarwadi	Junnar	90
4				4	Dholwad	Junnar	200
5				5	Umbraj	Junnar	450
5)	**Dimbhe dam**						
1	Dimbhe	Ambegaon	100	1	Mahalunge	Ambegaon	50
2	Supedhar	Ambegaon	90	2	Gangapur	Ambegaon	150
3	Shinoli	Ambegaon	200	3	Gonwadi	Ambegaon	200
4	Pimpalgaon Ghode	Ambegaon	190	4	Chincholi	Ambegaon	250
5	Ghodegaon	Ambegaon	650	5	Chass	Ambegaon	300
6	Narodi	Ambegaon	150	6	Sakori	Ambegaon	90
7	Wadegaon Kashimbe	Ambegaon	150	7	Nandur	Ambegaon	250
8	Sultanpur	Ambegaon	100	8	Kalamb	Ambegaon	160
9	Chandoli Kd	Ambegaon	90	9	Chandoli	Ambegaon	120
10	Pimpalgaon Khadaki	Ambegaon	150	10	Khadaki	Ambegaon	250
11	Nirgudsar	Ambegaon	90	11	Bharadi	Ambegaon	120
12	Pargaon	Ambegaon	130	12	Kathapur	Ambegaon	90
13	Kathapur Kd	Ambegaon	70	13	Pimparkhed	Shirur	50
14	Devgaon	Ambegaon	50	14	Chandoh	Shirur	70
15	Lakhangaon	Ambegaon	130	15	Fakate	Shirur	80
16	Kawate	Shirur	70	16	Sabalewadi	Shirur	50
17	Ahmadabad	Shirur	50	17	Takali Hazi	Shirur	300
18	Kohakadi	Shirur	70	18	Nimgaon dude	Shirur	50
19				19	Tamkarwadi	Shirur	40
20				20	Mhase Kd	Shirur	100

5 The disaster management plan has been papered by the concerned authorities of revenue and WRD for this emergency and circulated amongst all the concerned office also, as well as the public representative of Bhima Ghod & Kukadi Sub Basin.

6 O&M of K.T.weirs

Sr.No.	Name of river	No. Of K.T.weir
1	Kukadi	18
2	Ghod	25
3	Meena	24
4	Pushpawati	2
5	Mandavi	1

There are 70 K.T.weirs constructed on above rivers. The policy for Operation & Maintenance of these K.T.Weirs is necessary for irrigation & Drinking water purpose in Rabbi.

7 RECOMMENDATIONS OF STUDY GROUPS / COMMISSIONS / COMMITTEES

7.1 Recommendations related to Floods

i) The recommendation/guidelines have been ensured by Dam Safety Organization, Government of Maharashtra, Nasik as per Dam Safety Manual, Chapter-7 and 8.

ii) The National Water Policy, 2002 provides for –

a) There should be a master plan for flood control and management for each flood prone basin.

b) Adequate flood cushion should be provided in water storage projects, wherever feasible, to facilitate better flood management. In highly flood prone areas, flood control be given overriding consideration in reservoir regulation policy even at the cost of sacrificing some irrigation or power benefits.

c) While physical flood protection works like embankments and dykes will continue to be necessary, increased emphasis should be laid on non-structural measures such as flood forecasting and warning, flood plain zoning and flood proofing for the minimization of losses and to reduce the recurring expenditure on flood relief.

d) There should be strict regulation of settlements and economic activity in the flood plain zones along with flood proofing, to minimize the loss of life and property on account of floods.

e) The flood forecasting activities should be modernized, value added and extended to other uncovered areas. In flow forecasting to reservoirs should be instituted for their effective regulation.

iii) State Water Policy, 2003 provides for –

a) All the provisions included in National Water Policy, 2002.

b) Watershed Management through extensive soil conservation, catchment area treatment, preservation of forests and increasing the forest cover and the construction of check dams shall be promoted to reduce intensity of floods.

8 SWOT ANALYSIS

a) Strengths (S)

2) As far as flood is concerned there is no danger of heavy floods in the sub basin due to limited rainfall (The Kukadi Project has come in operation since 1978 and it is observed that out of the design discharge of 3480 Cumec a maximum discharge of 1415 Cumec has been let out on 15/10/1983).

(KID)

FLOOD (K5- MULLA MUTHA BASIN)

Table 1 - Major / Medium Category wise Project Details.

Sr. No	Name of Projects	Taluka	Planned Gross Use as per GoM Letter dt. 20/10/01 to CWC	
1	2	3	Major > 3 TMC	Medium 1-3 TMC
A	Major Projects			
1	Khadakwasla	Haveli	30.94	
2	Pawana	Mawal	12.92	
3	Chaskaman	Khed	10.82	
4	Panshet	Haveli	10.70	
5	Warasgaon	Haveli	13.21	
	Total		**78.59**	

3.0 Flood Prone Area of K5- MULLA MUTHA SUB River Basin :

Some areas of the K-5 basin suffer from floods. The years 2005 and 2006 observed heavy floods in the basins. Due to heavy rains in the catchment of Indrayani and Mula river Lonavala experienced heavy flood and low lying area of Pune city adjacent to river bank was affected in 2005.

Table 2 – Details of Project

Sr. No	Name of Projects	FRL Content in Mcum	Length of Dam in m	No. Of Gates	Size of Gates	Max. Design Flood in cumecs	Purpose of Dam.
1	2	4	6	8	9	10	11
A	Major Projects						
1	Khadakwasla	86.0	1939	11	12.19 × 4.77	2564	Irri
2	Panshet	303.30	765	4	12.19 × 4.77	871	Irri , HEP
3	Warasgaon	374.10	780	5	12.19 × 4.77	1033	Irri , HEP
4	Pawana	305.0	1329	6	12.19 × 4.77	1250	Irri , HEP
5	Chaskaman	241.69	958	5	12.19 × 4.77	3963	Irri , HEP

Irri = Irrigation , HEP = Hydro Electric Project

8. Real Time Decision Support System (RTDSS)

The Basin Simulation Division at Sinchan Bhavan, Pune was established in April 2008 as one of the recommendation of the Committee appointed under chairmanship of Retired Principal Secretary, WRD, GoM, Mr. Nandkumar D. Vadnere for study of floods of 2005 and 2006 in Krishna basin and provide guidance and state of art technology in use in flood forecasting. The division has assigned the task of basin simulation work of Krishna sub basin.

During the Mid term review taken by World Bank as a part of India Hydrology Project –II, the Real Time Stream flow Forecasting and Reservoir Operation System based on real time data acquisition system was proposed for Krishna bhima basin of state.

Work Executed by Basin Simulation Division Pune:

As a part of HPII Project, division has established, 249 Real time Hydro meteorological data collection stations (RTDAS) to measure various hydro meteorological parameters. The model for flood forecasting and reservoir operation system is also developed. Real time decision support center for Krishna and Bhima basin is established at Sinchan Bhavan Pune. Data is being received via VSAT/

GSM communication to servers at Pune. This data is made available to stakeholders on project website; http://www.rtsfros.com/mahakrishna at Real time data menu.

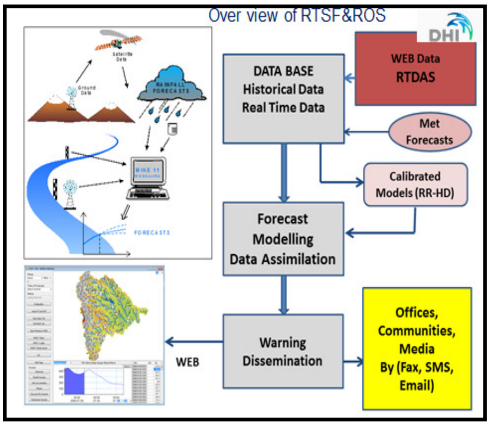
The sample installations are shown as below;

Figure 6- Automated Rainfall Station

Figure 7- Radar for Dam

The Real Time Stream Flow Forecasting and Reservoir Operation System for Krishna and Bhima Basins is developed in consultation with DHI(India), Water and Environment Pvt. Ltd., New Delhi as a prime Consultants with DHI, Denmark and Riverside Technology USA as sub consultants.

The real-time stream flow forecasting was shared with reservoir managers in monsoon 2013 and 2014. The Real Time Stream flow forecast for viewing/use of designated authorities and stakeholders of the basin is made available on website; http://www.rtsfros.com/mahakrishna in Real time Forecast menu. The advance warning system which forecasts the water level, discharge at various locations, critical from flood point of view, is helping now to the reservoir operators/stakeholders in taking decisions and to act on time during flood situations.



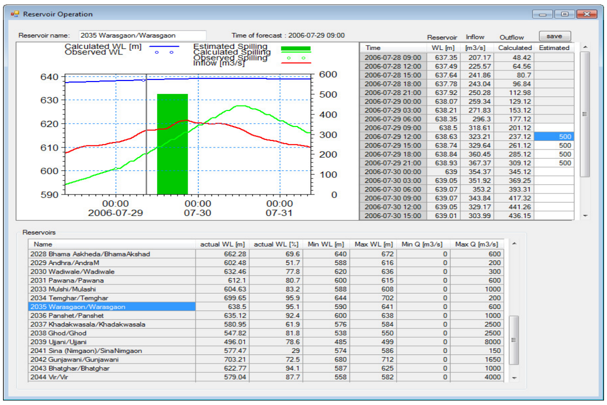
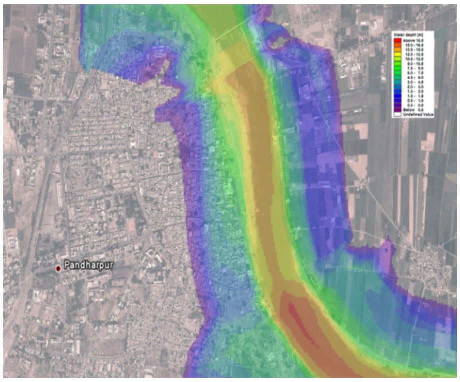
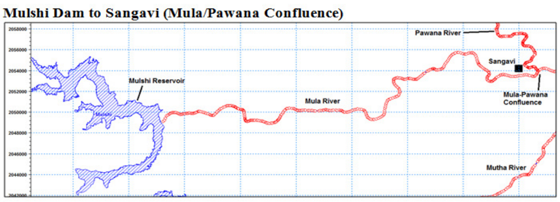


Figure 7- Overview of RTSF and ROS Figure 8- What If Scenario: Warasgaon Reservoir





Travel Time by		Distance	Remark
MIKE 11 Model	WRD		
6 Hours 20 Minutes	6 Hours	45 KM	Maximum Flood Discharge over Mulshi Reservoir Spillway has been used in MIKE 11 for routing (1900 m³/sec)

Figure 9 - Simulated flood map of Pandharpur Figure 10 - Travel time computation

B- EARTHQUAKE

An earthquake (also known as a quake, tremor or temblor) is the perceptible shaking of the surface of the Earth, which can be violent enough to destroy major buildings and kill thousands of people. The severity of the shaking can range from barely felt to violent enough to toss people around. Earthquakes have destroyed whole cities. They result from the sudden release of energy in the Earth's crust that creates seismic waves. The seismicity, seismism or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter magnitude scale. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly almost imperceptible or weak and magnitude 7 and over potentially cause serious damage over larger areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. The most recent large earthquake of magnitude 9.0 or larger was a 9.0 magnitude earthquake in Japan in 2011 (as of March 2014), and it was the largest Japanese earthquake since records began. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal.[1]

At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides, and occasionally volcanic activity.

In its most general sense, the word earthquake is used to describe any seismic event — whether natural or caused by humans — that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

The Disaster Response

As a part of disaster management programme the Maharashtra Emergency Earthquake Rehabilitation Project (MEERP) was launched in 1993.It was supported by the World Bank, United Nations Development Program (UNDP) as well as several bilateral donor agencies. With the purpose of recovery and mitigation of the disaster they supported the affected people by providing rescue, relief and rehabilitation.

The management policy adopted by the state government to reconstruct the disaster-affected economy is supported by a number of NGOs, private initiatives and the community. The project initiated by the state government for the purpose of rehabilitation is the largest rehabilitation package in India. The main aim of the project is to provide proper socio-economic rehabilitation of the affected people along with sustainable development as a whole.

The comprehensive strategies taken by the government include relocation of 52 severely damaged villages, reconstruction and repair of damaged houses and strengthening the undamaged houses by implementing earthquake-resistant building techniques. For relocating the severely damaged villages they have taken the help of remote sensing technique beside the consultative process side by side.

As a result of such initiatives the public utilities and infrastructure facilities are repaired and strengthened. The basic utility goods which support the primary, sustainable occupations of the poverty-stricken inhabitants of the affected area are modified and improved. For the sake of socio-economic rehabilitation special facilities are provided for the women and handicapped persons. Special training programmes are provided for the village artisans and civil engineers to make them familiar with the earthquake-resistant building designs and techniques.

Different dimensions of the response.

The response for disaster management was multi-dimensional. The strategies were mainly based on three types of plans:

1. Communication Network,
2. State Disaster Management Plan,
3. District Disaster Management Plan.

Communication Network .

A side-wide communication network is being set up as part of the Maharashtra Emrgency Earthquake Rehabilitation Programme. This network of telecommunication and information technology consists of an Emergency Operations Centre (Central Control Room) at Mantralaya, Mumbai, a standby Control Room at the Centre for Disaster Management, YASHADA, Pune, Control Rooms at each of the six divisional headquarters, and District Control Rooms at each district collectorate. This network is connected with VSAT telecommunication facilities for data, voice and information exchange and video teleconferencing. In a second level of communication network all tahsils are linked together through a VHF Wireless Network with nodes of the District Control Room reaching each tahsil headquarters. The following maps (figure 1 & 2) indicate the spread of the VHF wireless network in the districts and the VSAT network in the state.

This telecommunication network will facilitate video-teleconferencing among the nodes for more purposive and successful monitoring and management of such disaster. VHP Network is used to link the subdivisional and taluka headquarters with the respective district headquarters. Some up-to-date amenities like wireless base stations, mobile sets and walkie-talkie units are provided to the sub-divisional officers to improvise the contact with District Control Room.

State Disaster Management Plan.

Maharashtra is the first state to prepare a comprehensive State Disaster Management Plan and also undertake risk assessment and vulnerability analysis of the state. These studies address the vulnerability of various districts, talukas within these districts, and clusters of villages in these districts to earthquakes, floods and cyclones, epidemics, road accidents and fire, and chemical and industrial disasters. A separate volume on Standard Operating Procedures, details the manuals for various departments to be activated during an emergency Tremors were felt during the 1967 Koyna earthquake. The 1993 earthquake of Latur –Killari changed the zoning of the sub basin. It was included in Zone II.

It measured 6.2 on the moment magnitude scale, and approximately 10,000 people died, whilst another 30,000 were injured. The earthquake's focus was around 12 km deep – relatively shallow – allowing shock waves to cause more damage11 dead during the 1993 Latur earthquake. Included as seismic zone II. The irrigation structures like dam, canals and cross drainage works were audited for earthquake readiness and where necessary, strengthening works were carried out.

C – DROUGHT

Drought is an extended period when a region receives a deficiency in its water supply, whether atmospheric, surface or ground water. A drought can last for months or years, or may be declared after as few as 15 days.[1] Generally, this occurs when a region receives consistently below average precipitation. It can have a substantial impact on the ecosystem and agriculture of the affected region. Although droughts can persist for several years, even a short, intense drought can cause significant damage[2] and harm to the local economy.[3] Annual dry seasons in the tropics significantly increase the chances of a drought developing and subsequent bush fires. Periods of heat can significantly worsen drought conditions by hastening evaporation of water vapor.

As droughts are not a sudden phenomenon, the state can plan the measures in due time and execute the same effectively.

When the total storage in a sub basin is not above 33 % at the end of monsoon, the planning consists of reserving water for domestic purpose only, barring irrigation scheduling.

In K-5 sub basin, though the water availability is not overtly adequate, the droughts are very far and few. The better co-ordination of all state government departments makes the impact of drought minimal. The EGS scheme, rural development schemes and planning for making available drinking water, food and fodder in / near the affected area make the drought impact bearable.

In this region, the recorded famines and droughts are listed below.

Sr No.	**Year**	**Spread over**
1	1396	All India
2	1460	Deccan
3	1520	Deccan
4	1791	Deccan, Karnataka
5	1802	Deccan
6	1818	Deccan
7	1824	Deccan
8	1832	Deccan
9	1845	Deccan
10	1854	Deccan
11	1862	Deccan

12	1876-77	Deccan
13	1929	Maharashtra
14	1971	Maharashtra
15	1991	Maharashtra
16	2002	Maharashtra
17	2012-13	Maharashtra

CHAPTER-21 WATER BALANCE

21.0 Introduction

Water balance estimation is an important tool to assess the current status and trends in water resource availability in an area over specific period of time. This chapter deals with availability of surface water ,present use for various purposes, future requirement of water by 2030 and the balance water.

21.1 Yield in the Sub basin

The gross yield as approved by Chief Engineer, Planning and Hydrology, Nashik is given below

Table 21.1 Yield in the sub basin

Sr No	Dependability	50%	57.9 % (Average)	65%	75%
	Yield in Mm3	12046	11439	10686	9484

21.2 Availability and use of water

The planned use in the sub basin is finalized in view of allocation of water by Krishna Water Dispute Tribunal I. The availability and use of water is as follows

TABLE- 21.2- Availability of Water

All figures in Mm3

Particular		Present	Planning (2030)
1)	**Surface Water**		
a)	Maximum Permissible use as per KWDT I	8465	8465
b)	**Recycling :**		
	Domestic	1050	1183
	Industrial	272	299
	Total of (b)	**1322**	**1482**
c)	**Import from other sub basin**	727	828
d)	**Regenaration**	715	857
	G.Total (a)to(d)	**11229**	**11632**

2)	**Ground Water**	3593	3440
	G. Total (1) to (2)	**14822**	**15072**

21.3 Sectorial Water demands for Surface and Ground water

Sectorial Water demands for Surface and Ground water is as given below

All figures in Mm3

S.N.	Particular	Water Utilization at Present			Water Utilization Planned By 2030		
		Surface	Ground	Total	Surface	Ground	Total
1	Domestic	1159	153	1312	1245	234	1479
2	Industrial	279	0	279	307	0	307
3	Agriculture	8502	3440	11942	8260	3206	11466
	Total	**9940**	**3593**	**13533**	**9812**	**3440**	**13252**
4	Export						
a	Export to Other Sub Basin (K-6 Basin)	0	0	0	128	0	128
b	Export to West Ward Diversion Tata Mulashi (HEP) 45.0 Tmc	1274	0	1274	1274	0	1274
	Total Export	**1274**	**0**	**1274**	**1402**	**0**	**1402**
5	**Grand Total**	**11214**	**3593**	**14807**	**11214**	**3440**	**14654**

21.4 Water Available for future use

Table No 21.4 Water availability for future use

1	Net water available for Future use at 75% dependability	**Present**	**Future(2030)**
	13077	-456	-328

21.5 Per capita availability of water

The per capita availability of water is worked out for present and future (2030) population as below

Table-21.5 – Per capita availibility of water

Population	**Population**	**Per Capita availability of water**	
2011	**2030**	**(Cum)**	
16708599	**23077952**	**887**	**653**

It is observed through the pilot study conducted at an international level that well being of people is compromised if per capita water availability drops down than 1000 m3. Per capita availability of 1700 m3 is considered as satisfactory. If the same is reduced to 1000 m3, hardships are set in. These include uses of water for various purposes (agriculture, industry, urban use etc.) of human life. The requirement on count of livestock necessary to support the masses is also being fulfilled there from.

