Face Sheet – Aurangabad WSS

A. PROJECT DATA SUMMARY

No.	Particulars	Unit	Details
1	Name of the District		Aurangabad
2	No. of Taluka	No	9 Towns
3	Rural Population, 2050	No	4,404,898
4	Total Daily water demand (hot season)	m^3/day	780,492
5	No of secondary WSS	No	4
6	No of Intakes	No	2. Exclude in the current tender
7	No of P.S. (raw/potable)	No	2 Raw, / 3 Potable
8	No of WTP's	No	4 (2 new 2 extended)
10	Area (Sq.km)	Sq.km	10,029
11	Total length of BWS pipes,	Km	193
12	Total length of SWS pipes,	Km	490
13	Cost estimate	Cr INR	2026.50
14	Day of tender publishing	date	
15	Type of contract		DB by contractor
16	Duration of Execution	Years	
19	Volumes attached		Volume 1-5

B. PROJECT DESCRIPTION

Within the framework of Mekorot-MDE of Israel and MJP of Maharashtra India, the current PDR report is the 1st PDR of Aurangabad District water supply scheme (named WSS).

This PDR is results of the Water Supply Master Plan WSMP study for all Marathwada, addressing the areas within this region that mostly suffer from rainfall and water shortage. The entire Marathwada region is divided to eight (8) districts in which each one will contain several WSS. For the Aurangabad district four WSS (Water Supply Schemes) are suggested. Jaykawadi Dam is the main water resources for the proposed WSS.

The current PDR for the Aurangabad area as part of stage 7 in the WSMP for Marathwada region is focused on the WSS for Aurangabad district, with 4 sub WSS namely: Silod, Phulambari, Paithan and lower areas of Aurangabad district Gangapur and Vaijapur.

The main bulk water system (BWS) will convey raw water from the Jaykawadi dam through two new intakes to the WTP's that will locate in the region. In total there will be 4 WTP's. From the WTP's water will be deliver by pumping arrays (3 WSS by pumping, 1 by Gravity) to the potable water secondary grid. The biggest of all the WSS in the Aurangabad district is Phulambari WSS. In this WSS there will not be delivery pumping set for the potable water and all supply will be by gravity from the WTP. That become possible as the location of the Phulambari WTP will locates at new site at an elevation of +740/+750 meter above msl, enable gravity supply of the water to toward consumers.

C. HYDRAULIC DESIGN SUMMARY

C1. Main figures of the WSS's covering the Aurangabad water schemes are:

- Gangapur and Vaijapur namely WSS 1
- Phulambari namely WSS 2
- Silod North namely WSS 3
- Paithan namely WSS 4

Table C1: Pipe inventory of the Aurangabad district – from PDR

WSS	WSS Name	BWS, Km	SWS, Km	Remarks
1	Gangapur/Vaijap	31.44	104.34	
2	Phulambari,	94.42	190.61	
3	Silod	73.69	144.91	Includes main BWS from Jaykawadi to +550.
4	Paithan	5.43	37.52	
	Total	**204.98**	**477.38**	**Grand Total 682.36Km**

C2. The Aurangabad WSS will includes @@ P.S as described in the following table:

Table C2: Pumps inventory for 2040 of the Aurangabad district – from PDR

WSS	WSS Name	No of unit	Capacity (Cu.m/hr)	TDH per unit (m)	Remarks
1	Gangapur/Vaijapurr	4+2	1000	86	
2	Phulambari,	5+2	1000	204.23	Raw water
3	Silod	7+2	2100	100	Raw water
		4+2	1250	98	
4	Paithan	4+2	600	68	

C3. The preparation of the BWS +SWS for the Aurangabad region was done adopting hydraulic design criteria as listed in the table here with. Any change in the final drawings will have to follow the design criteria as presented herewith in table:

Table C3: hydraulic Design Criteria for the Aurangabad WSS's.

	Design Criteria	unit	Value	Remarks
1	Materials Dia<1000mm	type	DI	
2	Materials Dia>1000mm	type	MS	
3	CHW for pipes<1500 mm	unitless	140	For DI and MS pipes
4	CHW for pipes>1500 mm	unitless	145	For DI and MS pipes
5	Minimum Dia for BWS	mm	300	
6	Flow velocity range	m/sec	0.25-2.0	
7	Head loss gradient, Max	m/Km	5.0	
8	Number of supply hour	h/day	20	In BWS +SWS
9	MBR Volume requires	Hours	4	Supply hours
10	GSR Volume requires	%	50	Of daily demand
11	ESR Volume requires	%	100	Of daily demand
12	Pumps Redundancy	%	50	In case up to 5 units
13	Pumps Redundancy	%	25	for 8 units and above
14	Pumps detailed design	%	10	Minimum per unit for detailed design
15	VSP pumps installation	No	2	At least two VSP type units in any P.S.
16	P.S. execution horizon	Year	2040	Installation to 2040
17	Sluice valves density	1/Km		Plus, at any junction
18	Valves type Dia<1200	type	Gate	
19	Valves type Dia>1200	type	B. fly	
20	Air Valves density	1/Km	1	Or as required
21	Air valves size	mm	100-200	See table 18 for details
22	Score Valves density	1/Km	5	See table 19 for details
23	Score valves size	mm	150-250	See table 20 for details

MARATHWADA WATER SUPPLY MASTER PLAN

PDR-1 AURANGABAD WSS VER 02

IDENTIFICATION TABLE	
Client/Project owner	Maharashtra Jeevan Pradhikaran (MJP)
Project	Marathwada Water supply Master Plan
Study	PDR-1 Aurangabad WSS VER 02
Date	24/06/2019
File name	PDR-1: Aurangabad Water Supply Scheme WSS
Confidentiality	High
Language	English
Number of pages	52

APPROVAL

Version	Name		Position	Date	Signature	Modifications
1	**Production**	**DS/YG**	Chief Engineer	24.06.2019		
	Check	**YG/RS**	Team Leader	24.06.2019		
	Approval	**YG/DB**	Team Leader	24.06.2019		
2						

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ABSTRACT

The Water Supply Master Plan (WSMP) for the Marathwada region of the state of Maharashtra, India, was awarded to Mekorot Development & Enterprise Ltd. (MDE), a subsidiary of Mekorot, Israel National Water Co., by the Maharashtra Jeevan Pradhikaran (MJP), under the Ministry of Water Supply and Sanitation, Government of Maharashtra. The MDE-MJP contract was signed on February 21, 2018 under the umbrella of the Memorandum of Understanding (MoU) signed between the Government of Israel and the Government of Maharashtra as part of broader Government-to-Government (G2G) collaboration between India and Israel. According to the contract, the Mekorot team is to prepare a comprehensive Water Supply Master Plan, covering all types of water resources and demand categories (potable and urban, livestock and agriculture), in order to help achieve a sustainable long-term water balance and minimise water shortage crises in the region. This will be done by promoting advanced management of the region's water resources and advanced technology for increased efficiency in water use.

The entire study project is divided into 9 stages that are well defined in the technical appendix of the MDE-MJP contract. The proposed structure and phases of the Water Supply Master Plan Project (WSMP) was agreed upon by both the parties and attached as an annexure to the said agreement. The stages of reporting on the WSMP and the sequence of the entire study are summarised hereunder:

1. Study of the current situation.
2. Water resources potential: Rainfall ruff, surface water, groundwater potential.
3. Water demand forecast.
4. Water balance: Supply scenarios (WSMP).
5. Environment assessment: EIA.
6. Economic considerations.
7. Preliminary design report: 10 packages - 8 one per districts and 2 others.
8. Summary of the WSMP: The full WSMAP report.
9. Full completion of all WSMP deliverables.

On meeting held on 24th February 2019 of the Maharashtra Cabinet, Cabinet approves the GRID concept for the WSMP. Furthered more WSMP team proposal for same be divide into 8+2 PDR's was approved by the MJP .The current report – ***Aurangabad Water Supply Scheme (WSS) PDR 01***– is the first PDR (Preliminary Design Report) to be submitted by WSMP team to the MJP, as per the contract between MJP and MDE chapter 7. In total WSMP team will prepare and submitted 10 PDR's. They will cover the entire water supply grid for Marathwada includes 4,450 Km of water pipelines ranging from 2500 mm to 400 mm as well as PS, new or extended current intakes and WTP facilities.

