Executive Summary

Project Background

The State Water Policy of Government of Rajasthan, February 2010, provides for development of its Water resources in a well planned way. All new projects shall be planned based on micro watershed planning basis so as to ensure equity in use of surplus water. It is on this account that the Government of Rajasthan took up study to review and update all River Basin Master Plans for the integrated development and management of all its water resources. In this connection necessary provision of funds were made in EC funded State Partnership Program (SPP) under implementation in Rajasthan State.

The earlier comprehensive study on water planning for different river basins in Rajasthan State was carried out by TAHAL-WAPCOS Consultants during year 1994-1998. This study was considered quite old and had much reduced relevance in today's context. The present study therefore envisages to take-up review and fresh planning of all the water resources of Rajasthan based on updated water resources data and modern techniques now available in this field of study encompassing all necessary provisions made in the new water policy of the State Government.

The purpose of this assignment is to prepare a long term plan and policy for development and management of the water resources of the State of Rajasthan, both surface (internal and external) and ground water, on comprehensive and integrated basis. The period of planning envisaged is 2010-2060.

Scope of Work

1. Data Collection
2. Analysis of Agroclimatic Zone wise hydrology, temperature over a period of 20 years, find all changes in precipitation, no. of rainy days, rainfall intensity, temperature, humidity and the impact on water resources, cropping pattern and productivity and suggest futuristic strategies for water uses, cropping pattern, in view of the changes.
3. Study the basin wise / sub-basin wise water availability (at various dependabilities) both surface and ground water (including interstate share of Rajasthan from Ravi, Beas, Satluj, Chambal, Mahi and Yamuna Water), indicate changes as compared to the earlier TAHAL-WAPCOS Study with reasons for change.
4. Carry out detailed study of the catchment areas of all major, medium and minor irrigation projects, identify the WHSs constructed and the watershed works carried out and mark the same on GIS mapping with requisite hydrological details and assess their impact on water flows to the project, study the transevaporation of these small water bodies and resultant water loss, their impact on ground water recharging and suggest a future policy for construction of such structures in the catchment area.
5. Agroclimatic Zone wise ground water basins studies, delineation of aquifers on microshed basis, marking them on the GIS mapping Panchayat Samiti wise

and Village wise, based on the present exploitation and recharging of aquifers compute the remaining life of the aquifer so that this information could be disseminated Panchayat Samiti & Village wise.

6. Estimate the quantity of Water Pollution (Rivers, Industrial, Municipal etc.) Source wise, District wise and indicate costs of reclamation / treatment and possible uses.
7. Prepare Districtwise and Blockwise plans of supply and demand of water for various uses, crops, strategies to fill gap and estimated costs.
8. Identification of new projects in water surplus basins based on scientific study and survey and based on socio economic viability criteria.
9. Identification of projects for rehabilitation and/ or modernisation for existing major and medium projects based on socio economic viability criteria.
10. Preparation of comprehensive full scale integrated water resources plan for the State as a whole.
11. Imparting training to the staff and officers of SWRPD & WRD on planning and on use of software used in the study.

Integrated State Water Resources Plan

This report on Integrated State Water Resources Plan is the last one in the series of nine Final Reports. The objective of this report is to present a comprehensive full scale integrated plan for the State as a whole as well as to summarize the various aspects covered under other reports of this study on Planning of Water Resources of Rajasthan State and their conclusions and recommendations in form of an Action Plan highlighting responsible agencies for execution of the plans.

Project Related Features of Rajasthan

Rajasthan is the largest state in the Indian Union, with an area of 342,264 km^2. It is located in northwest India between longitudes 69°29’ and 78°17’ East and latitudes 23°30’ and 30°11’ North. The Tropic of Cancer passes through Rajasthan south of Banswara town.

Rajasthan features a variety of landforms, which have resulted from erosional and depositional processes over a long geological time period. Four major physiographic divisions have been identified in the State:

- Aravalli Hill Ranges,
- Eastern Plains,
- The Thar Desert, and
- The South Eastern Plateau.

The topography, rainfall, and geology are the most important factors affecting the extent and orientation of drainage, in Rajasthan in general and within a basin in particular.

The geological sequence of the State is highly varied and complex, showing the co-existence of the most ancient rocks of Pre-Cambrian age and the most recent alluvium, as well as wind-blown sands of Quaternary to Recent age.