Source: Maharashtra Water and Irrigation Commission 1999 Part I P.N.160

21.6 Water availability per ha of Cultivable area

The Water availability per ha of Cultivable area is as given below. The criterion for categorization of basin is as per II nd commission for water and irrigation, these norms are given in table 21.7

Table-21.6 – Water availability per Ha of Cultivable area

Water Availability at 75 % Dep.	CCA	Water Availability Cum per Ha	Category of Sub basin
Mm3	Lakh. Ha		
11229	38.1	2947	dificit

Table 21.7 Norms for Categorization of Basin

Sr. No	Surface Water Availability		Unit	Category of Basin
	From	To		
1	Less than 1500		Cum/Ha	Highly Deficit
2	1500	3000	Cum/Ha	Deficit
3	3000	8000	Cum/Ha	Normal
4	8000	12000	Cum/Ha	Surplus
5	More than 112000		Cum/Ha	Abundant

Source: Maharashtra Water and Irrigation Commission 1999 Part I P.N.160

CHAPTER – 22

FINANCIAL ASPECTS

22.0 INTRODUCTION :

The Irrigation Sector of Maharashtra is one of the largest in the Country, both in terms of Large Dams and the Live Storage capacity. Also the demand of water for irrigation purpose has been alarmingly increasing due to agricultural expansion and intensification. This chapter deals with district wise irrigation potential available, potential created, total expenditure incurred and expenditure required in future for potential to be created in K-5 Sub Basin. It also covers the relation between potential created and the investment made on different types of irrigation projects viz. Major, Medium, Minor projects in K-5 Sub Basin. Investment required to create one hactor of irrigation (cost efficiency) is also studied. The area under different crops, trend of change in production of different crops in K5 sub Basin, Role of Sugar factories in development of K5 Sub Basin, importance of micro irrigation in K5 sub Basin these points are also studied in this chapter.

The K-5 sub basin has total potential 1716387 hactors through state sector and local sector projects, out of which 71.09 percent i.e. 1220235 ha potential achieved so far. Total investment of Rs. 19429.65 crores requires to create irrigation potential 1716387 ha, out of which Rs. 10610.64 crores expenditure incurred up to March 2014. There is still 496152 ha potential to be created in future for which amount of Rs. 8819.00 crores is to be invested in K-5 sub basin.

There are 699 completed, 42 ongoing and 1 new administratively approved projects in state sector, while 4519 completed, 403 ongoing and 206 new administratively approved projects in local sector in K-5 Sub Basin. Further these projects are categorized as Major, Medium and Minor for state sector projects and Irrigation Tank, Storage Tank and K. T. Weir for local sector projects. District wise details of completed, ongoing and new administratively approved projects are given in Annexure I, II & III. There are 742 state sector projects (Major, Medium, Minor) in K-5 sub basin having 1539851 ha irrigation potential. Out of which 1070235 ha potential has been created and expenditure incurred for this is Rs. 9942.62 crores

K-5 sub basin includes total 5128 no of local sector projects having irrigation potential capacity 176536 Ha. Out of this 150000 ha potential has been created and expenditure incurred for this is Rs. 668.02 crores. Still 26536 ha irrigation potential is to be created through local sector projects for which amount of Rs. 305.25 crores is to be invested in future.

Annexure-22.1 Details of Existing /Completed Projects in K-5 sub basin (Districtwise above 250 Ha **)**

Status as on 31/3/2014

Area in Ha / cost in Crores

Sr. No.	Name of the Project	Category	District	Taluka	Original Administrative Approval		Revised Cost	Up To Date Expenditure	Balance Cost	Live Storage in Mm3	Design Potential	Potential Created		Balance Potential			
					Cost	Year						ICA	IP	ICA	IP	ICA	IP
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
A)	**Major Projects**																
1	TATA Hydro (5 Reservoirs) Including Mulashi Tunnel	**Major**	Pune	Mulashi	31.18	1966	1928.590	1928.590	0.000	1154.107	5000	5000	5000	5000	0	0	
2	Pawana	Major	Pune	Maval	7.75	2001	7.750	6.610	1.140	240.958	5304	6365	5304	6365	0	0	
3	Khadakwasala (3 Reservoi	Major	Pune	Haveli	108.58	1988	403.040	360.370	42.670	711.832	62146	62146	62146	62146	0	0	

	rs)															
4	Ghod	Major	Pune	Shirur	3.15	1954	5.940	5.940	0.000	154.881	20500	20500	20500	20500	0	0
4	**Total Pune**				150.66		2345.320	2301.510	43.810	2261.78	92950	94011	92950	94011	0	0
1	Bhataghar/Veer (Neera canals)	Major	Satara	Khandala	46.57		0.000	0.000	0.000	931.837	102576	102576	102576	102576	0	0
1	**Total Satara**				46.57		0	0	0.000	931.837	102576	102576	102576	102576	0	0
	Nil				0		0.000	0.000	0.000	0.000	0	0	0	0	0	0
0	**Total Sangali**				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
1	Bhima - Sina Link Canal	Major	Solapur	Madha	59.74	1996	332.85	230.20	102.650	6518.044	23000	32660	23000	32660	0	0
1	**Total Solapur**				59.74		332.85	230.20	102.650	6518.04	23000	32660	23000	32660	0	0.00
	Nil				0.00		0.00	0.00	0.000	0.000	0.00	0	0.00	0.000	0.00	0.000
	Total Ahemadnagar				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	**Nil**				0.00		0.00	0.00	0.000	0.000	0.00	0	0.00	0.000	0.00	0.000
	Total Osmanabad				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

0	**Nil**				0.00		0.00	0.00	0.000	0.000	0.00	0	0.00	0.000	0.000	0.000
	Total Beed				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	**Total for Major**				256.97		2678.17	2531.71	146.46	9711.66	218526.00	229247.00	218526.00	229247.00	0.00	0.00
B)	**Medium Projects**															
1	Shetphal	Medium	Pune	Indapur	0		0.000	0.000	0.000	0.000	1920	1920	1920	1920	0	0
2	Nazare	Medium	Pune	Purandar	5.59		0.000	0.000	0.000	16.423	3195	3195	3195	3195	0	0
3	Wadivale	Medium	Pune	Maval	34.11		69.880	32.800	37.080	30.297	4868	4868	4868	4868	0	0
4	Andra	Medium	Pune	Maval	96.00		126.500	99.210	27.290	82.679	5998	9177	5998	9177	0	0
5	Kasarsai	Medium	Pune	Mulashi	33.15		33.150	28.290	4.860	16.139	4119	4119	4119	4119	0	0
5	**Total Pune**				168.85		229.53	160.3	69.230	145.538	20100	23279	20100	23279	0	0
1	Ranand	Medium	Satara	Man	0.31		0.310	0.310	0.000	6.229	1093	1093	1093	1093	0	0
2	Mhasawad	Medium	Satara	Man	0.199		0.199	0.199	0.000	44.567	4049	4049	4049	4049	0	0
3	Andhali	Medium	Satara	Man	17.97		17.970	17.970	0.000	7.418	1498	2322	1350	2092	148	230
3	**Total Satara**				18.479		18.479	18.479	0.000	58.215	6640	7464	6492	7234	148	230
1	Doddana	Mediu	Sangli	Jath	0.96	1977	4.830	4.830	0.000	5.521	1215	1215	1215	1215	0	0

	lla	m														
2	Sankh	Medium	Sangli	Jath	3.00	1977	36.260	36.260	0.000	14.865	3100	3596	3100	3596	0	0
2	**Total Sangali**				3.96		41.09	41.09	0.000	20.39	4315	4811	4315	4811	0	0.00
1	Tisangi	Medium	Solapur	Pandharpur	0.59		0.590	0.590	0.000	24.464	4049	4049	4049	4049	0	0
2	Ekrukh	Medium	Solapur	N.Solapur	0.14	1866	0.140	0.140	0.000	61.160	2610	2610	2610	2610	0	0
3	Ashti	Medium	Solapur	Mohol	0.082	1879	0.082	0.082	0.000	23.006	4769	4769	4769	4769	0	0
4	Mangi	Medium	Solapur	Karamala	0.58	1897	0.660	0.660	0.000	24.371	3116	3117	3116	3117	0	0
5	Budhihal	Medium	Solapur	Sangola	0.58	1957	5.850	5.850	0.000	19.027	4251	4251	4251	4251	0	0
6	Hingani(P)	Medium	Solapur	Barshi	1.67	1968	9.110	8.000	1.110	25.629	6140	6168	6140	6168	0	0
7	Jawalgaon	Medium	Solapur	Barshi	2.60	1973	27.010	20.840	6.170	23.401	4451	5341	4451	5341	0	0
8	Padavalkarwadi	Medium	Solapur	Mangalwedha	0.12	1956	2.770	2.770	0.000	2.124	352	352	352	352	0	0
8	**Total Solapur**				6.36		46.21	38.93	7.280	203.18	29738	30657	29738	30657	0	0.00
1	Chandani	Medium	Osmanabad	Paranda	2.13	1956		0.710	-0.710	18.291	2024	5753	2024	5753	0	0
2	Khasapur	Medium	Osmanabad	Paranda	0.56	1945	0.560	0.560	0.000	13.053	2146	2146	2146	2146	0	0
3	Banganga	Medium	Osmanabad	Bhoom	0.51	1972	0.510	0.510	0.000	3.794	906	963	906	963	0	0
4	Ramganga	Medium	Osmanabad	Bhoom	0.95	1972	0.950	0.950	0.000	5.351	963	963	963	963	0	0

5	Khandeshwar	Medium	Osmanabad	Paranda	0.84	1967	2.050	2.050	0.000	8.806	1471	1521	1471	1521	0	0
6	Sakat	Medium	Osmanabad	Paranda	3.64	1989	20.000	18.550	1.450	13.478	2355	2355	2355	2355	0	0
6	**Total Osmanabad**				8.63		24.07	23.33	0.740	62.7737	9865	13701	9865	13701	0	0
1	Visapur	Medium	Ahmadnagar	Shrigonda	0.40	1896	0.400	0.400	0.000	25.596	5369	5745	5369	5745	0	0
2	Sina (with Bhose khind tunnel)	Medium	Ahmadnagar	Karjat	3.73	1972	93.000	93.000	0.000	52.099	8445	8192	8445	8192	0	0
3	Khairi	Medium	Ahmadnagar	Jamkhed	2.19	1977	19.440	15.260	4.180	13.591	2318	2851	2318	2851	0	0
3	**Total Ahemadnagar**				6.32		112.84	108.66	4.180	91.29	16132	16788	16132	16788	0	0.00
1	Kambali	Medium	Beed	Ashti	0.27	1946	0.270	0.270	0.000	3.115	972	972	972	972	0	0
2	Rooti	Medium	Beed	Ashti	0.10	1946	0.100	0.100	0.000	6.569	1862	1862	1862	1862	0	0
3	Talwar	Medium	Beed	Ashti	0.18	1945	0.180	0.180	0.000	3.228	668	668	668	668	0	0
4	Kadi	Medium	Beed	Ashti	0.41	1964	0.440	0.440	0.000	5.465	1084	1084	1084	1084	0	0
5	Kada	Medium	Beed	Ashti	0.52	1962	0.520	0.520	0.000	8.551	1214	1214	1214	1214	0	0
6	Mehakari	Medium	Beed	Ashti	0.57	1959	0.940	0.940	0.000	12.968	4048	4048	4048	4048	0	0

7	Rooti height raising	Medium	Beed	Ashti	2.16	1999	3.150	3.150	0.000	3.398	0	0	0	0	0	0
7	**Total Beed**				4.210		5.600	5.600	0.000	43.293	9848	9848	9848	9848	0	0
34	**Total for Medium**				216.81		477.82	396.39	81.43	624.67	96638.00	106548.00	96490.00	106318.00	148.00	230.00
	Minor Projects															
1	Varavand	Minor	Pune	Dound	0.0646		0.065	0.299	-0.234	5.267	1312	1312	1312	1312	0	0
2	Shirsufal	Minor	Pune	Dound	0.028		0.028	0.022	0.006	9.542	448	661	448	661	0	0
3	Matoba	Minor	Pune	Dound	0.0257		0.026	0.021	0.005	4.519	1090	1090	1090	1090	0	0
4	Bhadalwadi	Minor	Pune	Indapur	0.056		0.056	0.049	0.007	4.559	372	728	372	728	0	0
5	Palasdeo	Minor	Pune	Indapur	0.098		0.098	0.087	0.012	2.530	558	607	558	607	0	0
6	madanwadi	Minor	Pune	Indapur	0.111		0.111	0.099	0.012	4.700	546	682	546	682	0	0
7	Pisrve	Minor	Pune	Purandar	0.076		0.076	0.660	-0.584	1.642	243	243	243	243	0	0
8	Nimgaon bhogi	Minor	Pune	Shirur	0.041		0.041	0.036	0.005	0.453	162	162	162	162	0	0
9	tarangwadi	Minor	Pune	Indapur	0.097		0.097	0.085	0.012	1.756	161	200	161	200	0	0
10	Alegaon paga	Minor	Pune	Shirur	0.339		0.568	0.491	0.077	1.954	300	300	300	300	0	0
11	Jalgaonsupe	Minor	Pune	Baramati	0.199		0.393	0.314	0.079	0.453	60	60	60	60	0	0

12	Pondewadi	Minor	Pune	Indapur	0.113		0.113	0.099	0.014	1.500	253	328	253	328	0	0
13	Adavadi	Minor	Pune	Purandar	0		0	0	0.000	0.057	40	40	40	40	0	0
14	valha	Minor	Pune	Purandar	0		0	0	0.000	0.085	40	40	40	40	0	0
15	Waki	Minor	Pune	Baramati	0.16		0.160	0.127	0.033	2.293	329	329	329	329	0	0
16	Pingori	Minor	Pune	Purandar	0.058		0.058	0.051	0.007	0.566	40	40	40	40	0	0
17	Wakad	Minor	Pune	Mulashi	0.026		0.026	0.023	0.003	0.368	80	80	80	80	0	0
18	Alegaon	Minor	Pune	Shirur	0.116		0.116	0.102	0.014	4.474	1642	1642	1642	1642	0	0
19	Nimgaon mhalungi	Minor	Pune	Shirur	0.32		0.320	0.284	0.036	3.001	520	520	520	520	0	0
20	Jiregaon	Minor	Pune	Dound	0.087		0.100	0.088	0.012	0.890	176	176	176	176	0	0
21	Dahivadi	Minor	Pune	Shirur	0.158		0.158	0.142	0.016	1.019	125	125	125	125	0	0
22	Motewadi	Minor	Pune	Shirur	0.194		0.152	0.134	0.018	0.793	131	131	131	131	0	0
23	mahur	Minor	Pune	Purandar	0.19		0.434	0.361	0.073	1.840	432	432	432	432	0	0
24	Borkarwadi	Minor	Pune	Baramati	0.135		0.170	0.135	0.035	0.878	158	158	158	158	0	0
25	Tardoli	Minor	Pune	Baramati	0.26		1.045	0.830	0.215	1.048	143	143	143	143	0	0
26	rajgurunagar	Minor	Pune	Khed	0.029		0.055	0.505	-0.450	1.331	372	372	372	372	0	0
27	Balapudi	Minor	Pune	Indapur	0.069		0.069	0.060	0.009	0.590	103	103	103	103	0	0
28	Ghagargaon	Minor	Pune	Indapur	0.069		0.069	0.061	0.008	1.110	128	128	128	128	0	0
29	Dhamari	Minor	Pune	Shirur	0.102		0.124	0.110	0.014	0.906	153	153	153	153	0	0
30	Pilanwad	Minor	Pune	Purandar	0.234		0.465	0.382	0.083	1.812	399	399	399	399	0	0

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31	Nande	Minor	Pune	Mulashi	0.083		0.137	0.112	0.025	1.869	295	295	295	295	0	0
32	Warkute	Minor	Pune	Indapur	0.145		0.145	0.129	0.016	1.274	172	172	172	172	0	0
33	Brhanpur	Minor	Pune	Baramati	0.036		0.090	0.072	0.018	0.595	231	231	231	231	0	0
34	Tulapur	Minor	Pune	Haveli	0		0	0	0.000	1.982	213	213	213	213	0	0
35	Garade	Minor	Pune	Purandar	0.124		0.124	0.109	0.015	1.557	372	372	372	372	0	0
36	Naygaon degaon	Minor	Pune	Bhor	0.0127		0.330	0.271	0.059	1.076	163	163	163	163	0	0
37	Wadgao n	Minor	Pune	Bhor	0.04		0.059	0.045	0.014	0.595	226	226	226	226	0	0
38	Shere	Minor	Pune	Mulashi	2.57		2.570	2.080	0.490	0.651	129	129	129	129	0	0
39	Songaon gitewasti	Minor	Pune	Baramati	0.073		0.192	0.153	0.039	1.671	510	510	510	510	0	0
40	Dehu	Minor	Pune	Haveli	0.119		0.235	0.193	0.042	1.982	425	425	425	425	0	0
41	Sangavi sandas	Minor	Pune	Haveli	0.11		0.148	0.122	0.026	2.633	1215	1215	1215	1215	0	0
42	Malad	Minor	Pune	Dound	0.187		0.227	0.187	0.040	1.246	236	256	236	256	0	0
43	Lavale	Minor	Pune	Mulashi	0.085		0.188	0.165	0.023	2.039	402	402	402	402	0	0
44	Dhanore	Minor	Pune	Khed	0.062		1.118	0.104	1.014	0.793	357	357	357	357	0	0
45	Venwadi	Minor	Pune	Bhor	0.031		0.110	0.090	0.020	0.623	134	134	134	134	0	0
46	Rihe	Minor	Pune	Mulashi	0.148		0.289	0.238	0.051	1.274	182	182	182	182	0	0
47	Jamb	Minor	Pune	Purandar	0		0	0	0.000	2.605	835	835	835	835	0	0
48	Waphga on	Minor	Pune	Khed	0.163		0.351	0.308	0.043	2.690	312	312	312	312	0	0
49	Kadus	Minor	Pune	Khed	0.247		1.904	1.521	0.383	2.265	522	522	522	522	0	0

50	Pimpari	Minor	Pune	Khed	0.072		0.083	0.073	0.010	0.481	223	223	223	223	0	0
51	Shelpim palgaon	Minor	Pune	Khed	0.061		0.119	0.104	0.015	1.019	419	419	419	419	0	0
52	Khamga on	Minor	Pune	Dound	0.046		0.046	0.383	-0.337	2.378	446	688	446	688	0	0
53	Mohari	Minor	Pune	Bhor	0.166		0.637	0.567	0.070	0.510	255	255	255	255	0	0
54	Bhivega on	Minor	Pune	Khed	0.045		0.050	0.044	0.006	0.566	120	120	120	120	0	0
55	Bhomale	Minor	Pune	Khed	0.043		0.063	0.055	0.008	0.566	295	295	295	295	0	0
56	Nandgao n	Minor	Pune	Bhor	0.048		0.069	0.057	0.012	0.566	273	273	273	273	0	0
57	Kondiva de	Minor	Pune	Maval	0.041		0.100	0.088	0.012	0.651	219	219	219	219	0	0
58	Darvali	Minor	Pune	Mulashi	0.058		0.092	0.081	0.011	0.934	420	420	420	420	0	0
59	Ambega on	Minor	Pune	Haveli	0.188		0.188	0.598	-0.410	1.730	284	320	284	320	0	0
60	Adale	Minor	Pune	Maval	0.237		0.237	0.237	0.000	0.963	199	199	199	199	0	0
61	Bhugaon	Minor	Pune	Mulashi	0.221		0.221	0.594	-0.373	1.812	510	510	510	510	0	0
62	Savargao n	Minor	Pune	Mulashi	0.054		0.093	0.082	0.011	0.425	101	101	101	101	0	0
63	Kambles hwar	Minor	Pune	Baramati	0.143		0.653	0.369	0.284	2.010	450	450	450	450	0	0
64	Shiravali	Minor	Pune	Baramati	0.239		0.498	0.430	0.068	2.378	493	493	493	493	0	0
65	Didghar	Minor	Pune	Bhor	0.136		0.405	0.251	0.154	0.906	363	363	363	363	0	0
66	Chichwa d	Minor	Pune	Mulashi	0.177		0.903	0.606	0.297	1.472	204	204	204	204	0	0
67	Kolwan	Minor	Pune	Mulashi	0.02		0.058	0.048	0.010	0.255	113	113	113	113	0	0