The water supply grid is categorized with BWS pipe (1,100 KM), conveying raw water quality and Secondary water supply lines (some 3,344 Km) distributes water to Taluka wise, majority of them of potable water quality. Where possible, water from the BWS will flow to existing WTP's and suggest their expansion in the future to the required demand. For the stage development of the WTP and P.S it was concluded that:

- WTP's will be developed from initial phase toward demand of 2035.
- PS's will be developed from initial phase toward demand of 2040 (in sense of number of pumping units)

It was agreed that the ***treatment process*** of water to potable standard will be similar to the existing process on WTP's of MJP. The current PDR document is dedicated to the Aurangabad WSS (Water Supply Scheme). The water supply scheme covering the district are of Aurangabad is divided into 4 separate supply schemes (namely WSS1, WSS2, WSS3, and WSS4). The main components of Aurangabad WSS are:

A. Two intake facilities: one for the Ghangapur and Vaijapur local WSS. The second is a major intake from Jaykawadi Dam proposed for water extraction of some 1.0 Million M^3 per day, supplying water through the BWS to Jalna and Parabhani to the east of Marathwada. Intakes structures are excluded in the current tender.
B. 4 main pumping stations in the region: 2 of them for raw water, for delivery of water to north Silod and new Phulambari WTP (a pumps array's in the same PS house). Three PS are for potable water delivery. It has been decided that since the WTP's serves not only local location attached to the facilities, but some location in

remote areas, delivery potable water pump will be attached to the WTP's but in a separate yard.

C. Extension and new WTP's in the districts are detailed in chapter 4.0 of the current report. Some WTP's modules will be demolished as they are two smalls to extent or old (more than 15 years).

Within the Aurangabad districts the BWS pipe segment has a total length of 193 Km and SWS water supply pies with a total length of 490 Km. The materials of the pipelines vary from MS to DI depends on the diameter of the pipes. See section C for hydraulic design summary.

Some of the BWS pipes are trunk lines involving high pressure of operation. For the DI pipes, serve mostly the SWS segment, it was decided to use (K9) pressure grade. For MS pipes all pipes should have pressure grade for 64bar. Hydraulic test for pipes and joints will be done for pressure 1.5 times the design level of pressure in the pipes.

The current PDR includes 4 individual water supply schemes (WSS)

- Gangapur and Vaijapur namely **WSS 1**
- Phulambari namely **WSS 2**
- Silod North namely **WSS 3**
- Paithan namely **WSS 4**

The methodology approach for the secondary distribution network, is fully complied with the Mekorot experience and has no parallel to the common supply regimes in rural Maharashtra: water supply reliability will be 24/7 backup from central water supply schemes rather than local water sources. it is suggested that the potable water from the WTP's will be delivered to long distances with gravity force (priorities) and delivery pumps where required. This will enable:

- To supply water to tertiary grids to all local villages and communities located along the roads.
- Will avoid a situation in which few booster pumps will be required for the long distances from the WTP's centres. Those remote boosters are less reliable and cause higher operation costs and maintenance.

- Avoiding the construction of many small boosters in remote areas.

Only four Pumping stations are included in the current PDR document. They are mainly located at the downstream of the WTP's. It is recommended that all machinery for potable PS location will be development attached to the WTP's where human capacity for maintenance exists. The development of the water pumping capacities should be parallel to the demand in each block along the decades. As mentioned, all PS facilities will be developed for the stage 2040 as stated in the P.S. house line diagram (see volume 5).

The total population of the Aurangabad district for the year 2050 was calculated in report 3 "water demand projection" and estimates to 87,10,600 inhabitants in 2050. Table No 01 shows the districts Population for the decades 2030, 2040 and 2050. Table No 02 summarizes the rural+bovine +urban water demand to the Aurangabad districts,

Table 1. Aurangabad population projection for water demand at 2030,2040,2050

Taluka	2030	2040	2050
Aurangabad	2673984	3496580	4622344
Fulambari	189007	218103	251224
Gangapur	546169	608307	734266
Kannad	445252	551985	630696
Khuldabad	103082	107702	115138
Paithan	479498	566579	677348
Sillod	511322	697846	865474
Soygaon	160176	189768	223824
Vaijapur	415032	519192	590286
Total	**5523522**	**6956062**	**8710600**

Table 2. Aurangabad water demand projection for,2050

wss	WSS Name	Supply m^3/day			Remarks
		2030	2040	2050	
1	Gangapur/Vaijapu	67,955	79,392	100,964	By delivery pump
2	Phulambari,	346,815	405,185	129,714 & 368,024	By Gravity / Pumping
3	Silod	83,936	98,063	124,710	By delivery pump
4	Paithan	38,418	44,884	57,080	By delivery pump
	Total	**537,124**	**627,523**	**780,492**	

The content of the current PDR document includes:

1. General description of the WSS for the Aurangabad districts,
2. Water balance and demand summary for the proposed WSS's
3. The proposed water supply scheme topology and the water supply pattern,
4. Standard and norms for the calculation of hydraulics of the said grids,
5. Full hydraulic calculation using simulation software WATERGEMS for the sizing of the system,
6. WTP's and P.S. stage development as to meet the demand projections
7. Water treatment standards for the WSS and the proposed treatment facilities for the said WSS.
8. Specification for pipe layout, pumping house, hydraulic structures

   Skelton BOQ's of the proposed WSS as described in the MJP-MDE contract technical appendix

ACKNOWLEDGEMENTS

The WSMP team has compiled the "1st PDR of Aurangabad District", with the honourable support of various organisations in Aurangabad and other key institutes in the Marathwada region. Special mention/acknowledgement must necessarily be made of:

- The Office of the Additional Chief Secretary, Water Supply and Sanitation Department, Mantralaya, Mumbai.
- Member Secretary, Maharashtra Jeevan Pradhikaran-Mumbai
- The Office of the Divisional Commissioner, Department of Revenue, Aurangabad.
- The Office of the Executive Director, Godavari Marathwada Irrigation Development Corporation, Aurangabad.
- The Director, Groundwater Surveys and Development Authority, Pune
- The Chief Auditor and Administrator, Water and Irrigation Division, Government of Maharashtra, Aurangabad.
- The Office of the Chief Engineer, Maharashtra Jeevan Pradhikaran (MJP) Region Aurangabad
- The Office of the Chief Engineer, Aurangabad Division, Maharashtra State Electricity Distribution Company Limited.
- The Office of the Chief Engineer, Maharashtra Industrial Development Corporation (MIDC), Aurangabad.
- The Superintending Engineer Maharashtra Jeevan Pradhikaran (MJP) Circle Office, Aurangabad.
- The Office of the Deputy Director, Groundwater Surveys and Development Authority, Aurangabad.
- The Office of the Director, Groundwater Surveys and Development Authority, Pune.
- The Office of the Deputy Director, Department of Agriculture: Latur Division and Aurangabad Division.
- The District Deputy Commissioner Animal Husbandry, Aurangabad
- The Office of the Superintending Engineer, Hydrology Project, Water Resource Department, Government of Maharashtra-Nashik Circle.

- The Office of the Executive Engineer Hydrology Project, Water Resources Department, Government of Maharashtra-Aurangabad Division.
- Avi Malul, Manager of the Steering Committee, Mekorot
- Yaron Geller, Water Resources Expert and Team Leader, Mekorot
- Dr. Diego Berger, Special Scientific Advisor, Mekorot
- Niv Pintow, Chief engineer and deputy team Leader, Mekorot
- Roi Shapira, Groundwater Expert, Mekorot
- Dipen Shah, Chief Engineer
- Saar Mezuman Pesach, Water Supply Engineer, Mekorot
- Sachin Lone, GIS Specialist – Sasha
- Namita Undegaonkar, Hydrologist Engineer - Sasha
- Tom Bimka, Reservoir Engineer, Mekorot
- Swapnill Sardar, head of site coordination activities
- Sasha Infrastructure Pvt Ltd

ABBRIVIATION

ABSL	Above sea level
AW	Available water
BoQ	Bill of quantities
BH	boreholes
BWS	bulk water supply
Capex	capital expenditure
CCA	cultivated command area
DIA/D	diameter
DN	diameter nominal
EIA	environmental impact assessment
G2G	government to government
GCA	gross command area
GIS	geographic information system
GoI	(The) Government of India
GoM	(The) Government of Maharashtra
GW	groundwater
ha	hectare
HTH	high test hypochlorite
HQ	headquarters
ICA	Irrigation command area
LPCD	litre per capita per day
KTW/KT	Kolhapur Type Weir
MI	minor irrigation
MCM	million cubic metre
MDG	(UN) Millennium Development Goals
MDE	Mekorot Development and Enterprise
MIDC	Maharashtra Industrial Development Corporation
MJP	Maharashtra Jeevan Pradhikaran
MoU	memorandum of understanding
NGO	non-governmental organisation