A total of 19 hydrogeological units have been identified on the basis of CGWB and RGWD data base. The significant and mapable hydrogeological units are considered to serve the purposes of water resources planning. The hydrogeological units were delineated using water-bearing formation data of CGWB and RGWD. The same have been delineated on micro-watershed, using GIS, and also panchayat samiti-wise (block-wise) and village-wise.

Major 19 Hydrogeological Formations and their Areas in Rajasthan

S. No.	Hydrogeological Units / Hills	Area, Km^2
1	Younger Alluvium	48,070.05
2	Older Alluvium	94,968.09
3	Tertiary Sandstone	24,502.65
4	Deccan Traps (Basalt)	9,580.51
5	Jurassic Sandstone (Lathi, Parihar, Baisakhi, Bhadesar)	15,213.07
6	Vindhyan Sandstone (Nagaur, Jodhpur)	25,675.64
7	Bilara Limestone	9,522.51
8	Bhander Sandstone	13,954.29
9	Limestone (Alwar, Bhander, Upper Cretaceous)	4,853.08
10	Shale	3,906.68
11	Quartzite	5,325.02
12	Slate	367.65
13	Phyllite & Schist	35,728.18
14	Gneisses	1,967.40
15	Jalore Granite	5,612.72
16	Erinpura Granite	5,229.75
17	Rhyolite	5,046.40
18	Ultra Basics	107.72
19	Gneisses(B.G.C.)	21,724.31
20	Hills	10,908.08
	Total	342,263.80

Climate

Average annual rainfall of the state is 604 mm and average annual monsoon rainfall is 531 mm. The state has large variance in the climatic conditions. The distribution of rainfall, both over time and area, is highly uneven and erratic. The extreme hydrological events, floods and droughts, are usual features for the State.

The maximum temperature is highest in (37.4°C) the pre-monsoon season, while it is lowest (25.7°C) in cold weather season. Mean annual maximum temperature in Rajasthan is 33.2°C with a range of 25.7°C - 35.0°C. Minimum temperature attains its Mean highest value (25.1°C) during monsoon season, while it attains its Mean lowest value (9.6°C) in cold weather season. Mean annual Minimum temperature within Rajasthan is 19.1°C with a range of 11.8°C - 21.8°C.

Highest Maximum temperature attains its maximum value during Pre-Monsoon season (44.7°C) while it is lowest during Cold Weather season (34.6°C). Lowest Minimum temperature attains it lowest value during Cold weather (1.2°C) while it is highest during Monsoon season (17.8°C).

The highest mean monthly rainfall occurs in the middle months of July and August, with 198.4 and 164.0 mm respectively in each month, contributing about 67.1% of the annual rainfall, while June and September rainfalls contribute 10.5% and 14.0%, respectively. It is observed that contribution of the other three seasons to annual rainfall is marginal. Winter, pre-monsoon and the post-monsoon seasons contribute 2.2%, 3.4% and 2.8%, respectively.

Evaporation in Rajasthan is highly variable, both in spatial and temporal terms. Annual evaporation ranges from 140 cm to over 300 cm over the State. Values exceeding 300 cm occur over western Rajasthan (observed at the IMD weather station in Jaisalmer), which mainly comprises a desert area. It is generally the highest during May (when it ranges from about 26 cm to 43 cm) over most parts of the State and continues to be high in June too. The minimum usually occurs in December and January, when evaporation ranges from about 4 cm to 12 cm per month.

Relative humidity follows a sinusoidal pattern, decreasing from 54.7% in January to a minimum of 30.5% in April, increasing to a maximum of 72.6% in August, and again decreasing to 48.4% in October.

Trend analysis of different weather parameters have been studied during the past 20 years and impact of change in weather parameters on cropping pattern, productivity and water resources and future strategies in view of change in weather have been presented in detail in Final Report No. 4.1 and summarized in Chapter 3 of this report.