68	Hinjawa di	Minor	Pune	Mulashi	0.034		0.110	0.097	0.013	1.501	719	719	719	719	0	0
69	Waranga li	Minor	Pune	Purandar	0				0.000	0.560	107	113	107	113	0	0
70	Khoroch i	Minor	Pune	Purandar	0				0.000	1.869	384	384	384	384	0	0
71	Ghadage wadi	Minor	Pune	Baramati	0.18		0.614	0.515	0.099	2.577	606	606	606	606	0	0
72	Varude	Minor	Pune	Khed	0.057		0.136	0.112	0.024	0.453	204	204	204	204	0	0
73	Divale	Minor	Pune	Bhor	0.243		1.229	0.854	0.375	2.010	445	445	445	445	0	0
74	Bhoire	Minor	Pune	Maval	0.048		0.184	0.151	0.033	0.595	279	279	279	279	0	0
75	Chimbli	Minor	Pune	Khed	0.072		0.234	0.206	0.028	1.501	830	830	830	830	0	0
76	Burkega on	Minor	Pune	Haveli	0.253		0.554	0.326	0.228	2.067	727	727	727	727	0	0
77	Perane	Minor	Pune	Haveli	0.149		0.506	0.339	0.167	2.633	1158	1158	1158	1158	0	0
78	Waki	Minor	Pune	Khed	0.128		0.107	0.103	0.004	1.274	603	603	603	603	0	0
79	Kalus	Minor	Pune	Khed	0.148		0.936	0.746	0.190	1.925	720	720	720	720	0	0
80	Pimpoli	Minor	Pune	Mulashi	0.176		0.677	0.626	0.051	1.529	259	259	259	259	0	0
81	Bhose	Minor	Pune	Khed	0.065		0.358	0.324	0.034	0.878	313	313	313	313	0	0
82	Nighoje	Minor	Pune	Khed	0.073		0.426	0.325	0.101	1.331	613	613	613	613	0	0
83	Amboli	Minor	Pune	Khed	0.099		0.102	0.099	0.003	0.255	125	125	125	125	0	0
84	Shelgaon	Minor	Pune	Khed	0.067		0.131	0.122	0.009	0.283	240	240	240	240	0	0
85	Anjanga on	Minor	Pune	Baramati	0.28		0.634	0.507	0.127	0.906	368	368	368	368	0	0
86	Jambhali	Minor	Pune	Bhor	0.153		0.363	0.281	0.082	0.793	391	391	391	391	0	0
87	Niravaga	Minor	Pune	Baramati	0.258		1.555	1.091	0.464	2.973	679	679	679	679	0	0

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88	Donde	Minor	Pune	Khed	0.161		0.728	0.504	0.224	1.840	848	848	848	848	0	0
89	Hadashi 1	Minor	Pune	Mulashi	0.736		2.241	1.977	0.264	2.973	508	508	508	508	0	0
90	Bhor orlabs	Minor	Pune	Bhor	0.162		0.520	0.416	0.104	0.453	177	177	177	177	0	0
91	kasarsai	Minor	Pune	Mulashi	0.099		0.540	0.430	0.110	0.311	128	128	128	128	0	0
92	Ravade	Minor	Pune	Mulashi	0.328		0.889	0.708	0.181	1.897	737	737	737	737	0	0
93	Chikhali	Minor	Pune	Indapur	0		0	0	0.000	2.350	493	493	493	493	0	0
94	Boratwa di	Minor	Pune	Indapur	0		0	0	0.000	2.378	526	526	526	526	0	0
95	Nirwang i nimsakh ar	Minor	Pune	Indapur	0		0	0	0.000	2.633	595	595	595	595	0	0
96	Jalgaons upe	Minor	Pune	Baramati	0.20		0.000	0.000	0.000	0.538	225	225	225	225	0	0
97	Rahu	Minor	Pune	Dound	0.781		0.781	1.446	-0.665	9.825	1887	1887	1887	1887	0	0
98	Mahakos hi	Minor	Pune	Bhor	2.63		2.630	2.170	0.460	1.954	477	477	477	477	0	0
99	malegao n nasarapu r	Minor	Pune	Bhor	0.171		0.456	0.364	0.092	0.283	148	148	148	148	0	0
100	Umbare	Minor	Pune	Bhor	0.166		0.637	0.567	0.070	0.453	183	183	183	183	0	0
101	Ambheg har	Minor	Pune	Bhor	0.11		0.506	0.486	0.020	0.963	226	226	226	226	0	0
102	Sangise	Minor	Pune	Maval	0.00		0.000	0.000	0.000	0.283	82	82	82	82	0	0

103	Budhavadi	Minor	Pune	Maval	0.00		0.000	0.000	0.000	0.170	82	82	82	82	0	0
104	nane nanoli	Minor	Pune	Maval	0.126		0.420	0.335	0.085	0.283	137	137	137	137	0	0
105	Takave	Minor	Pune	Maval	0.00		0.000	0.000	0.000	0.170	300	300	300	300	0	0
106	Rajapuri	Minor	Pune	Maval	0.068		1.370	1.108	0.262	0.934	421	421	421	421	0	0
107	Pithewadi	Minor	Pune	Indapur	0		0	0	0.000	1.784	417	417	417	417	0	0
108	Walchandnagar	Minor	Pune	Indapur	0		0	0	0.000	1.642	563	563	563	563	0	0
109	Malwadi	Minor	Pune	Baramati	1.241		1.392	1.240	0.152	0.821	290	290	290	290	0	0
110	Shindewasti	Minor	Pune	Haveli	0.239		0.932	0.744	0.188	1.076	428	428	428	428	0	0
111	Vadgaon shinde	Minor	Pune	Haveli	0.256		0.507	0.405	0.102	1.671	656	656	656	656	0	0
112	Vadhu	Minor	Pune	Haveli	0.958		3.039	2.422	0.617	4.559	1783	1783	1783	1783	0	0
113	kavadi	Minor	Pune	Haveli	0.63		1.984	1.581	0.403	4.502	1323	1323	1323	1323	0	0
114	Bordara	Minor	Pune	Khed	0.123		0.474	0.379	0.095	0.453	180	180	180	180	0	0
115	Pur	Minor	Pune	Khed	0.183		0.459	0.322	0.137	0.538	184	184	184	184	0	0
116	Nimgaon tambewasti	Minor	Pune	Khed	0.403		0.895	0.698	0.197	1.302	439	439	439	439	0	0
117	kharpudi	Minor	Pune	Khed	0.564		1.077	0.872	0.205	1.416	525	525	525	525	0	0
118	Mutha	Minor	Pune	Mulashi	0		0	0	0.000	0.227	158	158	158	158	0	0
119	Ambavade (Bhoyachi mala)	Minor	Pune	Bhor	0		0	0	0.000	0.028	38	38	38	38	0	0

120	kanhersar	Minor	Pune	Khed	0.185		0.580	0.445	0.135	0.510	184	184	184	184	0	0
121	Sidhegavan	Minor	Pune	Khed	0.253		0.743	0.556	0.187	0.849	335	335	335	335	0	0
122	koregaon	Minor	Pune	Khed	0.554		1.086	0.830	0.256	1.812	658	658	658	658	0	0
123	Sadalgaon	Minor	Pune	Dound	0		0	0	0.000	3.681	894	894	894	894	0	0
124	Pimpara	Minor	Pune	Purandar	0.407		0.940	0.836	0.104	2.548	482	482	482	482	0	0
125	Tambad kolwade	Minor	Pune	Bhor	0.452		0.913	0.609	0.304	0.821	317	317	317	317	0	0
126	Nigade	Minor	Pune	Bhor	0.355		0.753	0.642	0.111	0.991	422	422	422	422	0	0
127	Dapode	Minor	Pune	Velha	0.117		0.434	0.346	0.088	0.255	102	102	102	102	0	0
128	Velhe kondhavale	Minor	Pune	Velha	0.087		0.308	0.246	0.062	0.227	109	109	109	109	0	0
129	khambvadi	Minor	Pune	Velha	0.119		0.441	0.352	0.089	0.255	126	126	126	126	0	0
130	Aaskvadi	Minor	Pune	Velha	0.12		0.458	0.366	0.092	0.283	133	133	133	133	0	0
131	Karanjvanesonde	Minor	Pune	Velha	0.046		0.148	0.121	0.027	0.510	240	240	240	240	0	0
132	margasani	Minor	Pune	Velha	0.047		0.122	0.100	0.022	0.651	298	298	298	298	0	0
133	Kondivali	Minor	Pune	Velha	0.048		0.128	0.113	0.015	0.680	337	337	337	337	0	0
134	khariv	Minor	Pune	Velha	0.155		0.311	0.192	0.119	0.849	429	429	429	429	0	0
135	Baburdi (Dhaphare mala)	Minor	Pune	Baramati	0.146		0.197	0.155	0.042	0.396	162	162	162	162	0	0

136	Baburdi (Salobadoh)	Minor	Pune	Baramati	0.231		0.482	0.399	0.083	0.764	267	267	267	267	0	0
137	Morgaon baburdi	Minor	Pune	Baramati	0.43		0.683	0.600	0.083	1.104	410	410	410	410	0	0
138	Medad	Minor	Pune	Baramati	0.256		0.383	0.326	0.057	0.453	173	173	173	173	0	0
139	Khairwagaj	Minor	Pune	Baramati	0.418		0.863	0.719	0.144	0.793	274	274		274	0	0
140	Phondwada(Gavthan)	Minor	Pune	Baramati	0.874		0.954	0.770	0.184	0.934	323	323	323	323	0	0
141	karhati	Minor	Pune	Baramati	0.389		0.922	0.736	0.186	1.331	405	405	405	405	0	0
142	Late	Minor	Pune	Baramati	0.184		1.507	1.578	-0.071	2.124	436	436		436	0	0
143	Songaon sangam	Minor	Pune	Baramati	0.123		1.450	1.450	0.000	1.727	451	451	451	451	0	0
144	Murum	Minor	Pune	Baramati	0.185		1.738	1.571	0.167	3.171	677	677	677	677	0	0
145	Korhale	Minor	Pune	Baramati	0.226		1.649	1.352	0.297	3.398	737	737	737	737	0	0
146	Shivtakrar mhalungi	Minor	Pune	Shirur	0.50		1.321	1.168	0.153	4.106	1528	1528	1528	1528	0	0
147	Inamgaon(gandhalemala)	Minor	Pune	Shirur	1.401		2.390	1.821	0.569	3.341	301	301	301	301	0	0
148	pathethan	Minor	Pune	Dound	0.307		1.640	1.007	0.633	2.435	896	896	896	896	0	0
149	Dahitane	Minor	Pune	Dound	0.758		0.758	3.264	-2.506	6.229	1134	1134	1134	1134	0	0

150	Nighutghar	Minor	Pune	Bhor	0		0	0	0.000	0.085	40	40	40	40	0	0
151	Karnavad kasunjai	Minor	Pune	Bhor	0		0	0	0.000	0.028	42	42	42	42	0	0
152	panhaval	Minor	Pune	Bhor	0		0	0	0.000	0.028	43	43	43	43	0	0
153	Sangvibhide	Minor	Pune	Bhor	0		0	0	0.000	0.085	43	43	43	43	0	0
154	Apati	Minor	Pune	Bhor	0.432		0.432	0.373	0.059	0.680	259	259	259	259	0	0
155	Chrholi	Minor	Pune	Khed	0.122		0.450	0.387	0.063	0.481	255	255	255	255	0	0
156	Watekarwadi	Minor	Pune	Khed	0.000		0.000	0.000	0.000	0.680	260	260	260	260	0	0
157	Koyali	Minor	Pune	Khed	0.190		0.415	0.333	0.082	1.642	656	656	656	656	0	0
158	pargaon	Minor	Pune	Dound	1.66		1.66	3.13	-1.475	5.78	1075	1075	1075	1075	0	0
159	Sonvadi	Minor	Pune	Dound	2.403		2.403	4.074	-1.671	19.53714	1967	1967	1967	1967	0	0
160	Nira	Minor	Pune	Purandar	1.623		1.646	1.137	0.509	2.180232	517	517	517	517	0	0
161	Jeur	Minor	Pune	Purandar	2.878		3.762	3.144	0.618	3.482708	680	680	680	680	0	0
162	Shinde	Minor	Pune	Bhor	0.938		0.938	0.69	0.248	1.274162	349	349	349	349	0	0
163	Uravade	Minor	Pune	Mulashi	0.22		1.722	1.377	0.345	1.897085	258	258	258	258	0	0
164	Saltar	Minor	Pune	Mulashi	0.682		0.74	0.74	0.000	1.302476	254	254	254	254	0	0
165	Gunvadi	Minor	Pune	Baramati	0.569		0.811	0.725	0.086	1.189217	429	429	429	429	0	0
166	bahuli	Minor	Pune	Haveli	0.129		0.47	0.436	0.034	0.297304	154	154	154	154	0	0
167	Bhivari	Minor	Pune	Haveli	2.498		2.727	2.082	0.645	4.530352	1242	1242	1242	1242	0	0
168	Walen Height raising	Minor	Pune	Mulashi	0		0	0	0.000	3.284505	754	754	754	754	0	0

169	vadgaon bonde	Minor	Pune	Dound	0.326		0.892	0.75	0.142	1.189217	255	255	255	255	0	0
170	Ghorwadi	Minor	Pune	Purandar	0.92		0	0	0.000	1.557309	279	279	279	279	0	0
171	pimpoli	Minor	Pune	Maval	0		0	0	0.000	0.141574	40	40	40	40	0	0
172	Walen	Minor	Pune	Mulashi	3.66		5.477	5.542	-0.065	5.068331	942	942		942	0	0
173	Jalgaon k p	Minor	Pune	Baramati	1.242		1.242	1.113	0.129	0.877756	302	302	302	302	0	0
174	Deulgaonraje	Minor	Pune	Dound	2.294		2.294	3.068	-0.774	3.652596	562	562	562	562	0	0
175	Khorvadi	Minor	Pune	Dound	4.088		4.088	4.747	-0.659	5.66294	795	795	795	795	0	0
176	Nirwangi Khalal	Minor	Pune	Indapur	0		0	0	0.000	1.104273	380	380	380	380	0	0
177	Nimbut	Minor	Pune	Baramati	1.389		2.244	1.267	0.977	1.840456	275	275	275	275	0	0
178	Hol	Minor	Pune	Baramati	1.941		2.367	2.08	0.287	2.746526	402	402	402	402	0	0
179	Shirasgaon kata	Minor	Pune	Shirur	1.586		1.586	1.297	0.289	1.245847	455	455	455	455	0	0
180	Ambadvet	Minor	Pune	Mulashi	0		0	0	0.000	1.132588	768	768	768	768	0	0
181	Phondwada(Jagtapwasti)	Minor	Pune	Baramati	0.229		0.469	0.377	0.092	0.792812	262	262	262	262	0	0
182	Nepatvalan	Minor	Pune	Baramati	1.234		1.234	0.835	0.399	0.821126	284	284	284	284	0	0
183	Chande	Minor	Pune	Mulashi	0		0	0	0.000	1.9254	1760	1760	1760	1760	0	0
184	Virnala	Minor	Pune	Purandar	0.247		3.113	2.505	0.608	1.982029	382	382	382	382	0	0
185	mandaki	Minor	Pune	Purandar	1.082		1.182	1.071	0.111	1.44405	658	658	658	658	0	0

186	Dongargaon	Minor	Pune	Mulashi	0.631		0.737	0.577	0.160	0.9627	320	320	320	320	0	0
187	Thitewadi	Minor	Pune	Shirur	1.366		15.977	14.95	1.027	7.135304	1078	1078	1078	1078	0	0
188	Bharekarwadi	Minor	Pune	Mulashi	0		0	0	0.000	0.9627	225	225	225	225	0	0
189	hadashi 2	Minor	Pune	Mulashi	2.39		2.56	2.56	0.000	1.302476	292	292	292	292	0	0
190	karhati highschool	Minor	Pune	Baramati	1.093		1.77	1.08	0.690	0.48135	269	269	269	269	0	0
191	Pedgaon	Minor	Pune	Dound	5.97		5.97	4.97	1.000	4.162261	928	928	928	928	0	0
192	kangaon	Minor	Pune	Dound	9.11		9.11	5.87	3.240	5.521367	991	991	991	991	0	0
193	Shere	Minor	Pune	Mulashi	0.04		0.076	0.067	0.009	1.670567	425	425	425	425	0	0
194	jadhavvadi	Minor	Pune	Maval	26.03		26.03	21.27	4.760	11.60903	1660	2872	1660	2872	0	0
195	Khamboli	Minor	Pune	Mulashi	3.97		3.97	3.53	0.440	1.840456	362	362	362	362	0	0
196	Inamgaon(nalage mala)	Minor	Pune	Shirur	2.39	1995	4.79	4.14	0.650	2.293491	530	530	530	530	0	0
197	Wagajwadi	Minor	Pune	Bhor	0		0	0	0.000	1.585623	273	273	273	273	0	0
198	Marnewadi	Minor	Pune	Mulashi	0		0	0	0.000	0.792812	158	158	158	158	0	0
199	Gaddavane(shindewadi)	Minor	Pune	Mulashi	0		0	0	0.000	2.066973	311	311		311	0	0
200	Malwandi	Minor	Pune	Maval	0		0	0	0.000	3.284505	437	437	437	437	0	0

201	Kolagaon-Dolas	Minor	Pune	Shirur	0.127	1974	0.164	0.152	0.012	1.047644	134	134	0	0	134	134
202	Otur	Minor	Pune	Junnar	0.081		0.096	0.085	0.011	0.537979	260	260	260	260	0	0
203	Nirgudsar	Minor	Pune	Ambegaon	0.043		0.284	0.227	0.057	1.160903	389	389	389	389	0	0
204	Khatahapur	Minor	Pune	Ambegaon	0.263		0.916	0.737	0.179	3.879114	1420	1420	1420	1420	0	0
205	Parunde	Minor	Pune	Junnar	0.192		1.092	0.91	0.182	0.849441	172	172	172	172	0	0
206	Sultanpur	Minor	Pune	Ambegaon	0.158		0.303	0.242	0.061	0.849441	186	186	186	186	0	0
207	Pargaon	Minor	Pune	Ambegaon	0.206		0.686	0.598	0.088	2.35012	836	836	836	836	0	0
208	Shirur	Minor	Pune	Shirur	1.287		1.683	0.191	1.492	0.537979	0	0	0	0	0	0
209	Chandoh	Minor	Pune	Shirur	0.349		0.882	0.579	0.303	1.698882	725	725	725	725	0	0
210	Yener	Minor	Pune	Junnar	0.205		0.515	0.413	0.102	1.698882	378	378	378	378	0	0
211	Pimpalgaon	Minor	Pune	Junnar	0.285		1.182	0.84	0.342	0.141574	35	35	35	35	0	0
212	Kalamb	Minor	Pune	Ambegaon	0.378		0.736	0.588	0.148	1.86877	666	666	666	666	0	0
213	Devgaon	Minor	Pune	Ambegaon	0.449		1.14	1.043	0.097	1.727197	686	686	686	686	0	0
214	Gohe	Minor	Pune	Ambegaon	0.309		1.656	1.547	0.109	1.132588	175	175		175	0	0
215	Valati-1	Minor	Pune	Ambegaon	0		0	0	0.000	0.141574	35	35		35	0	0
216	Ramjewadi	Minor	Pune	Junnar	0.273		2.452	1.967	0.485	1.415735	330	330	330	330	0	0
217	Savargaon	Minor	Pune	Junnar	0.288		0.933	0.741	0.192	0.198203	53	53	53	53	0	0
218	Hivare	Minor	Pune	Junnar	0.358		0.358	0.257	0.101	0.792812	289	289	289	289	0	0