O&M	operations and maintenance
OPEX	operational expenses
OPEX	operational expenditure
PDR	preliminary design report/review
RC	reinforced concrete
SAT	soil aquifer treatment
SPI	standardised precipitation index
ST	storage tank
STP	sewage treatment plant
TOR	terms of reference
UFW	unaccounted for water
UWSS	urban water supply system
WALMI	Water and Land Management Institute (India)
WB	The World Bank
WSMP	Water Supply Master Plan
WSS	water supply and sanitation
WTP	water treatment plant
WWTP	waste water treatment plant

UNIT MEASUREMENTS

km	kilometre
m	metre
mm	millimetre
M^3	cubic metre
Mm^3	million cubic metre
M^3/d	cubic metre per day
M^3/h	cubic metre per hour

1. THE WATER SUPPLY MASTER PLAN (WSMP) FOR MARATHWADA - OVERVIEW

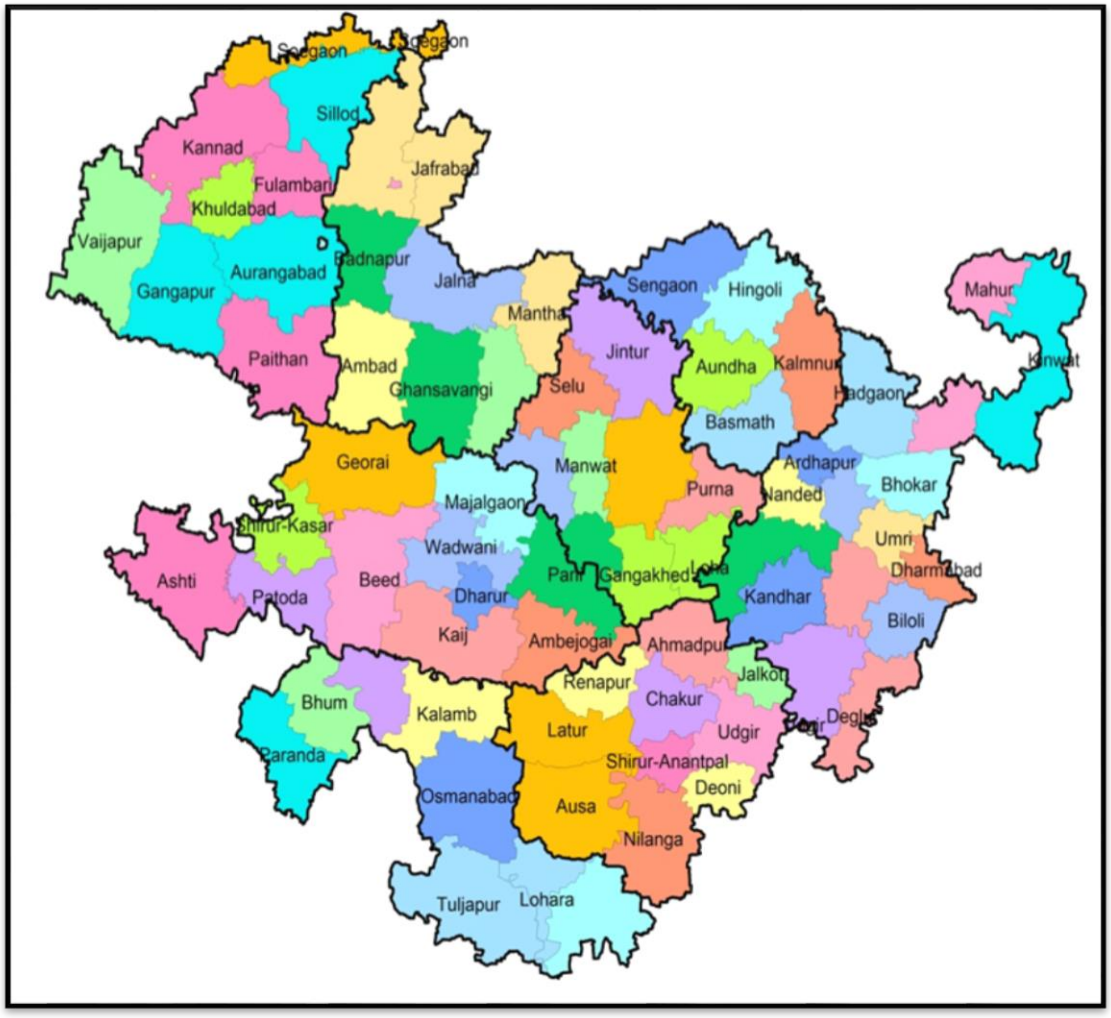
1.1 Objective of Water Supply Master Plan for Marathwada

The Government of Maharashtra has sought Israeli expertise in managing water resources in semi-arid and arid zones of Marathwada to prepare a water supply master plan for the region of Marathwada, which suffers acute rainfall shortage in the last decade. In contractual collaboration with the state-run MJP and Mekorot, Israel's national water company (also MDE – Mekorot Development and Enterprise) as part of the WSMP, Mekorot team will suggest introducing the Israeli approach for sustainable water development in Marathwada region. The main responsibilities Mekorot has been entrusted with are:

- To evaluate the region's surface water (SW) and groundwater (GW) resources and its availability for future propose, in time of climate changes, and their effects on the annual rainfall and water resources availability.
- To present scenarios for the future water balance, priorities water demand to urban sectors over the agriculture sector, and to suggest an allocation system for the one.
- To plot demand projections taking the year 2050 as the planning horizon cut-off with clear categorization of urban, rural industrial and bovine demand.
- To prepare a skeleton topology for the region's bulk water supply (BWS) differentiate between the BWS of raw water quality and SWS water supply schemes of potable quality. Potable water supply lines will be for Taluka wise
- To secure the need of potable water 24/7 and year-round by creating a BWS grid of a loop shape to enable, not only the direct supply to water consumers but shifting water between major and medium dams in order to ensure availability of water even in remote locations.

- To improve water management in the scarcity-prone region and to seek for adopting an allocation system with MJP to ensure the availability for drinking water to Marathwada inhabitants.

Figure 2 presents the jurisdiction and administrative boundaries of the Marathwada region for which the WSMP is mandated. Most of the land area lies within the Godavari river Basin, one of India's largest rivers in the Deccan plateau (The remaining land area lies along the Krishna basin area - the second largest river basin in India). A small portion of the area located within the Tapi basin (to north).



Source: www. Google.com

Figure 1. Marathwada region with sub-districts (by Taluka)

The main water resources are the SW of the Godavari basin and GW originating from natural replenishment in the monsoons: for the evaluation of the water resources, the

term "***AVAILABLE WATER***" was used instead the common term "water potential". AW is a proven methodology in water resources management and not a theoretical one. Using the AW methodology enable the WSMP team ***two major benefits*** for future water resources evaluation:

1. While using AW approach there is no need to evaluate water loss of all types: evaporation, percolation, soil infiltration and so. The use of the direct term available water eliminates the needs to calculate various losses, where coefficients has a high level of uncertainty (100%-300%). The term water availability was applied for both SW and GW.
2. Only using the current methodology enables one to estimates the future effect of the climate change on the water resources: climate change predicts the change in annual rainfall patterns, not on the actual water availability. It is impossible to calculate the change in SW availability and GW availability from this unknown rainfall variations. The use of AW methodology allows the use of the correlation equation related the annual rainfall change and the AW for the region.

Water demand has been calculated both for total consumption (2015) as well as LPCD water for domestic use (using 2011-15 data): 80 lpcd-105 lpcd and demonstrated over a wide range in CO's in the urban areas of Marathwada while it was 40 lpcd-50 lpcd in the Municipal Councils (MC's). Strikingly, the specific consumption for rural inhabitants was less than 30 LPCD. Data regarding such water scarcity in rural Marathwada was also examined by way of scarcity indexes; the first, generated by MJP officers, uses logical variables (0/1) for tanker water supply. In urban areas many residences are drilling and extracting water from private wells, thus the actual consumption is more than the presented calculated. It was agreed that some additional amount of water is under use but there is no way to evaluate it. Further investigation of the local drill water extraction was done in previous stage of the current WSMP study. Yet, in order to make the best in order to avoid this kind of private use of water (in the urban and semi urban sector) WSMP has calculated all specific water demand (LPCD, litre per capita per day) to be supplied from the BWS. For the long run with efficient infrastructure the accessibility for water will increase thus the demand as well.