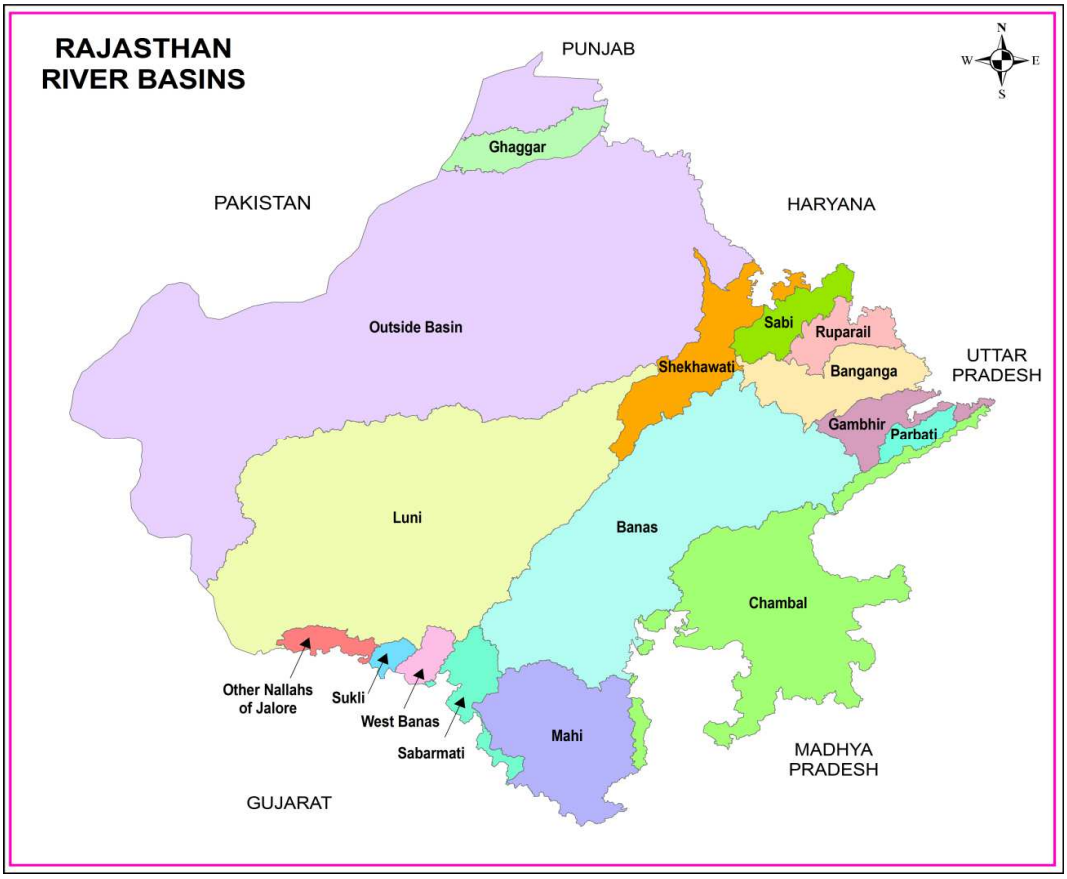
Agroclimatic Zones (ACZs)

There are 10 Agroclimatic Zones in Rajasthan namely: (Ia) Arid Western Plain, (Ib) Irrigated North Western Plain, (Ic) Hyper Arid Irrigated Western Plain Partially, (IIa) Transitional Plain of inland drainage, (IIb) Transitional Plain of Luni Basin, (IIIa) Semi arid Eastern Plain, (IIIb) Flood Prone Eastern Plain, (IVa) Sub humid Southern Plain, (IVb) Humid Southern Plain and (V)Humid South-Eastern Plain.

River Basins

In current study basin, sub-basin and micro-watershed boundaries have been delineated for the entire State using SRTM DEM (Shuttle Radar Topographic Mission, 90 m resolution data). Historically watersheds were delineated manually. This process is labour intensive, slow, tedious, inconsistent and error-prone. DEM-based techniques can efficiently form the basis of a geographic information system designed to address watershed based analysis. Applications to benefit from these techniques include evaporation modelling, tracing drainage paths and hydrologic simulation modelling.

Accordingly, 15 defined river basins and remaining area of Rajasthan has been defined as Outside Basin (designated as basin No.16) have been delineated, which differ in their sizes and potentialities. Within these river basins 58 sub-basins and 541 micro watershed have been delineated for the study purpose.