	No.1															
219	Vadgaon kandali	Minor	Pune	Junnar	0.061		0.119	0.098	0.021	1.075959	478	478	478	478	0	0
220	Ranjani 2	Minor	Pune	Ambegaon	0.47		0.47	0.346	0.124	0.084944	20	20	20	20	0	0
221	Ranjani 1	Minor	Pune	Ambegaon	0.267		0.81	0.616	0.194	0.198203	48	48	48	48	0	0
222	Avasari	Minor	Pune	Ambegaon	0.045		0.14	0.112	0.028	0.849441	163	163	163	163	0	0
223	Chasanarodi	Minor	Pune	Ambegaon	0.061		0.171	0.153	0.018	0.934385	384	384		384	0	0
224	Vadgaon kashimbei	Minor	Pune	Ambegaon	0.458		0.985	0.96	0.025	1.500679	606	606	606	606	0	0
225	Valati-2	Minor	Pune	Ambegaon	0.15		0.535	0.426	0.109	1.047644	406	406	406	406	0	0
226	Saradwadi	Minor	Pune	Shirur	0.323		0.323	0.45	-0.127	1.189217	456	456	456	456	0	0
227	Chandoli	Minor	Pune	Ambegaon	0.314		0.665	0.615	0.050	1.500679	366	366	366	366	0	0
228	Pimpalgaon Kh	Minor	Pune	Ambegaon	0.48		0	0	0.000	1.698882	416	416	416	416	0	0
229	Gonvadi	Minor	Pune	Ambegaon	0.38		1.29	0.903	0.387	1.245847	621	621	621	621	0	0
230	Varulwadi	Minor	Pune	Junnar	0		0	0	0.000	0.283147	56	56	56	56	0	0
231	Manjarwadi	Minor	Pune	Junnar	0.35		0.625	0.427	0.198	0.113259	103	103	103	103	0	0
232	Nimdari	Minor	Pune	Junnar	0		0	0	0.000	0.396406	38	38	38	38	0	0
233	Vadaj	Minor	Pune	Junnar	0.384		0.551	0.368	0.183	0.396406	100	100	100	100	0	0

234	Valanwadi	Minor	Pune	Junnar	0.117		0.275	0.22	0.055	0.48135	181	181	181	181	0	0
235	Shingave	Minor	Pune	Ambegaon	0		0	0.59	-0.590	0.141574	35	35	35	35	0	0
236	AAmadabad	Minor	Pune	Shirur	0.311		0.748	0.569	0.179	1.528994	134	134	134	134	0	0
237	Annapur	Minor	Pune	Shirur	0.348		0.582	0.468	0.114	1.132588	448	448	448	448	0	0
238	Khodad 1	Minor	Pune	Junnar	0.107		0.616	0.616	0.000	0.113259	25	25	25	25	0	0
239	Khodad 2	Minor	Pune	Junnar	0.28		0.398	0.338	0.060	0.113259	25	25	25	25	0	0
240	Peshavekalin Bandhara	Minor	Pune	Junnar	0.132		0.574	0.457	0.117	0.396406	147	147	147	147	0	0
241	Bori	Minor	Pune	Junnar	0.472		1.822	1.461	0.361	1.557309	580	580	580	580	0	0
242	Jadhavwadi	Minor	Pune	Junnar	0.471		1.45	1.163	0.287	1.245847	812	812	812	812	0	0
243	Pushpavati Bandhara	Minor	Pune	Junnar	0		0	0	0.000	1.274162	701	701	701	701	0	0
244	Chandoh Patvan (Lakhangaon)	Minor	Pune	Ambegaon	0		0	0	0.000	0.590361	157	157	157	157	0	0
245	Gangapur	Minor	Pune	Ambegaon	0.723		1.274	1.034	0.240	1.330791	316	316	316	316	0	0
246	Amondi	Minor	Pune	Ambegaon	0.727		0.981	0.687	0.294	1.330791	317	317	317	317	0	0
247	Nimgaon	Minor	Pune	Shirur	0.64		0.64	0.59	0.050	1.769669	683	683	683	683	0	0

	dude															
248	Kawathe Phakate	Minor	Pune	Shirur	0.399		1.009	0.818	0.191	2.580035	1048	1048	1048	1048	0	0
249	Otur wagdara	Minor	Pune	Junnar	0.25		0.971	0.778	0.193	0.849441	140	140	140	140	0	0
250	Arvi	Minor	Pune	Junnar	0		0	0	0.000	0.159978	40	40	40	40	0	0
251	Nimgaon dude (Kund)	Minor	Pune	Shirur	0.774		1.323	0.969	0.354	1.330791	410	410	410	410	0	0
252	Tandali - sangam	Minor	Pune	Shirur	0.61	1993	0.99	0.99	0.000	1.86877	700	700	0	0	700	700
253	Inamgaon (nalage mala)	Minor	Pune	Shirur	2.39	1995	4.79	4.14	0.650	4.162261	1032	1032	0	0	1032	1032
254	Jedhecha Doh	Minor	Pune	Junnar	0.577		0.876	0.592	0.284	0.781486	258	258	258	258	0	0
255	Hivare No.1	Minor	Pune	Junnar	0.358		0.358	0.257	0.101	0.289943	73	73	73	73	0	0
256	Sakori	Minor	Pune	Junnar	0.719		1.416	1.085	0.331	1.58987	358	358	358	358	0	0
257	Pargaon	Minor	Pune	Junnar	0.657		1.665	0.679	0.986	1.670567	383	383	383	383	0	0
258	Thikekar wadi	Minor	Pune	Junnar	1.006		1.193	0.799	0.394	1.288319	386	386	386	386	0	0
259	Mhase Bk.	Minor	Pune	Shirur	0.469		0.724	0.488	0.236	1.075959	282	282	282	282	0	0
260	Honewadi (Ta.Ha.)	Minor	Pune	Shirur	0		0	0.16	-0.160	1.199977	487	487	487	487	0	0
261	Bhakare wadi	Minor	Pune	Shirur	0.87		1.35	1.093	0.257	1.269914	508	508	508	508	0	0
262	Jambut	Minor	Pune	Shirur	0.901		1.42	0.876	0.544	2.419774	524	524	524	524	0	0

263	Udapur	Minor	Pune	Junnar	0.43		0.56	0.423	0.137	0.659166	253	253	253	253	0	0
264	Sabalewadi	Minor	Pune	Shirur	0.45		0.45	0.46	-0.010	0.420473	205	205	205	205	0	0
265	Babarmala	Minor	Pune	Shirur	0.00		0	0.32	-0.320	1.009702	225	225		225	0	0
266	Ane Pemdara	Minor	Pune	Junnar	2.437		4.824	3.183	1.641	1.698882	293	293	293	293	0	0
267	Sirasgaon Kata	Minor	Pune	Junnar	0		0	0	0.000	2.095288	455	455	455	455	0	0
268	Khodud 3	Minor	Pune	Junnar	0.40		0.40	0.32	0.080	0.159978	40	40	40	40	0	0
269	Tandali Khorewasti	Minor	Pune	Shirur	3.04	2001	3.04	3.04	0.000	2.123603	542	542	0	0	542	542
270	Dhalewadi (included in Uchchil M.I.)	Minor	Pune	Junnar	0.37		0	0	0.000	0.464644	202	202	202	202	0	0
271	Belsar	Minor	Pune	Junnar	1.34		1.34	1.26	0.080	1.053873	422	422	422	422	0	0
272	Khangaon	Minor	Pune	Junnar	1.455		1.455	1.455	0.000	0.59744	156	156	156	156	0	0
273	Shiroli	Minor	Pune	Junnar	0.452		0.452	0.455	-0.003	0.849441	165	165		165	0	0
274	Pimpalgaon satikon	Minor	Pune	Junnar	1.23		1.23	1.13	0.100	0.79989	261	261	261	261	0	0
275	Vaishakh khede	Minor	Pune	Junnar	1.239		1.67	1.67	0.000	1.661223	401	401	401	401	0	0

276	Kumshet	Minor	Pune	Junnar	0.70		0.70	0.70	0.000	1.217532	301	301	301	301	0	0
277	Nimgaon dude(ta mkarwad i)	Minor	Pune	Shirur	0.64		0.64	0.59	0.050	0.849944	295	295	295	295	0	0
278	Ballalwa di	Minor	Pune	Junnar	3.49		3.49	2.43	1.060	1.698882	288	288	288	288	0	0
279	Ghangal dare	Minor	Pune	Junnar	17.14		17.49	17.31	0.180	1.982029	450	450	450	450	0	0
280	Uchchil	Minor	Pune	Junnar	6.43		6.43	5.62	0.810	2.83147	699	699	699	699	0	0
281	Nira Narsiha mpur	Minor	Pune	Indapur	3.426		4.906	4.001	0.905	3.79417	1150	1150	1150	1150	0	0
282	Tannu takali	Minor	Pune	Indapur	2.863		4.485	3.155	1.330	6.285863	1255	1255	1255	1255	0	0
283	Narsiha mpur Shevare	Minor	Pune	Indapur	3.25		0	0	0.000	5.868901	1150	1150	1150	1150	0	0
284	Bhatnim gaon	Minor	Pune	Indapur	4.039		6.077	3.182	2.895	6.087661	1212	1212	1212	1212	0	0
284	**Total Pune**				197.57		297.76	256.40	41.358	478.44	119985	122369	117577	119961	2408	2408.00
1	Pingali	Minor	Satara	Man	0.04		0.04	0.04	0.000	2.35012	340	340	340	340	0	0
2	Bangang a	Minor	Satara	Phaltan	0.13		0.13	0.13	0.000	6.484066	916	916	916	916	0	0
3	Tambave	Minor	Satara	Phaltan	0.22		0.22	0.22	0.000	4.841814	708	708	708	708	0	0
4	Lodhava de	Minor	Satara	Man	0.10		0.1	0.1	0.000	0.707868	113	113	113	113	0	0
5	Mahabal eshwarw	Minor	Satara	Man	0.22		0.22	0.22	0.000	1.500679	197	197	197	197	0	0

	adi															
6	Masalwadi	Minor	Satara	Man	0.12		0.12	0.12	0.000	2.010344	204	204	204	204	0	0
7	Dhaval	Minor	Satara	Phaltan	0.13		0.13	0.13	0.000	0.9627	157	157	157	157	0	0
8	Vinchurni	Minor	Satara	Phaltan	0.18		0.18	0.18	0.000	1.047644	170	170		170	0	0
9	Hingangaon	Minor	Satara	Phaltan	0.14		0.14	0.14	0.000	1.245847	208	208	208	208	0	0
10	Kuravali Bk	Minor	Satara	Phaltan	0.16		0.16	0.16	0.000	1.019329	133	133	133	133	0	0
11	Dhumalwadi	Minor	Satara	Phaltan	0.50		0.5	0.5	0.000	0.707868	192	192	192	192	0	0
12	kuravali Kh	Minor	Satara	Phaltan	0.90		0.9	0.9	0.000	0.792812	147	147	147	147	0	0
13	Barad	Minor	Satara	Phaltan	0.11		0.11	0.11	0.000	0.651238	102	102	102	102	0	0
14	Gangoti	Minor	Satara	Man	0.18		0.18	0.18	0.000	1.359106	147	147	147	147	0	0
15	Vadgaon	Minor	Satara	Khandala	0.30		0.3	0.3	0.000	2.548323	280	280	280	280	0	0
16	Naygaon 1	Minor	Satara	Khandala	0.45		0.45	0.45	0.000	1.132588	238	238	238	238	0	0
17	Mulikwadi	Minor	Satara	Phaltan	0.63		0.63	0.63	0.000	1.359106	219	219	219	219	0	0
18	Sangavi shiraval	Minor	Satara	Khandala	1.48		1.48	1.48	0.000	0.90607	180	180	180	180	0	0
19	Dhakani	Minor	Satara	Man	0.40		0.40	0.40	0.000	2.661582	495	495	495	495	0	0
20	Jambhulani	Minor	Satara	Man	0.17		0.17	0.17	0.000	2.265176	416	416		416	0	0
21	Jhanshi	Minor	Satara	Man	0.29	1978	11.83	10.29	1.540	2.633267	306	306	265	265	41	41

21	**Total Satara**	Minor			6.85		18.39	16.85	1.540	39.1875	5868	5868	5827	5827	41	41
1	Atpadi	Minor	Sangli	Atpadi	0.25	1957	0.31	0.31	0.000	7.928116	1120	1120	1120	1120	0	0
2	Banapuri	Minor	Sangli	Atpadi	0.08	1969	0.1	0.1	0.000	1.274162	216	216	216	216	0	0
3	Kosari	Minor	Sangli	Jat	0.10	1965	1.43	1.11	0.320	1.415735	186	186	186	186	0	0
4	Tippehalli	Minor	Sangli	Jat	0.13	1970	1.14	1.14	0.000	1.415735	324	324	324	324	0	0
5	Goradwadi	Minor	Sangli	Atpadi	0.08	1972	0.12	0.12	0.000	0.849441	196	196	196	196	0	0
6	Raywadi	Minor	Sangli	Kavathe mahankal	0.27	1970	0.9	0.22	0.680	1.86877	364	396	364	396	0	0
7	Shetphale	Minor	Sangli	Atpadi	0.12	1972	0.14	0.14	0.000	1.132588	163	163	163	163	0	0
8	Dighanchi	Minor	Sangli	Atpadi	0.28	1971	0.31	0.31	0.000	3.114617	664	664	664	664	0	0
9	Walekhindi	Minor	Sangli	Jat	0.37	1972	1.12	0.42	0.700	2.83147	496	580	496	580	0	0
10	Sidhanath	Minor	Sangli	Jat	0.40	1973	1.18	0.44	0.740	4.813499	846	846	846	846	0	0
11	Kachare wasti	Minor	Sangli	Atpadi	0.27	1970	0.27	0.26	0.010	2.265176	428	428	428	428	0	0
12	Rewnanl	Minor	Sangli	Jat	0.20	1973	0.54	0.22	0.320	1.982029	252	252	252	252	0	0
13	Birnal	Minor	Sangli	Jat	0.27	1973	0.71	0.28	0.430	1.982029	256	256	256	256	0	0
14	Shegaon	Minor	Sangli	Jat	0.36	1970	1.02	0.39	0.630	5.66294	840	840	840	840	0	0
15	Tikondi No.1	Minor	Sangli	Jat	0.25	1976	0.95	0.32	0.630	2.548323	360	360	360	360	0	0
16	Jalihal	Minor	Sangli	Jat	0.25	1978	0.68	0.53	0.150	1.698882	294	294	294	294	0	0
17	Yelvi	Minor	Sangli	Jat	0.34	1971	0.53	0.33	0.200	1.982029	320	320	320	320	0	0

18	Soradi	Minor	Sangli	Jat	0.25	1975	1.4	0.51	0.890	3.680911	780	780	780	780	0	0
19	Dudhebhavi	Minor	Sangli	Kavathe mahankal	0.38	1972	3.08	0.41	2.670	3.397764	697	697	697	697	0	0
20	Nimbavade	Minor	Sangli	Atpadi	0.46	1973	1.19	1.19	0.000	5.66294	600	600	600	600	0	0
21	Pratapur	Minor	Sangli	Jat	0.77	1982	0.85	0.82	0.030	1.415735	212	212	212	212	0	0
22	Jambhulani	Minor	Sangli	Atpadi	0.28	1970	0.29	0.29	0.000	2.548323	408	408	408	408	0	0
23	Sanamadi	Minor	Sangli	Jat	0.18	1976	0.57	0.57	0.000	1.698882	385	385	385	385	0	0
24	Koutoli KTW	Minor	Sangli	Atpadi	0.17	1982	0.29	0.29	0.000	0.849441	196	196	196	196	0	0
25	Tikondi No.2	Minor	Sangli	Jat	0.60	1987	0.86	0.86	0.000	1.982029	309	309	309	309	0	0
26	Ghanand	Minor	Sangli	Atpadi	0.66	1978	1	0.71	0.290	1.132588	164	164	164	164	0	0
27	Ghorapadi	Minor	Sangli	Kavathe mahankal	0.06	1979	1.2	1.2	0.000	1.274162	198	198	198	198	0	0
28	Vibhutwadi	Minor	Sangli	Atpadi	0.23	1978	0.77	0.77	0.000	1.132588	150	169	150	169	0	0
29	Bhivargi	Minor	Sangli	Jat	10.88	1997	52.54	30.8	21.740	8.49441	1995	1995	1995	1995	0	0
30	Malevasti	Minor	Sangli	Atpadi	2.75	1997	4.55	2.03	2.520	1.132588	270	270	270	270	0	0
31	Arjunwadi	Minor	Sangli	Atpadi	4.06	1996	4.83	4.83	0.000	1.698882	281	281	281	281	0	0
32	Dighanchi (Yadavmala)	Minor	Sangli	Atpadi	0.62	1997	0.71	0.71	0.000	0.566294	275	275	275	275	0	0

	K.T.W															
33	Shiganhalli K.T.W.	Minor	Sangli	Jat	0.99	2000	1.12	1.12	0.000	1.132588	256	256	256	256	0	0
34	Shegaon No.2	Minor	Sangli	Jat	2.17	2000	3.93	3.93	0.000	0.849441	261	261	261	261	0	0
35	Daribadachi	Minor	Sangli	Jat	3.51	2000	8.08	8.08	0.000	1.415735	309	309	309	309	0	0
36	Pandozari	Minor	Sangli	Jat	5.76	1999	16.73	16.01	0.720	3.114617	576	576	576	576	0	0
36	**Total Sangli**				38.8		115.44	81.77	33.670	87.9455	15647	15782	15647	15782	0	0
1	karunde	Minor	Solapur	Malshiras	0.13		0.25	0.23	0.020	2.259577	373	373	0	0	373	373
2	Waki diversion weir	Minor	Solapur	Sangola	0		0	0	0.000	0	162	162	162	162	0	0
3	kalamwadi	Minor	Solapur	Malshiras	0.10		19.88	19.8	0.080	0.594609	128	128	128	128	0	0
4	Nimgaon	Minor	Solapur	Malshiras	1.81	2004	5.2	4.43	0.770	4.388779	842	842	842	842	0	0
5	Akluj	Minor	Solapur	Malshiras	0.08		0.23	0.22	0.010	4.530352	945	945		945	0	0
6	Girzani	Minor	Solapur	Malshiras	0.57	2004	3.3	2.48	0.820	1.472364	570	570	570	570	0	0
7	malinagar	Minor	Solapur	Malshiras	0.07		0.52	0.44	0.080	1.9254	1071	1071	1071	1071	0	0
8	Ozare tambave	Minor	Solapur	Malshiras	0.13		0.44	0.45	-0.010	1.415735	571	571	571	571	0	0
9	Phondshiras	Minor	Solapur	Malshiras	1.71		3.22	2.56	0.660	2.40675	448	448	448	448	0	0