The foundation for the BWS and the SW of the Marathwada region is the water demand projection as reported by the WSMP team in report 3 and the water resources study as present in report 2. Report 4 of the WSMP team, shows the water balance and the feasible options for the regional water grid. On February 24th, 2019, cabinet of the Maharashtra government decide that the LOOP option for the Marathwada water supply grid is the one to be executed. By this decision the kick-off of the second phase that is the design phase of the WSMP was initiated.

The objective of the WSMP is to promote more sustainable water supply systems and less dependency on irrigation systems. That will be considered in the WSMP for the future development of the bulk water supply. For the urban areas, it may be considered, at least for the big urban centres in the future, that each location be connected to two different independent water sources in order to secure the water supply and increase the reliability of the system.

1.2 Scope of the PDR stage of work.

This is the completion phase of all the PDRs created for the WSMP according to the Indian directives for hydraulic design. The MJP-MDE contract stipulates that 10 independent PDR reports should be completed prior to the completion of the final WSMP report. It was further suggesting the PDRs be submitted in series.

The scope of the PDR stage is well defined in the technical appendix of the contract and are summarized herein:

See the chapter 7 appendix from the MJP-MDE contract

Table 3. scope of the PDR content as in the MJP-MDE contract

7	Primary assignment	Preparation of PDR
	Stage Objective	Preliminary Design Report (PDR) of options selected by MJP.
	Secondary assignment	**Activities**

7.1	Preparation of PDR	Once the WSMP feasible option & scenario agreed by the MJP in a written form, PDR for the selected options and scenarios will be prepared. The PDR should include following details. • Drawing showing layout and arrangement of various structures. • Alignment of pipeline on GIS map. Principle Longitudinal section of pipeline alignment. • Hydraulic design of pipe line and obligatory levels of all the structures. • Pipeline size, length, material and type etc. • Details of material selection. • Engineering description of arrangement and layout, structures. • Design guidelines. • Specifications of the components and items of work. • Bill of Quantities showing measurements at the Level of PDR, (Skeleton BOQ's). • PDR shall include all the necessary information that is mentioned above and any other information which is required to float an EPC tender. • The Accuracy of PDR is to be such an extent that maximum deviation after doing detail survey and design done by the selected agency by EPC tendering will not be more than 10%.

2. TECHNICAL SUMMARY OF THE CURRENT PDR

2.1 The necessity of the current PDR to Aurangabad region

Several meetings held on previous stage of the WSMP identified the areas within the Marathwada region that mostly suffer from water shortage. Analyses included in report No 1 "asses of the current situation" utilizes data received from MJP regional office in Aurangabad, quantifies the shortage in water supply by means of record of water supply by tankers (trucks) to the consumers. Later, investigation of the data it was revealed that not only the data were partial but additional water supply by train cars tanks were made to some locations, making the tanker supply data present only portion of the real situation.

The data analysed with the said water supply enabled the WSMP team to achieve clear understanding that the area north of Aurangabad suffers from severe water availability. The following reasons justify the need to accelerate the need of enhancing water supply to this region:

- High rate Population growth:
- Location at the edge of the Godavari basin:
- Contains only few local water supply schemes:
- Located above the region main water resource the Jaykawadi Dam: (necessitating pumping)
- Location of the rural sector in this district to urban Aurangabad, the biggest city in Marathwada, causes migration of more and more inhabitants to the region, making the stress on water availability in the area even worst.

2.2 Key components of the current WSS (water supply scheme)

The current PDR main components are (summary of chapter 4):

2.2.1 Intakes facilities and water source:

Gangapur and Vaijapur local Intake. It is suggested that the new intakes will be executed in the north shore of the Jaykawadi, near an existing intake of the irrigation department. The reason for this location is benefits of utilize the electrical connection and access road to the site that may be used for the new intake. Obvious new electric transformers will be required and new facilitates for the pump and pipes connections

to the existing ones. The total yield of the intake will be 95,308 m3/day for 2050 and 79,392 m3/day for 2030. This intake is excluded from the current PDR.

The second is a major intake from Jaykawadi Dam proposed for water extraction of some 1.0 Million M^3 per day (at 2050), supplying water through the BWS to Jalna and Parabhani to the east of Marathwada through the BWS. This intake is one of the most sophisticated in the BWS as it will extract immense amount of water. In the horizon year, 2050, it will have to pump more than 10 m3/sec 20/7, with TDH of 150-170 meter. These huge amounts of flows required intensive amount of energy not to talk additional complexity of water hammering, stress, forces etc. all tjhose will be considered in the phase of the Intakes PDR's for MJP. This intake is excluded from the current PDR

2.2.2 Pipe Infrastructure

The total pipe length included in the first PDR is around 685 Km. Out of this some 205 Km of pipe are categorized as BWS and mainly will convey raw water. Among this segment of the system, the biggest pipe of all diameters will be included – this is a segment of 2500 mm in Diameter from the Jaykawadi intake to the splitting of the pipe to Silod and north and west toward Phrabhani. The SWS portion of the system includes some 477.38 Km of potable water pipe. This segment of the pipes contain Diameter range from 2,200 mm MS pipes down to 300 mm DI pipes. The specification for the pipe materials and other pipe related construction are fully detailed in chapter 6 which is the civil engineering specification for this work. See chapter 2.7 for pipe inventory.

2.2.3 Main pumping stations in the region:

There is one raw water deliver pump to north Silod and new Phulambari WTP. This pumping facility has been located attached to the Aurangabad-Jalna main road at an elevation of +550M absl. It is suggested that nearby this PS facility two water tank on ground level with a volume of 22,000 m^3 each will be constructed in order to ensure constant suction head for the pumps. All pumps are designed for 20h/day operation.

- The Silod raw water pump will delivered at the end stage of 2050 some 3,97,988 m3/day

- The Phulanbari raw water pump will delivered at the end stage of 2050 some 129,714 m3/day (Excluding the Aurangabad Urban demand)

Three delivery PS are for potable water at the downstream of the WTP's. It has been decided that since the WTP's serves not only the local location attached to the facilities, but some locations in remote areas, the delivery potable water pump will be attached to the WTP's not in separate yard.

2.2.4 Potable water pumps will be:

Table No 4 shows the total water demand in ach ne of the WSS's of the Aurangabad district as for the design horizon of 2030, 2040 and 2050. For hydraulic purpose all daily supplied considered for 20h/day operation period.

Table 4. Summary of all water demand at the 4 WSS for the period 2030,2040,2050

wss	WSS Name	Supply m^3/day			Remarks
		2030	2040	2050	
1	Gangapur/Vaijapu	67,955	79,392	100,964	By delivery pump
2	Phulambari,	346,815	405,185	129,714 & 368,024	By Gravity / Pumping
3	Silod	83,936	98,063	124,710	By delivery pump
4	Paithan	38,418	44,884	57,080	By delivery pump
	Total	**537,124**	**627,523**	**780,492**	

2.2.5 WTP's:

Extension and new WTP's in the district as detailed in chapter 4.0 of the current report. In general, it was concluded during pre-coordination process that all WTP's will be planned with two milestones of development from the day of commissioning to the horizon year of design:

Stage 1 – from 2020 to the design flow proposed to 2035

Stage 2– from 2035 to the design flow proposed at 2050

That is to say that the current BOQ of the current PDR will cover all the components of the WTP to meet the demand 2035. Beyond it the WTP will have to be extended as per the proposed flow at 2050. See table of WTP development in chapter 4

2.3 The hydraulic level of service and the transmission capacity

Preparation of the WSS for the Aurangabad districts were done using Indian local standards. Main hydraulic norms use for the creation of the PDR stage plan are listed in table 2 herewith:

Table 5. water supply schemes design level

Service Aspect	*Guideline*
Hours of service	Continuous – 24 hours per day
Hours of supply	All BWS and trunk lines are calculated for 20h/day operation
Water quality	Water supplied should comply with Indian standards **IS 10500 – 2012** guidelines for drinking water. Deviations may be made where the standards are difficult to achieve, provided such deviations are not injurious to health and provided consumers are notified of necessary precautions to be taken.
Reliability	To provide service to all consumers 24/7 supply by enhancing water from raw water resources to WTP's and furthered to GSR/ESR tank to enable continuous supply to the end consumer level.
Metering	All production, treatment and consumers should have metered supply.
Pressure	Not less than 15m residual pressure at any point in the grid. Any pressure of above 100mH2O in trunk line must be regulated before delivery to secondary users. Deviation may apply in extreme situations with approval of MJP.
Hydraulics	Gradients for flow less than 5.0m/Km or not more then 2.0-2.2m/sec. Min velocity of water 0.25-0.3 M/sec. Deviation may apply in extreme situations with approval of MJP.
Tertiary WSS	All local water supply schemes, and/or Tertiary wss that will be connected to the SWS, does not appear in the WSMP nor in the PDR.
Pipe pressure grade	K9 for DI pipes, MS pipes to sustain 64Bar pressure.