River Basins of Rajasthan State

S. No.	River Basin	Area, km²	Number of Sub-basins	Number of Micro-watersheds	Remarks
1	Shekhawati	9,750.88	3	25	Originates from Sikar, Jaipur and Ajmer district in Rajasthan, partly drains to northeast (Haryana State), partly southwest to Sambhar Lake
2	Ruparail	4,033.66	1	14	Originates from Alwar district in Rajasthan, drains towards Yamuna River
3	Banganga	8,583.34	1	32	Originates from Jaipur district in Rajasthan, drains towards Yamuna River
4	Gambhir	4,693.52	1	16	Originates from Karauli district in Rajasthan, drains to Yamuna River
5	Parbati	1,887.07	1	20	Originates from Karauli district in Rajasthan, drains to Gambhir River
6	Sabi	4,523.67	1	20	Originates from Sikar and Jaipur district in Rajasthan, drains to northeast (Haryana State)

S. No.	River Basin	Area, km^2	Number of Sub-basins	Number of Micro-watersheds	Remarks
7	Banas	47,060.27	10	71	Originates from Rajsamand district in Rajasthan, drains to Chambal River
8	Chambal	31,242.50	7	67	Originates in Madhya Pradesh, flows through south-east Rajasthan and drains to Yamuna River
9	Mahi	16,610.63	6	59	Flows through southern part of Rajasthan, but originates in Madhya Pradesh and continues to adjacent state (Gujarat)
10	Sabarmati	4,130.12	4	15	Originates from Udaipur district in Rajasthan, drains to southwest (Gujarat State)
11	Luni	69,302.10	12	94	Originates from Nagaur district in Rajasthan, drains to Rann of Kuchh (Gujarat State)
12	West Banas	1,831.34	1	14	Originates from Sirohi district in Rajasthan, drains to southwest (Gujarat State)
13	Sukli	990.44	1	11	Originates from Sirohi district in Rajasthan, drains to southwest (Gujarat State)
14	Other Nallahs of Jalore	1,900.27	1	9	Several streams originating from Jalore and Sirohi district in Rajasthan, some draining to southwest (Gujarat State)
15	Ghaggar	5,201.51	1	2	Originates in Himachal Pradesh, flows through Haryana and Punjab and enters north Rajasthan in Hanumangarh district and drains through Ganganagar district to Pakistan
16	Outside Basin	130,522.48	7	72	Western Rajasthan Thar Desert (not actually a river basin)
Total		**342,263.80**	**58**	**541**	

Population and Various Water Demands

Rajasthan is divided into seven administrative divisions and 33 districts. The districts are further divided into 244 Tehsils and 249 Blocks. More than almost half of all the inhabited villages in the State, numbering 44,672, have fewer than 500 inhabitants each. About 25% of ~69 million population of the State resided in 297 towns in 2011. The methodology adopted for population projections has been considered viable by the consultant as that being adopted by the Statistical Department of Govt. of Rajasthan in population projections. The present and projected population of Rajasthan is shown as follows.

Rajasthan Present and Projected Population, in millions				
Type	2010	2020	2040	2060
Rural	51.50	60.43	75.84	85.18
Urban	17.05	20.71	27.63	32.59
Total	68.55	81.14	103.47	117.77

By pertinent nature, non-agricultural water demand values are reflected in terms of administrative division of the State, i.e. Districts and Blocks. The water demands calculated for various non-agricultural sectors (i.e. Domestic, Institutional, Industrial, Livestock, Wildlife and Power) either on Block level or on specific locations were transferred to Basins / Sub-Basins using GIS overlay techniques.

For assessing domestic water demand, for the year 2010, the Consultants have adopted the norms established by the PHED, as follows, in litres per capita per day (lpcd).

Rural Water Supply

70 lpcd in DDP Blocks of Rajasthan
40 lpcd in non-DDP Blocks

Urban Water Supply

135 lpcd in towns having a population of more than 20,000
100 lpcd in towns having a population of less than 20,000

Revised norms of Water Supply

As per new guidelines of NRDWP issued by MORD, Govt. of India, the norms for future has been taken as below.

(A) Domestic Water Demand of Urban Population

For water demand of major towns having population more than 5.0 lac, a norm of 150 lpcd has been taken, as sewerage system are to be executed along with drinking water supply in these towns.