10	Velapur 2	Minor	Solapur	Malshiras	0.24		0.62	0.45	0.170	1.245847	608	608	608	608	0	0
11	Velapur 3	Minor	Solapur	Malshiras	0.11	1990	0.27	0.21	0.060	0.368091	175	175	175	175	0	0
12	Ughade wadi	Minor	Solapur	Malshiras	0.30		1.45	0.86	0.590	1.132588	220	220	0	0	220	220
13	sarati	Minor	Solapur	Malshiras	0		0	0	0.000	0.764497	250	250	250	250	0	0
14	Wadshiv ane	Minor	Solapur	Karamala	0.05	1902	0.05	0.04	0.010	4.247205	713	713	713	713	0	0
15	Parewadi	Minor	Solapur	Karamala	0.09	1945	0.11	0.09	0.020	4.049002	629	629	629	629	0	0
16	Sangavi	Minor	Solapur	Karamala	0.05	1949	0.065	0.05	0.015	2.491694	439	439	439	439	0	0
17	Veet	Minor	Solapur	Karamala	0.24	1970	0.26	0.25	0.010	2.038658	302	302	302	302	0	0
18	Higani(K)	Minor	Solapur	Karamala	0.38	1971	0.48	0.38	0.100	1.86877	401	401	401	401	0	0
19	Mhasew adi	Minor	Solapur	Karamala	0.17	1972	0.21	0.17	0.040	1.528994	203	203		203	0	0
20	Kondej	Minor	Solapur	Karamala	0.20	1973	0.23	0.2	0.030	1.500679	292	292	292	292	0	0
21	Kumbhej	Minor	Solapur	Karamala	0.40	1977	0.50	0.40	0.100	1.132588	212	212	212	212	0	0
22	Nerle	Minor	Solapur	Karamala	0.26	1972	0.34	0.27	0.070	2.095288	320	320	320	320	0	0
23	Rajuri	Minor	Solapur	Karamala	0.46	1975	0.57	0.45	0.120	2.038658	417	417	417	417	0	0
24	Potegaon	Minor	Solapur	Karamala	0.24	1990	0.8	0.64	0.160	1.585623	815	815	815	815	0	0
25	Taratgao	Minor	Solapur	Karamal	0.78	1994	1.37	1.18	0.190	1.415735	408	408	0	0	408	408

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26	Sangoba	Minor	Solapur	Karamala	0.81	1991	2.34	0.81	1.530	2.548323	817	817	0	0	817	817
27	Bhalewadi	Minor	Solapur	Karamala	1.29		1.89	1.41	0.480	2.265176	579	579	579	579	0	0
28	Pathari	Minor	Solapur	Barshi	0.07	1896	0.07	0.06	0.010	11.60903	647	647	647	647	0	0
29	Vairag	Minor	Solapur	Barshi	0.08	1953	0.09	0.07	0.020	1.44405	360	360	360	360	0	0
30	Kari	Minor	Solapur	Barshi	0.30	1968	0.19	0.15	0.040	1.472364	254	254	254	254	0	0
31	Gormale	Minor	Solapur	Barshi	0.28	1971	0.22	0.17	0.050	1.38742	283	283	283	283	0	0
32	Walwad	Minor	Solapur	Barshi	0.30	1974	0.30	0.30	0.000	0.90607	202	202	202	202	0	0
33	Kategaon	Minor	Solapur	Barshi	0.30	1978	0.30	0.30	0.000	1.245847	212	212	212	212	0	0
34	Tawadi	Minor	Solapur	Barshi	0.26	1977	0.258	0.26	-0.002	1.104273	214	214	214	214	0	0
35	Mamadapur	Minor	Solapur	Barshi	0.25	1976	0.58	0.46	0.120	1.897085	326	326	326	326	0	0
36	Shelgaon (R)	Minor	Solapur	Barshi	0.52	1976	0.65	0.52	0.130	2.689897	485	485	485	485	0	0
37	Koregaon	Minor	Solapur	Barshi	0.39	1958	0.19	0.15	0.040	2.35012	283	283	283	283	0	0
38	Chare	Minor	Solapur	Barshi	0.47	1977	0.59	0.47	0.120	1.330791	298	298	298	298	0	0
39	Kalambwadi	Minor	Solapur	Barshi	0.63	1975	1.90	1.60	0.300	2.321805	486	486	486	486	0	0
40	Tadawale	Minor	Solapur	Barshi	0.75	1992	1.6	1.27	0.330	1.982029	401	401	0	0	401	401
41	Ghanegaon	Minor	Solapur	Barshi	0.35	1994	0.54	0.46	0.080	1.500679	261	261	0	0	261	261
42	Irle	Minor	Solapur	Barshi	0.95	1994	1.29	1.18	0.110	1.982029	352	352	0	0	352	352
43	Sapatane	Minor	Solapur	Madha	0.12	1953	0.12	0.12	0.000	2.718211	728	728	728	728	0	0
44	Patrite	Minor	Solapur	Madha	0.18	1976	0.23	0.18	0.050	0.821126	132	132	132	132	0	0

45	Nimgaon	Minor	Solapur	Madha	0.24	1976	0.61	0.49	0.120	1.472364	296	296	296	296	0	0
46	Undargaon	Minor	Solapur	Madha	0.51	1982	0.55	0.55	0.000	4.407749	2754	2754	2754	2754	0	0
47	Mahisgaon	Minor	Solapur	Madha	0.54	1983	1.34	1.07	0.270	2.803155	1648	1648	1648	1648	0	0
48	Madha	Minor	Solapur	Madha	0.46	1988	0.61	0.49	0.120	1.44405	422	422	422	422	0	0
49	Khairav	Minor	Solapur	Madha	0.75	1979	0.85	0.68	0.170	1.86877	1050	1050	1050	1050	0	0
50	Darphal(U)	Minor	Solapur	Madha	0.33	1988	0.44	0.36	0.080	1.104273	322	322	322	322	0	0
51	Darphal Sina	Minor	Solapur	Madha	0.56	1997	0.7	0.61	0.090	0.849441	257	257	0	0	257	257
52	Kavhe	Minor	Solapur	Madha	1.12	1993	2.32	1.26	1.060	2.265176	653	653	0	0	653	653
53	Ridhore	Minor	Solapur	Madha	1.58	1993	2.1	2.08	0.020	2.83147	577	577	0	0	577	577
54	Nimgaon (madha)	Minor	Solapur	Madha	0.61	1995	0.81	0.65	0.160	0.283147	296	296	0	0	296	296
55	Pokhrapur	Minor	Solapur	Mohol	0.53	1977	0.6	0.53	0.070	1.642253	338	338	338	338	0	0
56	Bhambe wadi	Minor	Solapur	Mohol	0.27	1984	0.37	0.3	0.070	0.877756	262	262	262	262	0	0
57	Malikpeth	Minor	Solapur	Mohol	0.35	1983	0.44	0.36	0.080	1.739655	1951	1951	1951	1951	0	0
58	Bopale	Minor	Solapur	Mohol	0.50	1991	0.50	0.47	0.030	2.123603	2086	2086	2086	2086	0	0
59	Shirapur	Minor	Solapur	Mohol	0.57	1985	0.57	0.48	0.090	2.803155	1678	1678	1678	1678	0	0
60	Kolegaon	Minor	Solapur	Mohol	0.87	1983	1.26	0.93	0.330	2.774841	2118	2118	2118	2118	0	0
61	Degaon	Minor	Solapur	Mohol	0.73	1985	0.76	0.6	0.160	4.332149	2262	2262	2262	2262	0	0
62	Bhoyare	Minor	Solapur	Mohol	0.92	1993	1.06	0.92	0.140	2.038658	1209	1209	1209	1209	0	0
63	Shingoli	Minor	Solapur	Mohol	0.12	1993	1.42	1.14	0.280	2.151917	357	357	0	0	357	357
64	Arjunson	Minor	Solapur	Mohol	1.44	1996	2.15	1.95	0.200	1.698882	445	445	0	0	445	445

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65	Diksal	Minor	Solapur	Mohol	1.78	1997	1.9	1.74	0.160	3.482708	817	817	817	817	0	0
66	Angar	Minor	Solapur	Mohol	3.68		10.79	6.59	4.200	1.982029	508	508	0	0	508	508
67	Fondshiras (height raising)	Minor	Solapur	Malshiras	0.74	2004	3.22	3.56	-0.340	0.509665	180	180	0	0	180	180
68	Tirwandi	Minor	Solapur	Malshiras	0.15	1990	0.92	0.33	0.590	4.813499	1240	1240	0	0	1240	1240
69	Velapur-3	Minor	Solapur	Malshiras	0.11		0.27	0.21	0.060	0.566294	175	175	0	0	175	175
70	Ganeshgaon	Minor	Solapur	Malshiras	0.76	1987	1.78	1.78	0.000	3.680911	1473	1473	0	0	1473	1473
71	Bangarde	Minor	Solapur	Malshiras	0.81	1996	1.03	3.97	-2.940	1.982029	310	310	0	0	310	310
72	Girzani(height raising)	Minor	Solapur	Malshiras	0.57	2004	3.3	3.48	-0.180	0.566294	311	311	311	311	0	0
73	Kolegaon	Minor	Solapur	Malshiras	2.58	1996	6.42	3.87	2.550	3.680911	540	540	0	0	540	540
74	Mire	Minor	Solapur	Malshiras	4.07	1996	6.66	5.75	0.910	7.078675	1473	1473	0	0	1473	1473
75	Nimgaon (height raising)	Minor	Solapur	Malshiras	1.81	2004	1.81	1.81	0.000	1.897085	250	250	0	0	250	250
76	Waphegaon	Minor	Solapur	Malshiras	4.96	2003	11.34	8.61	2.730	9.060704	1820	1820	0	0	1820	1820
77	Mandave	Minor	Solapur	Malshiras	0.91		2.34	1.96	0.380	1.415735	332	332	133	133	199	199
78	Jambud	Minor	Solapur	Malshiras	3.57		11.85	2.35	9.500	6.965416	1465	1465	1465	1465	0	0

79	Puluj	Minor	Solapur	Pandharpur	0.35	1978	0.94	0.72	0.220	13.93083	3552	3552	3552	3552	0	0
80	Shetaphal	Minor	Solapur	Pandharpur	0.50	1985	1.09	0.89	0.200	2.548323	1592	1592	0	0	1592	1592
81	Bhandis hegaon	Minor	Solapur	Pandharpur	0.63	1992	0.95	0.96	-0.010	1.330791	338	338	0	0	338	338
82	sarkoli	Minor	Solapur	Pandharpur	0.34	1992	0.81	0.81	0.000	1.698882	522	522	0	0	522	522
83	Pirachi kuroli	Minor	Solapur	Pandharpur	2.06	1994	5.42	5.8	-0.380	4.247205	1169	1169	0	0	1169	1169
84	Mundhe wadi	Minor	Solapur	Pandharpur	2.77	1996	4.20	4.48	-0.280	5.946087	897	897	0	0	897	897
85	Gurasale	Minor	Solapur	Pandharpur	3.02	1996	3.61	3.61	0.000	5.096646	1295	1295	0	0	1295	1295
86	Gheradi	Minor	Solapur	Sangola	0.018	1929	0.018	0.02	-0.002	2.83147	417	417	417	417	0	0
87	Jawala	Minor	Solapur	Sangola	0.01	1942	0.02	0.02	0.000	1.330791	214	214	214	214	0	0
88	Chincholi	Minor	Solapur	Sangola	0.154	1953	0.15	0.15	0.000	2.633267	728	728	728	728	0	0
89	Junoni	Minor	Solapur	Sangola	0.041	1965	0.05	0.05	0.000	0.707868	116	116	116	116	0	0
90	Achakdani	Minor	Solapur	Sangola	0.199	1968	0.11	0.11	0.000	1.359106	186	186	186	186	0	0
91	Hangirage	Minor	Solapur	Sangola	0.164	1977	0.16	0.16	0.000	1.330791	223	223	223	223	0	0
92	Kole (Diversion weir)	Minor	Solapur	Sangola	0		0	0	0.000	0	151	151	151	151	0	0
93	wasud(A)	Minor	Solapur	Sangola	0.30	1982	0.71	0.69	0.020	2.089609	1274	1274	1274	1274	0	0
94	Kamalapur	Minor	Solapur	Sangola	0.29	1981	0.83	0.76	0.070	3.199561	1943	1943	1943	1943	0	0

95	Manjari	Minor	Solapur	Sangola	0.27	1978	0.58	0.58	0.000	1.9254	1164	1164	1164	1164	0	0
96	Wadhegaon	Minor	Solapur	Sangola	0.39	1986	1.78	1.43	0.350	2.293491	1327	1327	1327	1327	0	0
97	Medshingi	Minor	Solapur	Sangola	0.18	1982	0.71	0.62	0.090	1.38742	388	388	0	0	388	388
98	Balavadi	Minor	Solapur	Sangola	0.18	1992	0.99	0.77	0.220	1.670567	509	509	0	0	509	509
99	Khavaspur	Minor	Solapur	Sangola	0.72	1992	1.92	1.37	0.550	2.774841	398	398	0	0	398	398
100	Save	Minor	Solapur	Sangola	1.33	1996	2.57	2.22	0.350	1.953714	302	302	0	0	302	302
101	Nazare	Minor	Solapur	Sangola	1.08	1996	1.29	1.30	-0.010	3.397764	302	302	0	0	302	302
102	Lotewadi	Minor	Solapur	Sangola	0.83	1996	1.12	0.94	0.180	1.132588	344	344	0	0	344	344
103	Methavade	Minor	Solapur	Sangola	1.09	1995	1.56	1.43	0.130	1.982029	638	638	0	0	638	638
104	Watambare	Minor	Solapur	Sangola	1.09	1996	1.83	1.99	-0.160	1.415735	363	363	0	0	363	363
105	Sangole(A)	Minor	Solapur	Sangola	0.81	1993	2.06	1.92	0.140	2.236861	373	373		0	373	373
106	Kadalas	Minor	Solapur	Sangola	1.47	1996	2.46	2.18	0.280	1.982029	500	500	0	0	500	500
107	Chinake	Minor	Solapur	Sangola	0.95	1996	1.63	1.53	0.100	1.897085	332	332	0	0	332	332
108	Alegaon(K)	Minor	Solapur	Sangola	0.70	1996	0.88	0.86	0.020	1.075959	252	252	0	0	252	252
109	Bamani	Minor	Solapur	Sangola	2.36	2000	3.63	3.03	0.600	2.83147	654	654	0	0	654	654
110	Anakdhal(H)	Minor	Solapur	Sangola	2.73	2002	11.50	10.13	1.370	5.379793	837	837	0	0	837	837
111	Talsingi(Old)	Minor	Solapur	Mangalwedha	0.22	1896	0.25	0.25	0.000	1.359106	242	242	242	242	0	0
112	Talsingi(New)	Minor	Solapur	Mangalwedha	0.00	1896	0	0	0.000	1.047644	0	0	0	0	0	0

113	Huljanti	Minor	Solapur	Mangal wedha	0.19	1969	0.51	0.40	0.110	1.019329	184	184	184	184	0	0
114	Bhose	Minor	Solapur	Mangal wedha	0.15	1977	0.15	0.15	0.000	2.180232	266	266	266	266	0	0
115	Lavangi	Minor	Solapur	Mangal wedha	0.144	1973	0.20	0.10	0.100	0.877756	127	127	127	127	0	0
116	Dongarg aon	Minor	Solapur	Mangal wedha	0.295		0.30	0.29	0.010	1.528994	207	207	207	207	0	0
117	Maroli	Minor	Solapur	Mangal wedha	0.201	1974	0.15	0.15	0.000	1.528994	243	243	243	243	0	0
118	Bathan	Minor	Solapur	Mangal wedha	0.57	1990	1.97	1.97	0.000	4.530352	2690	2690	0	0	2690	269 0
119	Gharniki	Minor	Solapur	Mangal wedha	1.78	1996	2.55	2.09	0.460	2.83147	576	576	0	0	576	576
120	Mudhavi	Minor	Solapur	Mangal wedha	2.20	1996	2.97	3.43	-0.460	2.83147	614	614	0	0	614	614
121	Mallewa di	Minor	Solapur	Mangal wedha	1.78	1996	2.25	3.16	-0.910	3.114617	668	668	0	0	668	668
122	Marapur	Minor	Solapur	Mangal wedha	1.67	1995	2.87	0	2.870	2.83147	600	600	0	0	600	600
123	Huljanti	Minor	Solapur	Mangal wedha	0.13		0.13	0.13	0.000	0.9627	466	466	0	0	466	466
124	Machnur	Minor	Solapur	Mangal wedha	0.46	1989	3.20	3.32	-0.120	2.265176	545	545	0	0	545	545
125	Gunjega on	Minor	Solapur	Mangal wedha	0.48	1995	1.11	0.97	0.140	1.698882	796	796	0	0	796	796
126	Dharamg aon	Minor	Solapur	Mangal wedha	1.58	1996	3.08	2.64	0.440	2.548323	564	564	0	0	564	564
127	Arali	Minor	Solapur	Mangal wedha	2.61	2001	4.21	3.35	0.860	5.66294	1315	1315	0	0	1315	131 5
128	Darfal(B	Minor	Solapur	N.Solapu	0.24	1976	0.25	0.22	0.030	2.491694	447	447	447	447	0	0

	B)			r											
129	pakani	Minor	Solapur	N.Solapur	0.505	1978	0.66	0.54	0.120	3.142932	2167	2167	2167	2167	0	0
130	Soregaon	Minor	Solapur	N.Solapur	0.54	1992	4.22	3.59	0.630	1.189217	252	252	0	0	252	252
131	Hotagi	Minor	Solapur	South solapur	0.05	1899	0.05	0.05	0.000	5.27871	320	320	320	320	0	0
132	Bandalgi	Minor	Solapur	South solapur	0.17	1975	0.20	0.20	0.000	2.604952	760	760	760	760	0	0
133	wadakbal	Minor	Solapur	South solapur	0.05		0.05	0.05	0.000	0.792812	239	239	239	239	0	0
134	Nandur	Minor	Solapur	South solapur	0.408	1981	0.6	0.49	0.110	4.190576	2444	2444	2444	2444	0	0
135	Sindhakhed	Minor	Solapur	South solapur	0.61	1989	0.61	0.63	-0.020	2.038658	942	942	942	942	0	0
136	Auj	Minor	Solapur	South solapur	3.20	1996	3.57	3.25	0.320	9.060704	702	702	0	0	702	702
137	Vadapur (K)	Minor	Solapur	South solapur	1.64	1991	5.42	3.92	1.500	4.671926	1989	1989	0	0	1989	1989
138	Kudal	Minor	Solapur	South solapur	0.69	1993	2.25	2.18	0.070	1.472364	333	333	0	0	333	333
139	Akole(M)	Minor	Solapur	South solapur	0.52	1993	1.79	1.75	0.040	2.888099	652	652	0	0	652	652
140	Chinchapur	Minor	Solapur	South solapur	3.71	1996	6.88	3.72	3.160	5.889458	689	689	0	0	689	689
141	Korsegaon	Minor	Solapur	Akkalkot	1.25	1993	2.25	1.77	0.480	3.397764	1022	1022	0	0	1022	1022
142	Hilli	Minor	Solapur	Akkalkot	3.17	1996	4.62	4.07	0.550	5.351478	360	360	0	0	360	360
143	Khanapur	Minor	Solapur	Akkalkot	3.14	1996	4.19	3.38	0.810	4.983387	612	612	0	0	612	612
143	**Total**				117.75		255.89	211.86	44.031	365.15	98042	98042	57007	57007	4103	410