Hydraulic test grade	Minimum 1.5 times then the nominal, working pressure of the pipe

2.4 The Water Resources for the scheme (quantities)

Jaykawadi Dam is the main water resources for the proposed WSS.

There will be two separate intakes for the WSS's of Aurangabad:

- Major intakes from Jaykawadi Dam with 2050 capacity of 920,000 m3/day. This major intake final location will be done by MJP in coordination with the Irrigation Department.
- Secondary Intake at the north shore of the Jaykawadi water body, located near an existing intake of an irrigation lift scheme. Final location of Aurangabad district WSS will be clarified in consultation with the Irrigation Department.
- No intakes including in the current PDR.

2.5 Water quality consideration of the WSS (requirements standards and facilities)

In order to assure water quality level of the entire potable water system, the Aurangabad WSS suggested the construction of several WTP's or extensions of current ones as listed here in Table 03. Where parameters for the quality of water doesn't appear in the Indian standards, WHO figures should be adopted.

Table 6. The water quality minimum level to be provided by WTP's.

Substance	Unit	Maxi. Acceptable Concentration	Maxi. Allowable Concentration	Treated Water Standard as per IS 10500 - 2012
Total solids		500	1,500	–
Colour		5 units	50 units	5 Max
Turbidity	NTU	5 units	25 units	5 Max
Taste	NA	Unobjectionable	–	–
Odour	NA	Unobjectionable	–	Agreeable
Iron	ppm	0.3	1	0.3 Max

Manganese	ppm	0.1	0.5	–
Copper (Co)	ppm	1	1.5	–
Zinc (Zn)	ppm	5	15	–
Calcium (Cu)	ppm	75	200	–
Magnesium (Mg)	ppm	50	150	–
Sulphate (SO_4)	ppm	200	400	–
Chloride (Cl)	ppm	200	600	250 Max
pH range	Unit	7.0–8.5	6.5–9.2	6.5 - 8.5
Magnesium & sodium sulphate		500	1,000	–
Phenolic substances (as phenol)	ppm	0.001	0.002	–
Carbon chloroform extract (CCE) (from organic pollutants)	ppm	0.2	0.5	–
Alkyl benzyl sulfonate		0.5	1	–
Nitrates	ppm	–	–	45 Max
Residual free Chlorine	ppm	–	–	0.2 Min
Fluoride	ppm	–	–	1 Max
Total hardness		–	–	200 Max

2.6 Description of the WSS's (Topology. Water supply pattern)

For the Aurangabad district four WSS (Water Supply Schemes) are suggested. Three WSS will be deliver water by pumping the potable water from the downstream of the WTP's, while the fourth WSS will be supplied by gravity to consumers. This WSS is for the centre of Aurangabad districts and the largest one in this district. The approach is to lift the raw water to an elevation of the new WTP and from there to gravitate the water from the downstream side of the WTP. That was done in order to avoid multi-location of pumping unit in the hilly area of north Aurangabad.

Unlike other water supply scheme within Marathwada, the Aurangabad districts water supply will be fully relay on pumping raw water from the Jaykawadi Dam. The BWS was designed in a way that for the hot season all consumers (Rural, bovine and urban exclude some major urbans location) will fully supplied from the grid system. Most of the surface area in the region has an elevation above the Jaykawadi water dam thus in general two levels of pumping will be required for this region:

- Pumping raw water – one location from Jaykwadi dam
- Pumping potable water – three different location for three WSS name:

Ghangapur & Vaijapur Scheme, Paithan Scheme, Silod Scheme.

Three main water supply schemes of Aurangabad area cover the central area of the districts will be supplied according to the proposed design by gravity. The main WTP for this scheme will be located east of Phulambari. Raw water will be pimped by two stages to the WTP's at an elevation of roughly +740-+730 meter. From the WTP the water will be delivered to a storage tank (MBR at the downstream of the WTP) and later distributed to the Phulambari area through a big main BWS conduit of 1200 mm in diameter. This scheme of supply will ensure that water distributed in this scheme will done with no need for additional pumps.

2.7 Physical pipe inventory for proposed WSS's (both RW + PW quality)

Table No 04 summarizes the pipe inventory of the 4 WSS's of the Aurangabad districts.

Table 7. Pipe inventory of the Aurangabad district – from PDR

WSS	WSS Name	BWS, Km	SWS, Km	Remarks
1	Gangapur/Vaijapur	31.44	104.32	
2	Phulambari,	94.42	190.61	
3	Silod	73.69	144.91	Includes main BWS FROM Jaykawadi to +550.
4	Paithan	5.43	37.52	
	Total	**204.98**	**477.38**	**Grand Total 682.35Km**

The Phulambari water scheme is the biggest in term of pipe length out of the four water supply schemes. It consist some 94.42 Km of BWS + SWS out of 190.61 Km of all water supply mains in the BWS+SWS as well. See chapter 4 for rest of the WSS's.

3. KEY FEATURES AND DESIGN CRITERIA - AURANGABAD DISTRICTS WSS'S

3.1 Current Preliminary Design Report (PDR) features

The current PDR for the Aurangabad area as part of stage 7 in the WSMP for Marathwada region is focused on the WSS for Aurangabad district, with 4 sub WSS namely: Silod, Phulambari, Paithan and lower areas of Aurangabad district Ghangapur and Vaijapur. Key reason for this area is that during coordination between WSMP team and MJP official it was agreed that the development of the WSMP will be done from west to east to enable the connection of the main water resources of the region – Jaykawadi dam – to eastern areas of water supply.

The content of the current PDR report as mention herewith:

1. General description of the WSS for the Aurangabad districts, areas of supply, talukas covered by the proposed PDR, main roads of the region and geographical description.
2. Water demand summary for the proposed WSS.
3. Water resource for the supply North Aurangabad supply scheme.
4. The proposed WSS topology and the main water supply pattern.
5. Standard and norms for the calculation of hydraulics of the proposed WSS.
6. Full hydraulic calculation using simulation software WATERGEMS for the sizing of the system.
7. Water treatment standards for the WSS and the proposed treatment facilities for the said WSS.
8. Technical Specification for pipelines layout, pumping house, hydraulic structures etc.
9. Skelton BOQ's of the proposed WSS as described in the MJP-MDE contract technical appendix
10. Appendixes

3.2 Hydraulics design criteria's

Transmission mains will be designed to have minimum hydraulic slopes of 0.3% for DN ≤ 400 mm and 0.5% for DN > 200 mm. % is 10m/Km slope.

Flow velocities in transmission mains will be between 0.25 m/s and 2.2 m/s and may be lower in smaller diameter pipes and higher in larger diameter pipes at a range of 10%.

The maximum operating velocity will be 2.2 m/s to ensure safe operation of the pipeline. Deviation from the said criteria's will be possible under the approval of MJP engineers.

Transmission mains will be designed using the Hazen-Williams formula for pipeline head losses. Given that the pipelines will have to perform according to the required ultimate demand for planning years, the following C factors are recommended to be used for this project:

Steel or ductile iron (DI) pipe materials:	C = 140
Diameters bigger than 1,500 mm of any material:	C = 140
Diameters bigger than 2,000 mm of any material:	C = 145

Working pressure will be limited to 66.6% of the test pressure of the pipe. (Pressure test exceed 1.5 times the normal operation pressure of the pipes) The residual pressure will be maintained at a minimum of 15 m, except for sections downstream of break-pressure tanks. Deviation from the said residual pressure will be possible under the approval of MJP engineers.

3.3 Pumps design criteria's

The following list will be a guideline for the detailed planning of pumping units and pumping sets.

- Minimum pump efficiency 80% per each unit.
- At least 20% of the pumps in the pumping array (1 out of 5, 2 out of 10) will be equipped with variable frequency drive

- The manifold will be sized with two diameters larger than the impeller's diameter. Valves and non-return valves one diameter more than pump impellers.
- All pumping stations will be built and equipped with a minimum of a two meter distance between electric motors
- All civil engineering work will be done in a way that it will be possible to accommodate all pumps as for the 2050
- The required capacity of standby pumps will be calculated using the following equation: *% standby capacity > (1 / total no. of duty pumps)*
- It is recommended that pumps and impellers be installed vertically in dry installations (also called surface installation).
- Only in the case of pumping more than 150-160 meter TDH head and electric motors bigger than 850 Kw, it will be allowed to consider two attached pumps in inline configuration. That will allow resize of the electric motor size.
- Surge preventing systems with both surge tanks and surge anticipating valves will be a mandatory in each pump stations of any size and any TDH. Surge analyses will be calculated according to the standards for the said in India including detailed calculation for the size of tanks, size and number of the valves and the filling ration of the tank with pressurized air.
- For detailed design a redundancy of 10% per each umping unit should be applied
- Any additional pump design criteria that may applies from MJP will mandatory.

3.4 Service reservoirs design criteria's

Service storage within a bulk water supply system is generally intended to perform some or all the following functions:

- Compensation for fluctuations in water consumption during the day where water is delivered into the system at a constant rate
- Provision of emergency reserve in case of interruptions due to mechanical and electrical failures, or shutdown of supply main for repair or maintenance.

- Provision of reserve for firefighting.
- Equalization of pressures in the distribution system.
- Stabilization of pumping heads.

The efficiency with which these functions are performed by the service reservoirs is determined by the capacity, location and elevation of the reservoirs. The capacity required to compensate for fluctuations in water consumption is related to the size and pattern of variation of water consumption during the day and to the rate and duration of pumping and size of pumping main, such that this capacity needs to be determined on an individual basis.

However, experience has shown that adequate compensating capacity lies between 15% and 30% of the average daily demand. If there are reliable data on variations in consumption in the project areas, this percentage range will be updated.

Table 8. MBR/GSR/ESR calculated required volume per 1,000 m3/day.

All figures in MLD	Ground elevation	Storage % daily
MBR – master balancing reservoir	Generally, as the elevation of WTP	6 out of 24 hours
GSR – Ground storage reservoir	Up to 20 meter above ground	50%
ESR – Elevated storage reservoir	Up 15 meter above ground	100%

The size of emergency reserve in case of interruptions in supply is determined from a number of factors, including reliability of electric power supply, availability of standby pumping equipment and the speed with which burst pipes and other repair and maintenance works on the supply side can be attended to. The controlling factor in actual situations is the speed with which repairs can be carried out on mechanical and electrical equipment.

For obvious economic reasons, emergency storage will be provided as follows:

- 4 hours per day in cities

- 12 hours per day in townships
- 24 hours per day in small townships and rural communities

Deviation from the said residual pressure will be possible under the approval of MJP engineers.

In order to ensure proper equalization of distribution system pressures and stabilization of pumping heads, to ensure efficient operation of pumping stations, the siting of service reservoirs with respect to location and elevation will be determined with careful consideration for all systems at the stage of detailed final design.

3.5 Other components design criteria

Section valves (symbolized "SV") will be installed for facilitating maintenance of the system:

- Maximum 4 km distance between devices.
- Critical points.
- Valve type as in hydraulics design criteria table.

Air valves (symbolized AV) will be installed:

- Minimum 1.0 km distance between devices.
- High topographical points.
- Severe change and critical points in hydraulic gradient.
- Air Valve sizing as in hydraulics design criteria table.

Washout valves (symbolized "WV") will be installed at low points and sized to ensure drainage of the pipe sections. Valve sizing as in hydraulics design criteria table

Surge protection valves (symbolized "SPV") and cathodic protection equipment will be designed and installed according to detailed analysis by suitable experts.

Bulk water meters will be installed in offtakes of the main water BWS+SWS and the entry to the supply system for each WSS. Since the delivery of water from the bulk water supply system to the potable network grids will be done through the main SWS pipes, it is recommended that a water meter will locates on main SWS, hereby allowing MJP staff to measure outcoming volumes that are extracted toward the tertiary water grids. This will support the MJP in the future with better understanding of the nature of water

losses and will allow the company to track water losses and manage un-controlled demand.

Every PS will include main water meter at the di-suction side of the pum house. See pump line diagram

3.6 Water quality monitoring criteria's

Existing regional water laboratories are sufficient for periodic monitoring of borehole waters but each surface water treatment plant should have its own facility for monitoring the quality of both the raw water and the processed water at different stages of treatment. Well-equipped chemical laboratories will be provided for the large treatment plants and appropriate test kits will be provided for the smaller treatment plants.

The following methods of water treatment are considered to be suitable, used in different combinations as necessary to achieve the desired results:

- Screening or straining
- Roughing or pretreatment filters
- Primary sedimentation
- Chemical coagulation, flocculation and secondary settling
- Filtration either by slow sand or rapid gravity filtration
- Disinfection
- Control of algae
- Taste and odour control
- Softening
- Removal of iron and manganese
- De-fluoridation of water

Minimum treatment will be disinfection for groundwater sources and some form of filtration followed by disinfection for surface water sources. The most feasible option (technically and financially) will be developed for each town/source individually

4. THE AURANGABAD DISTRICT WATER SUPPLY SCHEMES

The scope of the current PDR document is to sum a technical paper regarding the WSS supply to north Aurangabad and the attached area for providing continuous supply of 24/7 and 365 days/year supply.

The area will include 4 WSS blocks name:

1. Gaangapur and Vaijapur WSS 1
2. Phulambari WSS 2
3. Silod and North Aurangabad WSS 3
4. Paithan WSS 4

The current chapter summarizes the water supply to each one of the areas, differentiates between the raw water supply scheme and the layout of the potable water distribution system to enable the conveyance of potable water quality only.

4.1 Gangapur and Vaijapur WSS 1

The current chapter summarizes the water supply scheme for Gangapur and Vaijapur: the scheme starts with a local intake at the northern shore of the Jaykwadi water floods. Gangapur and Vaijapur located both west of the Jaykawadi water body. Thus, water supply to this location by gravity is not possible. More than that, it was considered that to use Jaykawadi current intakes are not relevant as their location is more than 50 Km westward. The intake is not included in the this PDR/

In order to optimize the use of water and to reduce pumping from long distances a new intake is defined, located nearby an existing Intake (existing intake of irrigation department). During the site visit in April 2019 it was found that local intake is under construction in order to maintain water supply to Gangapur and Vaijapur. This intake may serve for scarcity supply and will play no role in the future Intake. The new local intake is dedicated to the Gangapur and Vaijapur and will be developed in stages in order to be extended in parallel to the development on demand. The location of the new intake near an existing one to ensure the use of the current road and other infrastructures like power grid connection.

The location of the intakes requires pre coordination with irrigation department by MJP. This is ongoing process.

Table No 9 shows the pipe inventory of the Gangapur and Vaijapur WSS 1.

Table No 10 shows the pump inventory and configuration for the Gangapur - Vaijapur WSS 1.

Table No 11 shows the WTP inventory and configuration for the Gangapur and Vaijapur WSS 1.

Table 9. Physical inventory of the Gangapur – Vaijapur WSS pipes.

WSS	WSS Name	BWS, Km	SWS, Km	Remarks
1	Gangapur/Vaijapur	31.44	104.34	

Table 10. Physical inventory of the Gangapur – Vaijapur WSS Pump development sequence.

Delivery potable water PS - Ghangapur	Phase 2030		Phase 2040		Phase 2050		Total Units
	Duty	Standby	Duty	Standby	Duty	Standby	
Number of pumps	3	1	4	2	4	2	4 + 2 = 6
Pump Unit capacity (m^3/h)	1,000						
Total Inst. Pump Unit (m^3/h)	3,000	1,000	4,000	2,000	4,000	2,000	
Pump Unit TDH (m)	86						
Power required per unit (kW)	313						
Total installed power (kW)	1252						

Table 11. Physical inventory of the Gangapur – Vaijapur WSS WTP development sequence.

Demand/capacity MLD	Required capacity	Add capacity	Total capacity	Design capacity*
Existing capacity 2018	8.0			
2035 (62.56)	56.0	14MLD, 4 units	64.0	76.8MLD
2050 (76.01)	20.0	10 MLD 2 units Demolish 8 MLD	76.0	91.2MLD

Remark: design capacity is 20% more than the required capacity as for operation of PS/WTP for 20h/day.