	Solapur														5	35.00
1	Yesarthav	Minor	Ahmadnagar	Akole	15.31		15.31	0.05	15.260	5.521367	1088	1088	1088	1088	0	0
2	Bhatodi	Minor	Ahmadnagar	nagar	0.04	1892	0.42	0.42	0.000	0.566294	120	120	0	0	120	120
3	Limajewadi	Minor	Ahmadnagar	Shrigonda	0.05	1943	0.05	0.05	0.000	0.736182	143	143	0	0	143	143
4	Kolgaon (Moharwadi)	Minor	Ahmadnagar	Shrigonda	0.13	1950	0.13	0.13	0.000	1.245847	226	226	0	0	226	226
5	Bahirobawadi	Minor	Ahmadnagar	Karjat	0.07	1950	0.07	0.07	0.000	1.132588	212	212	0	0	212	212
6	Guravpimpri	Minor	Ahmadnagar	Karjat	0.14	1952	0.14	0.14	0.000	3.142932	520	520	0	0	520	520
7	Gunavadi	Minor	Ahmadnagar	nagar	0.16	1951	0.16	0.16	0.000	5.66294	712	712	0	0	712	712
8	Durgaon	Minor	Ahmadnagar	Karjat	0.08	1953	0.08	0.08	0.000	1.812141	332	332	0	0	332	332
9	Mohari	Minor	Ahmadnagar	Jamkhed	0.12	1952	0.13	0.13	0.000	1.528994	232	232	0	0	232	232
10	Pargaon	Minor	Ahmadnagar	Shrigonda	0.08	1968	0.08	0.08	0.000	1.104273	189	189	0	0	189	189
11	Bardari	Minor	Ahmadnagar	nagar	0.19	1972	0.36	0.36	0.000	1.528994	300	300	0	0	300	300
12	Koudgaon	Minor	Ahmadnagar	nagar	0.18	1970	0.18	0.18	0.000	2.095288	340	340	0	0	340	340
13	Aoutewadi	Minor	Ahmadnagar	Shrigonda	0.20	1970	0.20	0.20	0.000	1.840456	328	328	0	0	328	328
14	Ghodegaon	Minor	Ahmadnagar	Shrigonda	0.18	1972	0.18	0.18	0.000	2.293491	485	485	0	0	485	485

15	Dhondpa rgaon	Minor	Ahmadn agar	Jamkhed	0.31	1973	0.31	0.31	0.000	2.180232	460	460	0	0	460	460
16	Vadgaon Tandali	Minor	Ahmadn agar	nagar	0.21	1972	0.29	0.29	0.000	1.897085	247	247	0	0	247	247
17	Deoolga on sidhhi	Minor	Ahmadn agar	nagar	0.27	1966	0.27	0.27	0.000	1.698882	366	366	0	0	366	366
18	Kamarga on	Minor	Ahmadn agar	nagar	0.20	1964	0.20	0.20	0.000	1.9254	453	453	0	0	453	453
19	Walki	Minor	Ahmadn agar	nagar	0.24	1971	1.26	1.1	0.160	1.86877	440	440	0	0	440	440
20	Chincho dipatil	Minor	Ahmadn agar	nagar	0.22	1973	0.23	0.23	0.000	2.151917	455	455	0	0	455	455
21	Rakshsa wadi Kh	Minor	Ahmadn agar	Karjat	0.18	1976	0.18	0.18	0.000	1.585623	356	356	0	0	356	356
22	Therwad i	Minor	Ahmadn agar	Karjat	0.21	1971	0.21	0.21	0.000	2.491694	428	428	0	0	428	428
23	Bhutava da(old)	Minor	Ahmadn agar	Jamkhed	0.48	1970	0.48	0.48	0.000	2.491694	650	650	0	0	650	650
24	Ruichatr apati	Minor	Ahmadn agar	Parner	0.16	1978	0.3	0.3	0.000	1.075959	188	188	0	0	188	188
25	Rakshsa wadi Bk	Minor	Ahmadn agar	Karjat	0.25	1976	0.16	0.16	0.000	1.104273	232	232	0	0	232	232
26	Dighi	Minor	Ahmadn agar	Karjat	0.10	1978	0.31	0.31	0.000	1.528994	545	545	0	0	545	545
27	Lonimav ala	Minor	Ahmadn agar	Parner	0.12	1973	0.26	0.26	0.000	0.877756	168	168	0	0	168	168
28	Naygaon	Minor	Ahmadn agar	Jamkhed	0.23	1972	0.29	0.29	0.000	1.897085	440	440	0	0	440	440
29	Takali khandes hwari	Minor	Ahmadn agar	Karjat	0.17	1977	0.62	0.62	0.000	0.9627	235	235	0	0	235	235

30	Nimgaon daku	Minor	Ahmadn agar	Karjat	0.28	1979	0.35	0.35	0.000	1.274162	657	657	0	0	657	657
31	Watepha l	Minor	Ahmadn agar	nagar	0.03	1975	0.05	0.05	0.000	0.594609	126	126	0	0	126	126
32	hanga	Minor	Ahmadn agar	Parner	0.19	1975	0.27	0.27	0.000	1.330791	226	226	0	0	226	226
33	Ratnapur	Minor	Ahmadn agar	Jamkhed	0.39	1979	1.31	1.31	0.000	1.670567	286	286	0	0	286	286
34	Kapasew asti	Minor	Ahmadn agar	Shrigond a	0.61	1982	0.61	0.61	0.000	1.38742	410	410	0	0	410	410
35	Javalake	Minor	Ahmadn agar	Jamkhed	0.32	1978	0.32	0.32	0.000	0.9627	208	208	0	0	208	208
36	Pimpalg aon Alava	Minor	Ahmadn agar	Jamkhed	0.21	1973	0.3	0.3	0.000	2.40675	535	535	0	0	535	535
37	Yesvadi	Minor	Ahmadn agar	Karjat	0.17	1978	0.17	0.17	0.000	1.330791	176	176	0	0	176	176
38	Thergao n	Minor	Ahmadn agar	Karjat	0.2	1979	2.13	2.13	0.000	0.934385	206	206	0	0	206	206
39	Telangsh i	Minor	Ahmadn agar	Jamkhed	0.14	1971	0.14	0.14	0.000	0.9627	156	156	0	0	156	156
40	Sakat	Minor	Ahmadn agar	nagar	0.2	1982	0.20	0.20	0.000	0.9627	246	246	0	0	246	246
41	Javala	Minor	Ahmadn agar	Jamkhed	0.42	1982	0.42	0.42	0.000	1.217532	315	315	0	0	315	315
42	Mathpim pri No.1	Minor	Ahmadn agar	nagar	0.05	1979	0.11	0.11	0.000	0.566294	297	297	0	0	297	297
43	Mhase Kh	Minor	Ahmadn agar	Parner	0.56	1984	0.49	0.45	0.040	1.330791	235	235	235	235	0	0
44	Dahigao n	Minor	Ahmadn agar	nagar	0.19	1986	0.53	0.53	0.000	0.934385	189	189	0	0	189	189

45	Gadilagav	Minor	Ahmadnagar	Parner	0.82	1995	0.82	0.82	0.000	1.698882	300	300	300	300	0	0
46	Dhotri	Minor	Ahmadnagar	Jamkhed	0.28	1978	0.95	0.95	0.000	1.44405	280	280	0	0	280	280
47	Jadhavwadi	Minor	Ahmadnagar	Parner	2.20	1973	2.92	1.83	1.090	1.38742	280	280	280	280	0	0
48	Renvadi	Minor	Ahmadnagar	Parner	0.88	1996	1.05	1.05	0.000	1.690388	361	361	361	361	0	0
49	Vadner	Minor	Ahmadnagar	Parner	0.49	1984			0.000	1.250094	505	505	505	505	0	0
50	pimparkhed	Minor	Ahmadnagar	Jamkhed	0.47	1982	0.47	0.47	0.000	0.736182	168	168	0	168	168	0
51	Kohkadi	Minor	Ahmadnagar	Parner	0.39	1994	0.47	0.47	0.000	0.849441	335	335	0	0	335	335
52	Thoratwasti(Thoratvadi)	Minor	Ahmadnagar	Karjat	0.40	1996	0.40	0.40	0.000	0.594609	258	258	0	0	258	258
53	Karamanwadi	Minor	Ahmadnagar	Karjat	0.41	1996	0.41	0.41	0.000	0.594609	163	163	163	163	0	0
54	Rashin	Minor	Ahmadnagar	Karjat	0.41	1996	0.41	0.41	0.000	0.594609	161	161	161	161	0	0
55	Giravali	Minor	Ahmadnagar	Jamkhed	0.40	1996	0.40	0.40	0.000	0.651238	260	260	0	0	260	260
56	Sangavi	Minor	Ahmadnagar	Jamkhed	0.36	1996	0.36	0.36	0.000	0.849441	272	272	0	0	272	272
57	Kavadgaon	Minor	Ahmadnagar	Jamkhed	0.90	1996	0.97	0.97	0.000	1.472364	305	305	0	0	305	305
58	Choundi	Minor	Ahmadnagar	Jamkhed	0.92	1995	1.01	1.01	0.000	0.90607	360	360	0	0	360	360
59	Nighoj (Honewa	Minor	Ahmadnagar	Parner	0.41	1998	0.41	0.41	0.000	0.849441	258	258	0	0	258	258

	di)															
60	Gunore	Minor	Ahmadnagar	Parner	1.03	1996	1.02	0.90	0.120	1.38742	206	206	206	206	0	0
61	Kashti	Minor	Ahmadnagar	Shrigonda	1.05	1996	1.05	1.05	0.000	2.123603	542	542	542	542	0	0
62	Dhanagarwadi	Minor	Ahmadnagar	Shrigonda	1.36	1996	1.36	1.36	0.000	2.208547	592	592	0	0	592	592
63	Nimgaon gangarda	Minor	Ahmadnagar	Karjat	0.66	1996	0.66	0.66	0.000	1.982029	307	307	307	307	0	0
64	Waluj No.1	Minor	Ahmadnagar	nagar	0.31	1992	0.366	0.366	0.000	0.849441	311	311	311	311	0	0
65	Waluj No.2	Minor	Ahmadnagar	nagar	0.55	1996	0.48	0.48	0.000	0.594609	257	257	0	0	257	257
66	Mathpimpri No.2	Minor	Ahmadnagar	nagar	0.60	1996	0.76	0.76	0.000	0.821126	270	270	0	0	270	270
67	Hathvalan	Minor	Ahmadnagar	nagar	0.53	1996	0.60	0.60	0.000	0.821126	297	297	297	297	0	0
68	Renavadi	Minor	Ahmadnagar	nagar	0.92	1996			0.000	1.38742	361	361	361	361	0	0
69	Shivdoh	Minor	Ahmadnagar	Parner	2.41	1998	3.55	3.55	0.000	1.160903	635	635	635	635	0	0
70	Wadzire	Minor	Ahmadnagar	Parner	4.33	1998	4.33	4.33	0.000	1.698882	982	982	982	982	0	0
71	Devibhoyare	Minor	Ahmadnagar	Parner	2.67	1998	5.52	5.52	0.000	2.774841	1498	1498	1498	1498	0	0
72	Narayandoh	Minor	Ahmadnagar	nagar	0.53	1992	0.06	0.06	0.000	1.585623	310	310	0	0	310	310
73	Chinchodipatil	Minor	Ahmadnagar	nagar	0.57	1996	0.08	0.08	0.000	0.594609	278	278	0	0	278	278
74	Walki B	Minor	Ahmadnagar	nagar	1.15	2000	1.26	1.1	0.160	1.189217	450	450	450	450	0	0

75	Chorachi wadi	Minor	Ahmadn agar	Shrigond a	0.23	1997	0.23	0.23	0.000	0.594609	160	160	0	0	160	160
76	Bhandga on	Minor	Ahmadn agar	Parner	2.69	2000	5.8	5.33	0.470	1.982029	383	383	337	337	46	46
77	Bhutava da Jod Talav	Minor	Ahmadn agar	Jamkhed	3.23	1999	5.49	5.49	0.000	1.698882	255	255	15	15	240	240
77	**Total Ahmad nagar**				58.8		73.926	56.626	17.300	114.84	27518	27518	9034	9202	1848 4	183 16
1	Sonari	Minor	Osmanab ad	Paranda	0.09	1955	0.09	0.09	0.000	1.302476	425	425	425	425	0	0
2	Yamai	Minor	Osmanab ad	Tuljapur	0.15	1967	0.15	0.15	0.000	1.557309	472	472	472	472	0	0
3	Ambi	Minor	Osmanab ad	Bhoom	0.10	1965	0.10	0.10	0.000	1.302476	308	308	308	308	0	0
4	Bagalwa di	Minor	Osmanab ad	Bhoom	0.15	1965	0.15	0.15	0.000	1.330791	340	340	340	340	0	0
5	Valgud	Minor	Osmanab ad	Osmana bad	0.15	1965	0.15	0.15	0.000	1.44405	518	518	518	518	0	0
6	Jejali	Minor	Osmanab ad	Paranda	0.13	1965	0.13	0.13	0.000	0.821126	168	168	168	168	0	0
7	Mugaon	Minor	Osmanab ad	Paranda	0.24	1966	0.24	0.243	-0.003	0.821126	180	180	180	180	0	0
8	Anala	Minor	Osmanab ad	Paranda	0.13	1965	0.13	0.13	0.000	1.245847	330	330	330	330	0	0
9	Kamatha	Minor	Osmanab ad	Tuljapur	0.16	1964	0.16	0.16	0.000	1.245847	358	358		358	0	0
10	Pohaner	Minor	Osmanab ad	Osmana bad	0.24	1976	0.96	0.96	0.000	1.047644	216	216	216	216	0	0
11	Horti	Minor	Osmanab	Tuljapur	0.22	1972	0.22	0.22	0.000	1.245847	290	290	290	290	0	0

			ad													
12	Kunthalgiri	Minor	Osmanabad	Bhoom	0.44	1976	0.44	0.44	0.000	0.651238	116	116	116	116	0	0
13	Titraj	Minor	Osmanabad	Paranda	0.55	1980	0.55	0.55	0.000	1.132588	275	275	275	275	0	0
14	Goramala	Minor	Osmanabad	Bhoom	0.59	1984	0.59	0.51	0.080	1.132588	202	202	202	202	0	0
15	Masala	Minor	Osmanabad	Tuljapur	0.37	1983	1.37	1.37	0.000	1.359106	187	187	187	187	0	0
16	Belgaon	Minor	Osmanabad	Bhoom	0.20	1989	0.2	0.2	0.000	0.537979	172	172	172	172	0	0
17	Chinchpur Dhage	Minor	Osmanabad	Bhoom	0.18	1990	0.18	0.18	0.000	0.48135	146	146		146	0	0
18	Khanapur	Minor	Osmanabad	Osmanabad	1.40	1994	1.00	0.00	1.000	1.330791	173	173	173	173	0	0
19	Raghuchiwadi	Minor	Osmanabad	Osmanabad	0.2	1990	0.22	0.22	0.000	3.567652	362	362	362	362	0	0
20	Arasoli	Minor	Osmanabad	Bhoom	1.00	1977	5.62	5.62	0.000	6.399122	966	966	966	966	0	0
21	Malakapur	Minor	Osmanabad	Kalamb	0.70	1994	0.70	0.70	0.000	0.877756	222	222	222	222	0	0
22	Chorakhali	Minor	Osmanabad	Kalamb	1.71	1994	3.8	3.77	0.030	3.142932	712	712	712	712	0	0
23	Tambewadi	Minor	Osmanabad	Bhoom	2.13	1989	2.13	2.13	0.000	4.077317	528	528	528	528	0	0
24	Gaonsud	Minor	Osmanabad	Osmanabad	1.38	1993	2.49	2.34	0.150	1.500679	252	252	252	252	0	0
25	Valgud	Minor	Osmanabad	Osmanabad	1.75	1996	1.95	1.63	0.320	1.047644	280	280	280	280	0	0
26	Bhotra	Minor	Osmanabad	Paranda	2.21	1997	2.71	2.71	0.000	2.957446	683	683	683	683	0	0

27	Pathrud	Minor	Osmanabad	Bhoom	1.45	1994	3.82	3.19	0.630	2.038658	280	280	280	280	0	0
28	Wadaji	Minor	Osmanabad	Vashi	2.62	1996	1.25	1.25	0.000	1.585623	485	485	485	485	0	0
29	Yeramala	Minor	Osmanabad	Kalamb	1.9	1996	3.47	3.47	0.000	1.274162	383	383	383	383	0	0
30	Awarpimpri	Minor	Osmanabad	Paranda	1.20	1999	1.91	1.91	0.000	1.163782	383	383	383	383	0	0
31	Shelgaon	Minor	Osmanabad	Paranda	2.04	2000	3.14	3.14	0.000	1.217532	312	312	312	312	0	0
32	Watefal	Minor	Osmanabad	Paranda	5.70	1999	6.10	4.97	1.130	3.907429	861	861	861	861	0	0
33	Nandgaon	Minor	Osmanabad	Bhoom	1.91	1996	4.67	4.67	0.000	1.613938	310	310	310	310	0	0
34	Devakurli	Minor	Osmanabad	Tuljapur	1.95	1999	2.90	2.57	0.330	1.160903	252	252	252	252	0	0
35	Dhotri	Minor	Osmanabad	Tuljapur	2.21	1999	3.50	3.10	0.400	1.415735	318	318	318	318	0	0
36	Kemwadi	Minor	Osmanabad	Tuljapur	3.59	1999	7.14	5.17	1.970	2.661582	560	560	560	560	0	0
37	Sawargaon	Minor	Osmanabad	Tuljapur	4.94	1999	8.01	4.01	4.000	3.001358	686	686	686	686	0	0
38	Sonegaon	Minor	Osmanabad	Osmanabad	1.45	1994	3.10	2.55	0.550	1.727197	262	262	262	262	0	0
39	Kati Dahiwadi	Minor	Osmanabad	Tuljapur	0.77	1998	3.65	2.95	0.700	1.812141	252	252	252	252	0	0
40	Tamalwadi	Minor	Osmanabad	Tuljapur	2.95	1999	3.86	2.65	1.210	1.698882	254	254	254	254	0	0
41	Sangavi Kati	Minor	Osmanabad	Tuljapur	0.32	1984	1.20	1.44	-0.240	1.075959	291	291	291	291	0	0

42	Sangavi Malumbra	Minor	Osmanabad	Tuljapur	2.62	1994	2.62	2.62	0.000	3.199561	335	335	335	335	0	0
43	Dhekari	Minor	Osmanabad	Tuljapur	2.69	2001	2.69	2.69	0.000	1.727197	372	372	372	372	0	0
44	Apasinga	Minor	Osmanabad	Tuljapur	1.95	1999	1.81	1.65	0.160	1.160903	290	290	290	290	0	0
45	Kadaknathwadi	Minor	Osmanabad	Vashi	2.10	2001	1.23	1.23	0.000	0.821126	309	309	309	309	0	0
46	Koudgaon	Minor	Osmanabad	Osmanabad	1.65	2001	1.76	1.76	0.000	0.991015	260	260	260	260	0	0
47	Ambejavalaga	Minor	Osmanabad	Osmanabad	1.98	2001	2.21	2.21	0.000	0.991015	300	300	300	300	0	0
48	Jamb	Minor	Osmanabad	Bhoom	3.75	1996	3.34	2.66	0.680	1.86877	273	273	273	273	0	0
49	Giralgaon	Minor	Osmanabad	Bhoom	2.47	2001	2.47	2.47	0.000	1.217532	286	286	286	286	0	0
50	Ghulewadi	Minor	Osmanabad	Bhoom	2.40	2001	2.83	2.83	0.000	1.274162	330	330	330	330	0	0
51	Yedeshwari	Minor	Osmanabad	Kalamb	1.70	2001	1.50	0.00	1.500	1.104273	274	274	274	274	0	0
52	Dukkarwadi	Minor	Osmanabad	Bhoom	2.53	2001	2.99	2.99	0.000	1.189217	252	252	252	252	0	0
53	Jamb	Minor	Osmanabad	Bhoom	1.77	2001	7.37	7.37	0.000	0.934385	255	255	255	255	0	0
54	Umachiwadi	Minor	Osmanabad	Bhoom	2.63	2001	4.19	3.63	0.560	1.302476	282	282	282	282	0	0
55	Ambehol	Minor	Osmanabad	Osmanabad	1.92	2006	12.5	10.89	1.610	0.764497	258	258	258	258	0	0
56	Vangijavala	Minor	Osmanabad	Paranda	7.03	2001	11.63	7.88	3.750	3.79417	813	813	813	813	0	0

57	Nimnakhairi Bu	Minor	Osmanabad	Paranda	18.82	1999	36.92	33.89	3.030	8.437781	1149	1149	1149	1149	0	0
58	Bedakinala Bu	Minor	Osmanabad	Osmanabad	1.89	1992	7.08	7.08	0.000	3.567652	601	601	601	601	0	0
59	Hiwarda	Minor	Osmanabad	Bhoom	4.62	1996	12.80	7.14	5.660	3.142932	477	477	477	477	0	0
59	**Total Osmanabad**				116.09		202.09	172.883	29.207	108.404	21886	21886	21886	21886	0	0
1	Kini	Minor	Beed	Ashti	0.10	1965	0.10	0.10	0.000	1.245847	380	380	380	380	0	0
2	Incharana	Minor	Beed	Patoda	0.14	1967	0.14	0.14	0.000	1.9254	555	555	555	555	0	0
3	Chinchpur	Minor	Beed	Ashti	0.02	1962	0.02	0.02	0.000	0.991015	162	162	162	162	0	0
4	Pimpala	Minor	Beed	Ashti	0.11	1964	0.11	0.11	0.000	0.736182	196	196	196	196	0	0
5	Wadgaon	Minor	Beed	Ashti	0.12	1970	0.12	0.12	0.000	1.302476	222	222	222	222	0	0
6	Brahmagaon	Minor	Beed	Ashti	0.19	1971	0.19	0.19	0.000	1.557309	259	259	259	259	0	0
7	Loni	Minor	Beed	Ashti	0.13	1972	0.13	0.13	0.000	1.330791	233	233	233	233	0	0
8	Velaturi	Minor	Beed	Ashti	0.20	1971	0.20	0.20	0.000	1.613938	313	313	313	313	0	0
9	Pandhari	Minor	Beed	Ashti	0.21	1976	0.21	0.21	0.000	1.019329	210	210	210	210	0	0
10	Khel	Minor	Beed	Ashti	0.23	1976	0.23	0.23	0.000	1.38742	277	277	277	277	0	0
11	Belgaon	Minor	Beed	Ashti	0.41	1977	0.41	0.41	0.000	2.35012	457	457	457	457	0	0
12	Khadakat no 1	Minor	Beed	Ashti	0.30	1982	0.30	0.30	0.000	0.792812	124	124	124	124	0	0
13	Matakuli	Minor	Beed	Ashti	0.76	1980	0.76	0.76	0.000	1.500679	290	290	290	290	0	0
14	Paragaon (G)-1	Minor	Beed	Ashti	0.61	1978	0.61	0.61	0.000	0.566294	113	113	113	113	0	0

15	Sangavi	Minor	Beed	Ashti	0.24	1982	0.24	0.24	0.000	0.9627	160	160	160	160	0	0
16	Sindewadi	Minor	Beed	Ashti	1.01	1989	1.01	1.01	0.000	0.566294	105	105	105	105	0	0
17	Paragaon (G)-2	Minor	Beed	Ashti	2.20	1996	3.45	3.45	0.000	1.472364	320	320	320	320	0	0
18	Talawar Med Project to Pargaon MI TankG-2 with Link canal	Minor	Beed	Ashti	0.45	2000	0.45	0.45	0.000	0					0	0
19	Khadakat no 2	Minor	Beed	Ashti	1.49	1996	2.49	2.49	0.000	2.151917	480	480	480	480	0	0
20	Sangavi (s)	Minor	Beed	Ashti	1.76	1996	2.55	2.55	0.000	2.661582	594	594	594	594	0	0
21	Koyal	Minor	Beed	Ashti	1.40	1996	2.60	2.60	0.000	1.160903	262	262	262	262	0	0
22	Kuntephal	Minor	Beed	Ashti	1.40	1996	3.94	3.94	0.000	1.132588	298	298	298	298	0	0
23	Takalsing	Minor	Beed	Ashti	1.11	1999	1.78	1.78	0.000	1.500719	344	344	344	344	0	0
24	Lambarwadi	Minor	Beed	Patoda	1.73	1999	2.61	2.61	0.000	1.727197	308	308	308	308	0	0
25	Bhurewadi	Minor	Beed	Patoda	2.85	1999	4.98	4.98	0.000	1.812141	405	405	405	405	0	0
26	Balewadi	Minor	Beed	Ashti	2.39	1999	5.25	5.25	0.000	1.86877	420	420	420	420	0	0
27	Ramesh	Minor	Beed	Patoda	4.37	1996	5.99	5.99	0.000	2.83147	772	772	772	772	0	0

	war Soutada															
28	Hingani	Minor	Beed	Ashti	0.97	2001	1.85	1.85	0.000	1.217532	264	264	264	264	0	0
29	Pimpri Ghumari	Minor	Beed	Ashti	1.11	1999	2.00	2.00	0.000	1.500679	276	276	276	276	0	0
30	Dhaman gaon	Minor	Beed	Ashti	1.79	1996	4.48	4.48	0.000	1.075959	256	256	256	256	0	0
31	Vasantw adi	Minor	Beed	Patoda	1.55	2002	3.17	3.17	0.000	1.38742	306	306	306	306	0	0
32	Suleman Devala	Minor	Beed	Ashti	2.55	1996	10.98	10.98	0.000	1.698882	500	500	500	500	0	0
33	Jalagaon	Minor	Beed	Ashti	2.76	2002	5.94	5.94	0.000	1.44405	332	332	332	332	0	0
34	Pimpalsu ti Pulavaja	Minor	Beed	Ashti	1.85	2007	2.88	2.88	0.000	1.472364	287	287	287	287	0	0
35	Dhimdi Pulavaja	Minor	Beed	Ashti	2.56	2007	4.71	4.71	0.000	2.038658	445	445	445	445	0	0
36	Pimpari Ghumari	Minor	Beed	Ashti	3.03	2007	3.70	3.70	0.000	1.217532	268	268	268	268	0	0
37	Kada	Minor	Beed	Ashti	2.09	2007	2.80	2.80	0.000	1.698882	348	348	348	348	0	0
38	Pandhari	Minor	Beed	Ashti	4.27	2007	5.36	5.36	0.000	1.415735	278	278	278	278	0	0
39	Ashti (Ni) Chobha	Minor	Beed	Ashti	3.68	1989	19.18	19.18	0.000	6.540696	1400	1400	1400	1400	0	0
39	**Total Beed**				54.14		107.92	107.92	0.00	60.88	13219.0 0	13219. 00	13219. 00	13219. 00	0.00	0.00
659	**Total M.P.**				590.00		1071.42	904.31	167.11	1254.85	302165. 00	304684 .00	24019 7.00	242884 .00	6196 8.00	618 00.0
	Grand Total				1063.78		4227.41	3832.41	395.00	11591.18	617329. 00	640479 .00	55521 3.00	578449 .00	6211 6.00	620 30.0

Annexure - 22.2 Details of Ongoing Projects in K-5 sub basin(Districtwise above 250 Ha)

Status as on 31/03/2014

Area in Ha

Cost in Crores

-137.2

Sr. No.	Name of Project	Category	District	Taluka	Original Administrative Approval		Revised Cost	Up To Date Expenditure	Balance Cost	Live Storage in Mm3	Design Potential		Potential created		Balance Potential	
					Cost	Year					ICA	IP	ICA	IP	ICA	IP
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A)	**Major Projects**															
1	Temghar	Major	Pune	Mulashi	323.53	2000	323.53	304.120	19.410	104.784	1000	1000	1000	1000	0	0
2	Gunjavani	Major	Pune	Velha	316.60	2000	596.720	205.070	391.650	104.501	16500	26686	0	0	16500	26686
3	Bhama Asakhed	Major	Pune	Khed	548.20	1999	575.840	224.730	351.110	216.563	23110	29465	340	434	22770	29031
4	Nira Deodhar	Major	Pune	Bhor	910.91	2000	1334.360	542.290	792.070	331.627	43050	60581	3617	5419	39433	55162
5	Chasakman	Major	Pune	Khed	388.13	2003	728.490	517.320	211.170	213.391	44170	56096	39846	50604	4324	5492
6	Kukadi (5 Reservoirs)	Major	Pune	Junnar	692.18	1994	2184.160	19.280	2164.880	864.893	146053	156278	129279	138329	16774	17949
6	**Total Pune**				**3179.55**		**5743.1**	**1812.81**	**3930.29**	**1835.75904**	**273883**	**330106**	**174082**	**195786**	**99801**	**134320**
0	Nil				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Satara				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	Nil				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	Total Sangali				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	Sangola Branch canal project	Major	Solapur	Sangola	0		0.000	0.000	0.000	0.000	8735	13140	5397	7667	3338	5473
2	Bhima(Ujjani)	Major	Solapur	Madha	1405.67	2004	2107.38	1307.960	799.420	1517.386	182683	259539	163018	229708	19665	29831
2	**Total Solapur**				1405.67		2107.38	1307.96	799.42	1517.3856	191418	272679	168415	237375	23003	35304
0	**Nil**				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Ahemadnagar				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1	Sina-Kolegaon	Major	Osmanabad	Paranda	70.88		455.28	297.17	158.110	76.209	12100	12585	7369	7665	4731	4920
1	**Total Osmanabad**				**70.88**		**455.28**	**297.17**	**158.11**	**76.21**	**12100.00**	**12585.00**	**7369.00**	**7665.00**	**4731.00**	**4920.00**
0	**Nil**				0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Beed				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total for Major				**4656.10**		**8305.76**	**3417.94**	**4887.82**	**3429.35**	**477401.00**	**615370.00**	**349866.00**	**440826.00**	**127535.00**	**174544.00**
B)	**Medium Projects**															
1	Kalmodi	Medium	Pune	Khed	54.31	1996	203.160	53.930	149.230	42.76	5065	5622	0	0	5065	5622
2	Chilhewadi	Medium	Pune	Junnar	123.63		194.230	115.510	78.720	24.64	6372	7455	1000	1070	5372	6385
2	**Total Pune**				**177.94**		**397.39**	**169.44**	**227.95**	**67.40**	**11437.00**	**13077.00**	**1000.00**	**1070.00**	**10437.00**	**12007.00**
0	Nil	Medium			0		0.000	0.000	0.000	0.000	0	0	0	0	0	0
	Total Satara				**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1	Mhasawad RBC km 1 to 8	Medium	Sangli	Atapadi	0.11	1977	8.240	0.180	8.060	0.00	300	300	0	0	300	300
1	**Total Sangali**				**0.11**		**8.24**	**0.18**	**8.06**	**0.00**	**300.00**	**300.00**	**0.00**	**0.00**	**300.00**	**300.00**
1	Pimpalgaon(Dhale)	Medium	Solapur	Barshi	121.49		129.61	103.810	25.800	9.63	2400	3384	1239	1747	1161	1637
1	**Total Solapur**				**121.49**		**129.61**	**103.81**	**25.80**	**9.63**	**2400.00**	**3384.00**	**1239.00**	**1747.00**	**1161.00**	**1637.00**

0	Nil	Medium			0.00		0.00	0.000	0.000	0.000	0	0	0	0	0	0
	Total Ahemadnagar				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	Nil	Medium			0.00		0.00	0.00	0.000	0.000	0	0	0	0	0	0
	Total Osmanabad				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	Nil	Medium			**0.00**		**0.00**	**0.00**	0.000	**0.000**	**0**	**0**	**0**	**0**	**0**	**0**
	Total Beed				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total for Medium				**299.54**		**535.24**	**273.43**	**261.81**	**77.03**	**14137.00**	**16761.00**	**2239.00**	**2817.00**	**11898.00**	**13944.00**
C)	**Minor Projects**															
1	Bopgaon	Minor	Pune	Purandar	0.109		5.130	0.250	4.880	**1.27**	265	265	0	0	**265**	**265**
2	Otur (Wakwasti)	Minor	Pune	Junnar	1.59		1.920	0.000	1.920	**0.93**	320	320	0	0	**320**	**320**
3	Bhongavali	Minor	Pune	Bhor	24.86		24.86	13.940	10.920	**3.06**	504	504	100	100	**404**	**404**
4	Kondhaval	Minor	Pune	Ambegaon	3.159		9.38	1.050	8.330	**1.59**	256	256	0	0	**256**	**256**
4	**Total Pune**				**29.718**		**41.29**	**15.24**	**26.05**	**6.85344**	**1345**	**1345**	**100**	**100**	**1245**	**1245**
0	NIL	Minor			0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Satara				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1	Mahadikwadi	Minor	Sangli	Atapadi	2.74	1997	4.550	3.680	0.870	**1.70**	416	520	140	175	**276**	**345**
2	Ankalagi	Minor	Sangli	Jath	8.68		15.140	10.490	4.650	**3.96**	705	705	705	705	**0**	**0**
2	**Total Sangli**				**11.42**		**19.69**	**14.17**	**5.52**	**5.664**	**1121**	**1225**	**845**	**880**	**276**	**345**
1	Chikalgi	Minor	Solapur	Mangalwedha	1.69	1981	8.630	5.980	2.650	**7.65**	1100	1100	210	210	**890**	**890**
2	Pout	Minor	Solapur	Mangalwedha	4.31	2000	13.040	0.050	12.990	5.66	1509	1509	0	0	**1509**	**1509**
3	Babhulgaon	Minor	Solapur	Barshi	3.83	1992	49.080	25.730	23.350	5.38	1280	1856	340	492	**940**	**1364**

4	Ekatpur(S)	Minor	Solapur	Sangola	2.20	2000	9.440	0.003	9.437	2.27	256	256	0	0	**256**	**256**
5	Hatid No.1	Minor	Solapur	Sangola	2.44	2000	12.010	0.009	12.001	0.49	283	283	0	0	**283**	**283**
6	Suste-Tarapur	Minor	Solapur	Pandharpur	0.87	1989	16.530	0.002	16.529	4.81	2804	2804	0	0	**2804**	**2804**
6	**Total Solapur**				**15.34**		**108.73**	**31.7734**	**76.9566**	**26.263968**	**7232**	**7808**	**550**	**702**	**6682**	**7106**
1	Palsunde	Minor	Ahmadnagar	Akole	0		0.000	0.000	0.000	**2.44**	500	500	0	0	**500**	**500**
2	Hingani	Minor	Ahmadnagar	Shrigonda	5.49	2011	5.490	0.000	5.490	**1.50**	1132	1132	0	0	**1132**	**1132**
3	Amrutling	Minor	Ahmadnagar	Jamkhed	1.69		1.690	0.100	1.590	**1.25**	260	260	0	0	**260**	**260**
3	**Total Ahmadnagar**				**7.18**		**7.18**	**0.100**	**7.08**	**5.18256**	**1892**	**1892**	**0**	**0**	**1892**	**1892**
0	NIL	Minor			0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Osmanabad				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1	Krhewadi	Minor	Beed	Ashti	4.61	2007	0.000	0.000	0.000	**1.64**	442	442	0	0	**442**	**442**
1	**Total Beed**				**4.61**		**0**	**0**	**0**	**1.64256**	**442**	**442**	**0**	**0**	**442**	**442**
	Total Minor				**68.27**		**176.89**	**61.28**	**115.61**	**45.61**	**12032.00**	**12712.00**	**1495.00**	**1682.00**	**10537.00**	**11030.00**
	LIS								0.000							
1	Janai Shirsai	LIS	Pune	Daund	411.72	2011	411.72	262.91	148.810	7445.611	14080	15488	11183	12301	2897	3187
2	Purandar	LIS	Pune	Haveli	250.00		608.90	313.79	295.110	8886.533	25498	25753	18285	18468	7213	7285
2	**Total Pune**				**661.72**		**1020.62**	**576.70**	**443.92**	**16332.14**	**39578.00**	**41241.00**	**29468.00**	**30769.00**	**10110.00**	**10472.00**
1	Tembhu	LIS	Satara	Karad	654.06	1996	1769.74	816.27	953.47	23116.766	37155	51645	0	0	37155	51645
1	**Total Satara**				**654.06**		**1769.74**	**816.27**	**953.47**	**23116.77**	**37155.00**	**51645.00**	**0.00**	**0.00**	**37155.00**	**51645.00**
1	Mhaisal Lift Irritation Project (Jath Reach)	LIS	Sangli, Solapur	Jath, Sangola, Mangalwedha	0.00		0.00	**0.00**	0.000	0.000	23970	24330	957	971	23013	23359

1	**Total Sangli**				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**23970.00**	**24330.00**	**957.00**	**971.00**	**23013.00**	**23359.00**
1	Sangola	LIS	Solapur	Sangola	73.59	2000	152.85	0.19	152.660	5.381	6525	10701	0	0	6525	10701
2	Ashti	LIS	Solapur	Mohol	49.60	1996	142.06	80.87	61.190	2290.238	9000	12780	0	0	9000	12780
3	Shirapur	LIS	Solapur	Mohol	90.57	1996	290.34	145.65	144.690	4124.808	10000	14200	0	0	10000	14200
4	Barshi	LIS	Solapur	Barshi	131.39	1996	197.07	153.65	43.420	4351.368	15000	21300	0	0	15000	21300
5	Ekrukh	LIS	Solapur	N.Solapur	87.48	1996	264.28	111.68	152.600	3162.778	17310	24580	0	0	17310	24580
6	Dahigaon	LIS	Solapur	Karamala	57.66	1996	213.00	131.48	81.520	3723.514	10500	13335	0	0	10500	13335
7	Sina madha	LIS	Solapur	Madha	54.49	1994	524.80	290.63	234.170	8230.642	16151	24550	988	11871	16151	12679
7	**Total Solapur**				**544.78**		**1784.40**	**914.15**	**870.25**	**25888.73**	**84486.00**	**121446.00**	**544.78**	**11871.00**	**544.78**	**109575.00**
0	NIL	LIS			0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Ahmadnagar				**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1	Shirala	LIS	Osmanabad	Paranda	23.00		106.28	50.44	55.840	1428.461	2850	4047	1936	2850	914	1197
1	**Total Osmanabad**				**23.00**		**106.28**	**50.44**	**55.84**	**1428.46**	**2850.00**	**4047.00**	**1936.00**	**2850.00**	**914.00**	**1197.00**
1	Sina - Mehakari (मेहकरी स्त्रोत वृध्दी)	LIS	Beed	Ashti	52.97	2004	0.00	0.00	0.000	0.000	0	0	0	0	0	0
1	**Total Beed**				**52.97**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total LIS				**1936.53**		**4681.04**	**2357.56**	**2323.48**	**66766.10**	**188039.00**	**242709.00**	**1640.66**	**46461.00**	**1640.66**	**196248.00**
	Total for Major, Medium, Minor & LIS Projects				**6960.44**		**13698.93**	**6110.21**	**7588.72**	**70318.09**	**691609.00**	**887552.00**	**7751.50**	**491786.00**	**7751.50**	**395766.00**

Annexure-22.3 Details of New AA Projects in K-5 sub basin

Status as on 31/3/2014 | Area in Ha | cost in crores

Sr.No.	Name of the Project	Category	District	Taluka	AA		IP	Live Storage Mm3	Status
					cost	year			
1	2	3	4	5	6	7	8	9	10
A)	**Major Projects**								
		Major			0		0	0	
B)	**Medium Projects**								
		Medium			0		0	0	
C)	**Minor Projects**								
		Minor			0		0	0	
D)	**LIS**								
1	Mangalwedha	LIS	Solapur	Mangalwedha	530.04	2014	11820	----	A A Approved.
	Total for LIS				530.04		11820		
	Total Future Projects				**530.04**		**11820**		