4.2 Phulambari WSS 2

The biggest of all water supply schemes in the Aurangabad districts is by no means the Aurangabad scheme. The total length of the BWS+SWS pipe in the scheme is 285 Km, some 41% of the total pipe length in the Aurangabad districts. The pipe segments in this district is divided into two categories:

The raw water pipe segment includes the header from the Jaykwadi water dam to the main BWS vein of the system and with a branch to the proposed pumping station at +550-meter elevation. This main water booster pump will pump raw water toward the new proposed WTP at +740-+750-meter above msl. From the WTP the water will flow to a MBR that will hold the water for the water supply scheme of the centre areas Marathwada. From the MBR the potable water will gravitate to the WSS excluding any additional need for a Booster pumps. At its western edge of the system a connection between the west end of the distribution grid and the edge of the Vaijapur WSS is recommended.

For normal operations the connection between the two WSS will includes valve at NC position. Just in case of water shortage in the Gangapur- Vaijapur WSS, it will be possible to shift water between the two WSS.

Table 12. Physical inventory of the Phulambari WSS pipes.

WSS	WSS Name	BWS, Km	SWS, Km	Remarks
3	Phulambari,	94.42	190.61	

Phulambari potable water supply scheme by gravity. no potable delivery pumps.

Table 13. Physical inventory of the Phulambari WSS WTP development sequence.

Demand/capacity MLD	Required capacity	Add capacity	Total capacity	Design capacity*
Existing capacity 2018	4.5			
2035 (84.495)	84.5.0	42MLD, 2 units Demolish 4.5 MLD	84.0	100.8MLD
2050 (105.875)	22.0	22 MLD 1 units	106.0	127.2MLD

Remark: design capacity is 20% more than the required capacity as for operation of PS/WTP for 20h/day.

4.3 Silod and north Aurangabad WSS 3

The water supply scheme for Silod is the northern supply scheme is proposed for the Aurangabad district. This WSS will be supplied with raw water from two different sources:

The WSS for north Silod will includes several components, allowing the extraction of water from the main source and diverting the water to two pumping stages. Since Silod is about 200Meters above level of Jaykawadi dam, two stages of pumping will be required in order to deliver the water toward the existing Silod WTP. The Silod WTP will require major extension. First stage in from the Intake structure that are not part of the current tender document.

Main source of water for the Silod WSS will be water from Jaykawadi Dam. The raw water will be pumped utilized two stages of pumping:

- From the Jaykawadi intake to the booster site location at +550-meter absl. The water will be delivered to two holding tank with a capacity of 15MLD to be used as a suction head for the boosters.
- From the +550-meter above msl to the WTP site of the Silod at an elevation of +670-meters above msl.

The central booster pump at +550-meter site will pump raw water toward two additional WTP located at same elevations and suppling water to:

- Bhakordan and Jafrabad Taluka both of Jalna District
- Bhadnapur Taluka of Jalna District.

Silod existing WTP: the current extension of the water works, and the future proposed extension will be the foundation for treated level potable water for all north Aurangabad region.

The Khadhapurna Dam local supply scheme commissioned by MJP in 2018 and suppling water to Silod will be utilized as well for this scheme as the second possible source for this region. This scheme is not part of the current PDR.

The latter water supply scheme was commissioned as a scarcity project in order to enhance the supply to the region and ensure basic water needs to the area. The main pipe-line of the water scheme is 800 mm. Yet, projection of the demand for the period of 2050 shows clearly that more water will be required for this area. Thus, it was decided to priorities the water scheme for this region.

Table No 14 shows the pipe inventory of the Silod WSS.

Table No 15 shows the pump inventory and configuration for the Silod WSS.

Table No 16 shows the WTP inventory and configuration for the Silod WSS.

Table 14. Physical inventory of the Silod-north WSS pipes.

WSS	WSS Name	BWS, Km	SWS, Km	Remarks
2	Silod	73.69	144.91	Includes main BWS to 550+

Table 15. Physical inventory of the Silod Raw water WSS Pump development sequence.

For Raw water +550 SITE	Phase 2030		Phase 2040		Phase 2050		Total Units
	Duty	Standby	Duty	Standby	Duty	Standby	
Number of pumps	6	2	7	2	9	3	9 + 3 = 12
Pump Unit capacity (m³/h)	2100						
Total Inst. Pump Units (m³/h)	12,600	4,200	14,700	4,200	18,900	6300	
Pump Unit TDH (m)	100						
Power required per unit (kW)	756						
Total installed power (kW)	5292						

Table 16. Physical inventory of the Silod-potable water WSS Pump development sequence.

For potable water Silod WWTP SITE	Phase 2030		Phase 2040		Phase 2050		Total Units
	Duty	Standby	Duty	Standby	Duty	Standby	
Number of pumps	3	1	4	2	4	2	4 + 2 = 6
Pump Unit capacity (m³/h)	1250						
Total Inst. Pump Unit (m³/h)	3,750	1,250	5000	2,500	5,000	2,500	
Pump Unit TDH (m)	98						
Power required per unit (kW)	445						
Total installed power (kW)	1,780						

Table 17. Physical inventory of the Silod-north WSS WTP development sequence.

Demand/capacity MLD	Required capacity	Add capacity	Total capacity	Design capacity*
Existing capacity 2018	16.75			
2035 (78.84)	63.00	21 MLD, 3 units	79.75	96MLD
2050 (108.812)	38.0	19 MLD 2 units Demolish 8.75 MLD	109.00	130.8MLD

Remark: design capacity is 20% more than the required capacity as for operation of PS/WTP for 20h/day.

4.4 Paithan WSS 4

The smallest WSS of the Aurangabad district is the Paithan. It is required in order to enhance and increase accessibility to water in the areas located north east of the Jaykawadi dam. One intake from the Jaykawadi dam serves today the distribution network of the Paithan area. The water is pumped from a separate intake on the north Jaykawadi shore and delivered through an WTP not far away from the dam. The proposed water scheme includes increasing of the capacity of the existing WTP and adding a branch line type water supply scheme in order to increase the accessibility for water to the residence of the area.

The Paithan water supply scheme will have to meet water demand much more than the current. The reason for this is the intense increase in the population of the area as it is attached to the main hub of the region, namely Aurangabad Corporation. On the other hand, Paithan is close by to the Jaykawadi dam and therefor does not necessitate intensive infrastructures, as other supply schemes in the region. It is suggested that for the stage of 2030 no new intakes will be commissioned to this supply scheme. Major rehabilitation as well as new proposed force main pipe will be commissioned on the foundation of the current intake of the Paithan and the delivery main from the intake to the WTP. WTP will have to be extended (see table for that in this chapter) as well as new potable force main to the consumers areas.

Table No 18 shows the pipe inventory of the Paithan WSS 4.

Table No 19 shows the pump inventory and configuration for the Paithan WSS 4.

Table No 20 shows the WTP inventory and configuration for the Paithan WSS 4.

Table 18. Physical inventory of the Paithan WSS 4 pipes.

WSS	WSS Name	BWS, Km	SWS, Km	Remarks
4	Paithan WSS	5.43	37.52	

Table 19. Physical inventory of the Paithan WSS 4 Pump development sequence.

For potable water Paithan WWTP SITE	Phase 2030		Phase 2040		Phase 2050		Total Units
	Duty	Standby	Duty	Standby	Duty	Standby	
Number of pumps	3	1	4	2	4	2	4 + 2 = 6
Pump Unit capacity (m^3/h)	600						
Total Inst. Pump Unit (m^3/h)	1800	600	2400	1200	2400	1200	
Pump Unit TDH (m)	68						
Power required per unit (kW)	148						
Total installed power (kW)	592						

Table 20. Physical inventory of the Paithan WSS 4 WTP development sequence.

Demand/capacity MLD	Required capacity	Add capacity	Total capacity	Design capacity*
Existing capacity 2018	8.6			
2035 (33.05)	24.00	12 MLD, 2 units	32.6	40MLD
2050 (43.81)	20.0	10 MLD 2 units Demolish 8.6 MLD	44.00	52.8MLD

Remark: design capacity is 20% more than the required capacity as for operation of PS/WTP for 20h/day.

4.5 Other system components

Accessories, fittings and another pipe miscellaneous were designed on a principle of thumb rule and site visit. It is important to note that all thumb rule figures are just for the case of BoQ's where detailed design for execution will be prepared for final counting of all accessories as required.

Table No 21 detailed the density of air valves for water mains. All air valve will be combined type air valve including both static and dynamic.