22.1.2 Financial status of State Sector Projects in K-5 Sub Basin as on 31/3/2014

Cost in Crores

Sr. No	District	Status	Type	No.	Financial Status			Reference
					Updated Cost	Up To Date Expenditure	Balance cost	
1	**Pune**	completed	Major	4	2345.32	2301.51	43.810	
			Medium	5	229.53	160.30	69.230	
			Minor	284	297.76	256.40	41.358	
			Total	**293**	**2872.61**	**2718.21**	154.398	
		Ongoing	Major	6	5743.10	1812.81	3930.290	
			Medium	2	397.39	169.44	227.950	
			Minor	4	41.29	15.24	26.050	
			LIS	2	1020.62	576.70	443.920	
			Total	**14**	**7202.40**	**2574.19**	4628.210	
		New A A	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			Total	**0**	**0.00**	**0.00**	**0.000**	
	Total for Pune			**307**	**10075.01**	**5292.40**	**4782.608**	

2	**Satara**	completed	Major	1	0.00	0.00	0.000	
			Medium	3	18.48	18.48	0.000	
			Minor	21	18.39	16.85	1.540	
			Total	**25**	**36.87**	**35.33**	**1.540**	
		Ongoing	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			LIS	1	1769.74	816.27	953.470	
			Total	**1**	**1769.74**	**816.27**	953.470	
		New A A	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			Total	**0**	**0.00**	**0.00**	0.000	
	Total for Satara			**26**	**1806.61**	**851.60**	**955.010**	
3	**Sangli**	completed	Major	0	0.00	0.00	0.000	
			Medium	2	41.09	41.09	0.000	
			Minor	36	115.44	81.77	33.670	
			Total	**38**	**156.53**	**122.86**	33.670	
		Ongoing	Major	0	0.00	0.00	0.000	
			Medium	1	8.24	0.18	8.060	
			Minor	2	19.69	14.17	5.520	
			LIS	1	0.00	0.00	0.000	
			Total	**4**	**27.93**	**14.35**	13.580	
		New A A	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	

			Minor	0	0.00	0.00	0.000	
			Total	**0**	**0.00**	**0.00**	0.000	
	Total for Sangli			**42**	**184.46**	**137.21**	**47.250**	
4	**Solapur**	completed	Major	1	332.85	230.20	102.650	
			Medium	8	46.21	38.93	7.280	
			Minor	143	255.89	211.86	44.031	
			Total	**152**	**634.95**	**480.99**	153.961	
		Ongoing	Major	2	2107.38	1307.96	799.420	
			Medium	1	129.61	103.81	25.800	
			Minor	6	108.73	31.77	76.957	
			LIS	7	1784.40	914.15	870.250	
			Total	**16**	**4130.12**	**2357.69**	1772.427	
		New A A	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			LIS	1	530.04	0.00	530.040	
			Total	**1**	**530.04**	**0.00**	530.040	
	Total for Solapur			**169**	**5295.11**	**2838.69**	**2456.428**	
5	**Ahemadnagar**	completed	Major	0	0.00	0.00	0.000	
			Medium	3	112.84	108.66	4.180	
			Minor	77	73.93	56.63	17.300	
			Total	**80**	**186.77**	**165.29**	21.480	
		Ongoing	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	3	7.18	0.10	7.080	

			LIS	0	0.00	0.00	0.000	
			Total	**3**	**7.18**	**0.10**	7.080	
		New A A	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			Total	**0**	**0.00**	**0.00**	0.000	
	Total for Ahemadnagar			**83**	**193.95**	**165.39**	**28.560**	
6	**Osmanabad**	completed	Major	0	0.00	0.00	0.000	
			Medium	6	24.07	23.33	0.740	
			Minor	59	202.09	172.88	29.207	
			Total	**65**	**226.16**	**196.21**	29.947	
		Ongoing	Major	1	455.28	297.17	158.110	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			LIS	1	106.28	50.44	55.840	
			Total	**2**	**561.56**	**347.61**	213.950	
		New A A	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			Total	**0**	**0.00**	**0.00**	0.000	
	Total for Osmanabad			**67**	**787.72**	**543.82**	**243.897**	
7	**Beed**	completed	Major	0	0.00	0.00	0.000	
			Medium	7	5.60	5.60	0.000	
			Minor	39	107.92	107.92	0.000	
			Total	**46**	**113.52**	**113.52**	0.000	

		Ongoing	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	1	0.00	0.00	0.000	
			LIS	1	0.00	0.00	0.000	
			Total	**2**	**0.00**	**0.00**	0.000	
		New A A	Major	0	0.00	0.00	0.000	
			Medium	0	0.00	0.00	0.000	
			Minor	0	0.00	0.00	0.000	
			Total	**0**	**0.00**	**0.00**	0.000	
	Total for Beed			**48**	**113.52**	**113.52**	**0.000**	
			Grand Total	**742**	**18456.38**	**9942.62**	**8513.75**	

22.1.3 Financial status of Local Sector Projects in K-5 Sub Basin as on 31/3/2014

i) Details Of Local Sector Projects (101 to 250 Ha)

Status	Type	No. Of Projects							Total
		Pune	Satara	Sangli	Solapur	Ahemadnagar	Osmanabad	Beed	
completed	Irrigation Tank	27	19	2	22	17	19	2	108
	Storage Tank	0	1	1	0	1	12	1	16
	KT weirs	68	0	1	34	19	248	10	380
	Total	**95**	**20**	**4**	**56**	**37**	**279**	**13**	**504**
Ongoing	Irrigation Tank	9	1	5	26	0	0	0	0
	Storage Tank	0	0	10	0	0	0	0	10
	KT weirs	5	1	4	13	2	5	2	32
	Total	**14**	**2**	**19**	**39**	**2**	**5**	**2**	**83**
Future	Irrigation Tank	0	2	1	7	0	3	1	14
	Storage Tank	0	0	0	0	0	59	0	59
	KT weirs	0	0	0	2	4	22	6	34
	Total	**0**	**2**	**1**	**9**	**4**	**84**	**7**	**107**
	Note :- Local Sector Data Not Available								

ii) Details Of Local Sector Projects (0 to 100 Ha)

	Status	Type	No. Of Projects							Total
			Pune	Satara	Sangli	Solapur	Ahemadnagar	Osmanabad	Beed	
	completed	Irrigation Tank	2	0	535	0	0	0	0	537
		Storage Tank	0	0	261	2431	0	0	0	2692
		KT weirs	25	0	42	719	0	0	0	786
		Total	**27**	**0**	**838**	**3150**	**0**	**0**	**0**	**4015**
	Ongoing	Irrigation Tank	0	0	16	0	0	0	0	16
		Storage Tank	3	0	109	150	0	0	0	262
		KT weirs	4	0	26	12	0	0	0	42
		Total	**7**	**0**	**151**	**162**	**0**	**0**	**0**	**320**
	Future	Irrigation Tank	0	0	6	0	0	0	0	6
		Storage Tank	0	0	31	50	0	0	0	81
		KT weirs	0	0	5	7	0	0	0	12
		Total	**0**	**0**	**42**	**57**	**0**	**0**	**0**	**99**

22.1.1 Summary of financial status on 31/3/2014 :

Table No. 22.1
Financial status Of State Sector Projects

Status as on 31/3/2014 — Cost in Crores

Sr. No	District	Total No. of projects			Total No	Total Updated cost	Expenditure Incurred	Expenditure to be done
		Completed	Ongoing	Future				
1	**Pune**	293	14	0	**307**	10075.01	5292.40	4782.61
2	**Satara**	25	1	0	**26**	1806.61	851.60	955.01
3	**Sangli**	38	4	0	**42**	184.46	137.21	47.25
4	**Solapur**	152	16	1	**169**	5295.11	2838.69	2456.43
5	**Ahemadnagar**	80	3	0	**83**	193.95	165.39	28.56
6	**Osmanabad**	65	2	0	**67**	787.72	543.82	243.90
7	**Beed**	46	2	0	**48**	113.52	113.52	0.00
	Total	**699**	**42**	**1**	**742**	**18456.38**	**9942.62**	**8513.75**

Table No.22.2
Financial status Of Local Sector Projects

Status as on 31/3/2014 Cost in Crores

	District	Total No. of projects			Total No	Total Updated cost	Expenditure Incurred	Expenditure to be done
		Completed	Ongoing	Future				
1	**Pune**	122	21	0	**143**	105.84	61.63	44.21
2	**Satara**	20	2	2	**24**	18.81	17.95	0.86
3	**Sangli**	842	170	43	**1055**	179.61	129.75	49.86
4	**Solapur**	3206	201	66	**3473**	503.86	371.23	132.63
5	**Ahemadnagar**	37	2	4	**43**	19.65	15.68	3.97
6	**Osmanabad**	279	5	84	**368**	132.26	61.48	70.78
7	**Beed**	13	2	7	**22**	13.24	10.30	2.94
	Total	**4519**	**403**	**206**	**5128**	**973.27**	**668.02**	**305.25**

Table No 22.3
Financial status Of K-5 Sub Basin

Status as on 31/3/2014 Cost in Crores

	District	Total No. of projects			Total No	Total Updated cost	Expenditure Incurred	Expenditure to be done
		Completed	Ongoing	Future				
1	Pune	415	35	0	**450**	10180.85	5354.03	4826.82
2	Satara	45	3	2	**50**	1825.42	869.55	955.87
3	Sangli	880	174	43	**1097**	364.07	266.96	97.11
4	Solapur	3358	217	67	**3642**	5798.97	3209.92	2589.06
5	Ahemadnagar	117	5	4	**126**	213.60	181.07	32.53
6	Osmanabad	344	7	84	**435**	919.98	605.30	314.68
7	Beed	59	4	7	**70**	126.76	123.82	2.94
	Total	**5218**	**445**	**207**	**5870**	**19429.65**	**10610.64**	**8819.00**

Table No 22.3
Financial status Of K-5 Sub Basin

Status as on 31/3/2014 Cost in Crores

	District	Total No. of projects			Total No	Total Updated cost	Expenditure Incurred	Expenditure to be done
		Completed	Ongoing	Future				
1	Pune	415	35	0	**450**	10180.85	5354.03	4826.82
2	Satara	45	3	2	**50**	1825.42	869.55	955.87
3	Sangli	880	174	43	**1097**	364.07	266.96	97.11
4	Solapur	3358	217	67	**3642**	5798.97	3209.92	2589.06
5	Ahemadnagar	117	5	4	**126**	213.60	181.07	32.53
6	Osmanabad	344	7	84	**435**	919.98	605.30	314.68
7	Beed	59	4	7	**70**	126.76	123.82	2.94
	Total	**5218**	**445**	**207**	**5870**	**19429.65**	**10610.64**	**8819.00**

22.2.4 Irrigation potenitial status of State Sector Projects in K5Sub Basin

Status as on 31/3/2014

Area in Ha

Sr. No	District	Status	Type	No.	Irrigation potential Status (I P) Design Potential	Potential created	Balance Potential
1	**Pune**	completed	Major	4	94011	94011	0
			Medium	5	23279	23279	0
			Minor	284	122369	119961	2408
			Total	**293**	**239659**	**237251**	**2408**
		Ongoing	Major	6	330106	195786	134320
			Medium	2	13077	1070	12007
			Minor	4	1345	100	1245
			LIS	2	41241	30769	10472
			Total	**14**	**385769**	**227725**	**158044**
		New A A	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	0	0	0	0
			Total	**0**	**0**	**0**	**0**
	Total for Pune			**307**	**625428**	**464976**	**160452**
2	**Satara**	completed	Major	1	102576	102576	0
			Medium	3	7464	7234	230
			Minor	21	5868	5827	41
			Total	**25**	**115908**	**115637**	**271**
		Ongoing	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	0	0	0	0
			LIS	1	51645	0	51645
			Total	**1**	**51645**	**0**	**51645**
			Major	0	0	0	0

		New A A	Medium	0	0	0	0
			Minor	0	0	0	0
			Total	0	**0**	**0**	0
	Total for Satara			**26**	**167553**	**115637**	**51916**
3	**Sangli**	completed	Major	0	0	0	0
			Medium	2	4811	4811	0
			Minor	36	15782	15782	0
			Total	**38**	**20593**	**20593**	**0**
		Ongoing	Major	0	0	0	0
			Medium	1	300	0	300
			Minor	2	1225	880	345
			LIS	1	24330	971	23359
			Total	**4**	**25855**	**1851**	**24004**
		New A A	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	0	0	0	0
			Total	**0**	**0**	**0**	0
	Total for Sangli			**42**	**46448**	**22444**	**24004**
4	**Solapur**	completed	Major	1	32660	32660	0
			Medium	8	30657	30657	0
			Minor	143	98042	57007	41035
			Total	**152**	**161359**	**120324**	**41035**
		Ongoing	Major	2	272679	237375	35304
			Medium	1	3384	1747	1637
			Minor	6	7808	702	7106
			LIS	7	121446	11871	109575
			Total	**16**	**405317**	**251695**	**153622**
		New A A	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	0	0	0	0

			LIS	1	11820	0	11820
			Total	**1**	**11820**	**0**	**11820**
	Total for Solapur			**169**	**578496**	**372019**	**206477**
5	**Ahemadnagar**	completed	Major	0	0	0	0
			Medium	3	16788	16788	0
			Minor	77	27518	9202	18316
			Total	**80**	**44306**	**25990**	**18316**
		Ongoing	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	3	1892	0	1892
			LIS	0	0	**0**	0
			Total	**3**	**1892**	**0**	**1892**
		New A A	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	0	0	0	0
			Total	**0**	**0**	**0**	0
	Total for Ahemadnagar			**83**	**46198**	**25990**	**20208**
6	**Osmanabad**	completed	Major	0	0	0	0
			Medium	6	13701	13701	0
			Minor	59	21886	21886	0
			Total	**65**	**35587**	**35587**	**0**
		Ongoing	Major	1	12585	7665	4920
			Medium	0	0	0	0
			Minor	0	0	0	0
			LIS	1	4047	2850	1197
			Total	**2**	**16632**	**10515**	**6117**
		New A A	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	0	0	0	0

			Total	**0**	**0**	**0**	0
	Total for Osmanabad			**67**	**52219**	**46102**	**6117**
7	**Beed**	completed	Major	0	0	0	0
			Medium	7	9848	9848	0
			Minor	39	13219	13219	0
			Total	**46**	**23067**	**23067**	**0**
		Ongoing	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	1	442	0	442
			LIS	1	0	0	0
			Total	**2**	**442**	**0**	**442**
		New A A	Major	0	0	0	0
			Medium	0	0	0	0
			Minor	0	0	0	0
			Total	**0**	**0**	**0**	0
	Total for Beed			**48**	**23509**	**23067**	**442**
			Grand Total	**742**	**1539851**	**1070235**	**469616**

Table No. 22.4

22.2.1 Irrigation potenitial status of State Sector Projects in K-5 Sub Basin

Status as on 31/3/2014 Area in Ha

	District	Total No. of projects			Total No	Design Potential	Potential created	Balance Potential
		Completed	Ongoing	Future				
1	Pune	293	14	0	**307**	625428	464976	160452
2	Satara	25	1	0	**26**	167553	115637	51916
3	Sangli	38	4	0	**42**	46448	22444	24004
4	Solapur	152	16	1	**169**	578496	372019	206477
5	Ahemadnagar	80	3	0	**83**	46198	25990	20208
6	Osmanabad	65	2	0	**67**	52219	46102	6117
7	Beed	46	2	0	**48**	23509	23067	442
	Total	**699**	**42**	**1**	**742**	**1539851**	**1070235**	**469616**

22.2 Irrigation Potential summary

Table No. 22.5

22.2.2 Irrigation potential status Of Local Sector Projects in K5 sub basin

Status as on 31/3/2014 Area in Ha

Sr. No	District	Total No. of projects			Total No	Design Potential	Potential created	Balance Potential
		Completed	Ongoing	Future				
1	Pune	122	21	0	143	20598	18104	2494
2	Satara	20	2	2	24	4173	3769	404
3	Sangli	842	170	43	1055	25540	24844	696
4	Solapur	3206	201	66	3473	95992	82466	13526
5	Ahemadnagar	37	2	4	43	6897	6127	770
6	Osmanabad	279	5	84	368	19641	12170	7471
7	Beed	13	2	7	22	3695	2520	1175
3								
	Total	**4519**	**403**	**206**	**5128**	**176536**	**150000**	**26536**

Table No 22.6

22.2.3 Irrigation potential status Of K-5 Sub Basin

Status as on 31/3/2014 Area in Ha

Sr.No.	District	Total No. of projects			Total No	Design Potential	Potential created	Balance Potential
		Completed	Ongoing	Future				
1	Pune	415	35	0	**450**	646026	483080	162946
2	Satara	45	3	2	**50**	171726	119406	52320
3	Sangli	880	174	43	**1097**	71988	47288	24700
4	Solapur	3358	217	67	**3642**	674488	454485	220003
5	Ahemadnagar	117	5	4	**126**	53095	32117	20978
6	Osmanabad	344	7	84	**435**	71860	58272	13588
7	Beed	59	4	7	**70**	27204	25587	1617
	Total	**5218**	**445**	**207**	**5870**	**1716387**	**1220235**	**496152**

22.7 Comparison between Financial Investment and Irrigation Potential in K-5 sub Basin

Table No- 22.7

Sr No.	District	Total No. of projects			Total No	Irrigatin Potential			Financial Status		
		Completed	Ongoing	Future		Design Potential	Potential created	Balance Potential	Total Updated cost	Expenditure Incurred	Expenditure to be done
1	**Pune**	293	14	0	307	625428	464976	160452	10075.01	5292.40	4782.61
2	**Satara**	25	1	0	26	167553	115637	51916	1806.61	851.60	955.01
3	**Sangli**	38	4	0	42	46448	22444	24004	184.46	137.21	47.25
4	**Solapur**	152	16	1	169	578496	372019	206477	5295.11	2838.69	2456.43
5	**Ahemadnagar**	80	3	0	83	46198	25990	20208	193.95	165.39	28.56
6	**Osmanabad**	65	2	0	67	52219	46102	6117	787.72	543.82	243.90
7	**Beed**	46	2	0	48	23509	23067	442	113.52	113.52	0.00
	Total	**699**	**42**	**1**	**742**	**1539851**	**1070235**	**469616**	**18456.38**	**9942.62**	**8513.75**

22.8 Cost efficiency:

i)State Sector Projects:

Total potential of state sector projects in K-5 sub basin is 1539851 Ha. Out of which 1070235 ha potential created at the end of March 2014 and expenditure incurred for this is Rs.9942.62 crores. Hence the cost efficiency for created potential of state sector projects in K-5 sub basin is Rs 0.93 lakhs per Ha.

ii) Local Sector Projects:

Total potential of local sector projects in K-5 sub basin is 176536 Ha. Out of which 150000 ha potential created at the end of March 2014 and expenditure incurred for this is Rs 668.02 crores. Hence the cost efficiency for created potential of local sector projects in K-5 sub basin is Rs 0.45 lakhs per Ha.

22.9 Conclusion :

Total Irrigation Potential in K-5 sub basin is 1716387 Ha out of which 1220235 Ha irrigtion potential developed through State sector and local sector projects in K-5 Basin and expenditure incurred for this is Rs.10610.64 Crores. Hence cost efficiency for created irrigation potential in K-5 sub basin is Rs .87 lakhs per Ha. Still 496152 Ha irrigation potential likeley to be achieved in K-5 Basin for which amount of Rs 8819.00 crores is to be invested in future. Per Ha cost for future potential creation in K-5 Basin is Rs 1.78 Lakhs .

22.10 References:

1 Maharashtra Krishna Valley Development Corporation,Pune Prapatra-1

2 Jilha Mahiti Pustika Pune 2014

3 Jilha Mahiti Pustika Satara 2014

4 Jilha Mahiti Pustika Sangli 2014

5 Jilha Mahiti Pustika Solapur 2014

6 Jilha Mahiti Pustika Ahemadnagar 2014

7 Jilha Mahiti Pustika Osmanabad 2014