Table No 22 detailed the density of scour valves for water mains.

Table No 23 detailed the type and density of valves for water mains.

Table No 24 detailed expansion joints density for water mains.

Table 21. Guide for the density of Air valve along main lines – size and density.

Pipe Diameter, mm	Average valve Diameter for air valve	Density
up to 800	100 mm	Per 1 Km or as required subject to MJP approval
800-1200	150 mm	
1200 -2000	200 mm	
>2000	2 X 150 mm	

Table 22. Guide for the location of location of scour valve along main lines – size and density.

Pipe Diameter, mm	Average valve Diameter,	Density not less then
>=800	150 mm	Per 5 Km or as required subject to MJP approval
500 - 800	200 mm	
1500>	250 mm	

Table 23. Guide for the type and density of main valves along lines.

Pipe Diameter, mm	Valve Type	Density not less then
Less than 1200	Sluice valve	1 per 4 Km subject to MJP approval
Bigger than 1200	Butterfly valve	1 per 2.5 Km subject to MJP approval

Note : Valve density along potable main lines excludes valve at "TW junction and tapping points.

Table 24. Guide for the location of expansion joints main lines - size and density.

Pipe Diameter, mm	Type of Pipe	Interval	Pipe OG/UG.
400-800	DI	4KM	under
800-1000	DI	4KM	OG/UG.
1000 - 1200	DI	4KM	OG/UG.
1200 -1500	M.S.	2.5KM	OG/UG.
1500 - 2000	M.S.	2.5KM	OG/UG.
2000 onwards	M.S.	2.5KM	OG/UG.

OG- Over Ground, UG – Under Ground

5. PLANNING COMPONENTS

5.1 Hydraulic simulations of WSS

- **Hydraulic simulation for the purpose pipe Diameters**
  - The principles of establishing and running a successful hydraulic model are the adequate incorporation of two types of data, as follows:
  - **Physical data** of the water network (pipes, elevations, diameters, pipe materials and roughness, etc.) – variables that are not time dependent
  - **Dynamic network data** (water consumption, water supply, condition and state of the water resources, pumps and dynamic attributes of equipment's etc.) – time-dependent variables that may change within short periods, measured in minutes or hours.
  - For the master plan study – which includes the development program for each one of the phases, and in parallel, the range of operational options – the hydraulic simulation tool can answer both, as the software combines both the physical layer of the development as well as the dynamic operations layer.
  - For any hydraulic simulation, the first necessary step is the compilation of the physical data of the existing system, thus creating the models foundation.
  - Combining these two levels, the physical and the dynamic, enables simulations of the flows in the water pipeline systems and residual water pressure readings at the demand centres.
  - Water pressure readings at the demand centres are an essential operational variable of the system. Water delivery utilities are obligated to operate the system within specific directives and parameters. Low water pressure can result in consumer complaints regarding low quality of services, whereas excess pressure may result in pipe bursts and increased leakages.
  - Hence, the main objective of the hydraulic simulation is to compute the water pressures in the various demand centres of the network and in relation to each one or each group, to specify if there is sub-pressure (less than 15 m) or excess pressure (for which pressure-reducing valves may be required).
  - The hydraulic simulation model can be utilized for both design needs as well as for the evaluation of different states of system operations. When design is the main target, the simulation is used in order to identify the parameters of

the hydraulic components. Basic assumptions are drafted with regard to the size and capacity of the components (valves, pumps, etc.) and solutions to the flow system are conducted. This enables the performance of a mathematical appraisal of the components selected and the specifications of different parameters in relation to the supply system in order to achieve optimal results.

- When directing the analysis of the operational aspects of the system, all physical parameters of the system are given and are not open for change. The operational simulation is mostly needed to appraise different alternatives for operation of pumping equipment and/or filling tanks in order to achieve optimal operational efficiency that uses a minimum amount of energy.
- For efficient running of the hydraulic model, the following layers have been prepared:
- Input of topographical data, based on GIS mapping information, elevations and other contours, with elevation resolution of 10 m
- Input of the current water system capacity – current water lines, water components/facilities, water production facilities
- Input of data on other components – sluice valves, pressure valves, etc.
- Verification, based on field staff observations, with regard to the gaps between water systems mapped on the formal maps and the actual situation on the ground
- Input of population data and water demand proposed according to population and demand projections
- Dynamic data:
- Data on water facilities, pumps and boosters
- Apply water demand to the hydraulic model (hydraulic loads

- **Longitude section of the proposed BWS pipelines**

  In order to understand the nature of hydraulics in the region, the TDH of the pumps array and as well as the foundation of the region BWS hydraulics, the PDR report contain full longitude sections (Drawing VOL V) of the BWS section of the pipes. Each longitude sections consists of:

  - Ground elevation section
  - Hydraulic grade line
  - TDH of pumping units

5.2 Preliminary pumping station consideration

- **Hydraulic Criteria for PS**

  The following list presents the design criteria for pumps and boosters for the level of preliminary design report. Given that the pipes will have to perform according to the required ultimate demand for planning years, the following criteria recommended to be used for this project:

  - Minimum pump efficiency 80%
  - The manifold will be sized with one diameter larger than the impeller's diameter.
  - All pumping stations will be built and equipped with a minimum of a two pump array (distance >4 m)
  - The required capacity of standby pumps will be calculated using the following equation: *% standby capacity = (1 / total no. of duty pumps)*
  - It is recommended that pumps and impellers be installed vertically in dry installations (also called surface installation).
  - Number of stands by pump will not be less than 1 Stand by motor per 3 working motors
  - Any other criteria that will be submitted or revised by MJP will be mandate for the creation of final drawings.

Pumping house design criteria:

- Minimum net height of house – 5 meters
- Minimum space between pumping units – 4 meters
- All houses will include staff room, electric room, control room, high voltage room
- Free passage in the building for load/unload heave equipment – 5 meters
- Crane for lifting heavy loads – up to 2 ton .
- Any other criteria that will be submitted or revised by MJP will be mandate for the creation of final drawings.

Electric consideration criteria:

- Electric motor power – units of 350 Kw and 500 KW
- Soft starters for Pumps will be mandatory

- At least two pumps units will be equipped with variable frequency drive
- All grid connection will be high voltage grid
- Each site will include electric transformation unit to low voltage supply
- Electric room will be separate for high and low voltage
- Local SCADA (System Control and Data acquisition) system for each pump array, will be part of the final drawing of the PS.
- Any other criteria that will be submitted or revised by MJP will be mandate for the creation of final drawings.

Miscellaneous:

- All pumping stations will include surge preventing system. Calculation of the required size/No of valve by the contractor.
- All pumping stations will include surge preventing tank. Calculation of the required size/No of valve by the contractor.
- All accessories like air valves (static and kinetics), PRV valve if required, score valves, water meter, manifold accessories, pressure and flow gauges will be part of the final drawing of the PS.
- Water hammer preliminary analyses will be done at the stage of finalizing the pumps array, the TDH as a result of the pumps curve.
- Any other criteria that will be submitted or revised by MJP will be mandate for the creation of final drawings.

5.3 Summary of the BOQ's and cost analyses

- **Total cost evaluation for the Aurangabad District WSS Refer Vol IV**

  The following is summary of the capital expanses is reflected from the detailed BoQ's that were prepared as part of the design level for the PDR's.

  The detailed specifications refer Volume- III

  The detailed BOQ's refer Volume-IV

  The following components of Capex ***does not include*** in the BOQ's and will have to be cover by MJP and exclude in the BOQ's:

  - Intakes
  - Tertiary water supply schemes and/or the connections between the SWS pipelines and the local existing WSS.
  - Electricity grid connections costs;
  - Transformation sub stations costs for transforming high voltage to low one

- **Summary of all capital expanses (CAPEX)**

  The total Capex expanses for the development of the Aurangabad district WSS is summarized in the herein table.

  Table 28 shows the sum of the required expenses by components: Pipes, WTP, Pumps and boosters etc

Table 25. Cost summary of all Capex of the Aurangabad WSS, exclude intakes

No	WSS Name	Total Cost (Cr. INR)
1	Gangapur/Vaijapur	310.08
2	Phulambari,	1000.81
3	Silod	579.34
4	Paithan WSS	89.31
	Total	**1980.00**

Note: Above cost are not includes pump and pumping machinery cost.

5.4 Current PDR additional volumes

Volume 2 – Hydraulic Design

Volume 3 - Specifications

Volume 4 – Bill of Quantities (BOQ)

Volume 5 – Drawings