(B) Domestic Water Demand of Rural Population

To cover maximum habitation through piped water supply schemes, the above norms have been replaced with 100 lpcd in DDP blocks and 70 lpcd in non DDP blocks for planning water demand for rural population due to future needs of conversion of existing drinking water schemes (from present hand pump schemes, pump and tank etc. to Piped Water Supply Schemes in maximum possible habitations).

The domestic water demand is calculated separately for Urban and Rural areas for each Block. Urban water demand is calculated for Towns / Cities and Rural domestic water demand calculated for Blocks. Further, the gross demand was estimated by considering 30 losses in urban areas and 10% losses in rural areas. The relation between Block and Basin / Sub-Basin has been achieved by GIS on area proportional basis; accordingly, the rural gross water demand has been

transferred to Basin / Sub-Basin level. Concerning urban areas (i.e. Town / City), their location in terms of micro watershed has been achieved by GIS, and per case basis of their location in relevant Basin / Sub-Basin, the urban gross water demand has been transferred. The institutional demand has been considered as 5% of gross domestic demand.

On the basis of available data of livestock census for 12 times (1951 to 2007), the trend diagrams for the various main categories of domestic animals, such as cattle, buffalos, sheep, goats, camels, pigs, poultry and remaining others (dogs, horses, donkeys, rabbits etc.) have been plotted and projected for the year 2010, 2020, 2040 and 2060.

According to information from Animal Husbandry Department the daily water consumption by different animals is as follows.

	lpcd
Cows	65
Buffaloes	65
Sheep	6
Goats	5
Horses	60
Asses	60
Camels	65
Pigs	17
Ducks	3
Rabbits	0.3
Elephants	150
Poultry	0.25

On the basis of water demand per capita per day given above, the water demand for different categories of livestock has been worked out District wise and Block wise. The relation between Block and Basin / Sub-Basin has been achieved by GIS on area proportional basis, accordingly, the livestock water demand has been transferred to Basin / Sub-Basin level.

The total number of wild animals as per the 2010 census is 261,233 or 0.26 million. This number is very small in comparison with the livestock which is 56.59 million, plus some other livestock such as dogs, horse, donkeys, poultry, rabbits etc. Thus, the number of wildlife can be taken as about 0.46% of livestock. But water is also needed by other unaccounted wildlife. Therefore, a provision of 1% of livestock water demand is considered by the Consultants as proper for a realistic assessment of water demand for wildlife. Hence, wildlife water requirements are taken as 1% of livestock demand (in each planning stage) for the state as a whole, and this value has been distributed between the blocks in proportion to the forest areas in these blocks for the year 2010. The relation between Block and Basins / Sub-Basins has been achieved by GIS on area proportional basis, accordingly, the wildlife water demand has been transferred to Basins / Sub-Basins level.

The cooling water requirement for power sector has been assessed for specific locations where power plants exist as per data of RVUNL and other reports. The

location of power plants in terms of Basins / Sub-Basins has been achieved by GIS, accordingly, the power station's cooling water demand has been duly transferred on its location in Basins / Sub-Basins.

The Rajasthan State Industrial Development and Investment Corporation (RIICO) have assessed industrial water demand on the basis of industrial area developed. The present industrial water requirements have been estimated at 4.54 m^3 per acre per day (i.e. 11.22 m^3 per ha per day) of industrial area developed. On the basis of norms of RIICO, the industrial water demand for industries in RIICO area scattered in various blocks of Rajasthan has been worked out. Besides it, there are many industries outside the RIICO area at various locations. For the industries outside RIICO area it has been assumed that their requirement would be 20% of the water demand of the RIICO area. Besides it, at some, locations, there are industries having more than 20% industrial area and having more water demand than that of RIICO area. Such information collected from industry department and from WRD reports of 2009, have been incorporated while working out water demand outside RIICO area. The projections have been made for the year 2020, 2040 and 2060. It is anticipated that, due to globalization there would be rapid expansion of industries which will result increase in water demand also. It has been estimated that there would be 25% more water demand in the next decade. Hence while projecting water demand 25% increase per decade has been considered. The future projections of water demand for industries district-wise and block-wise have been worked out. Since, the water requirement for industrial sector has been calculated on specific locations where clusters of industries exist. The location of the industrial units (cluster) in terms of Basins / Sub-Basins has been achieved by GIS, accordingly, the industrial water demand has been transferred by its location in Basins / Sub-Basins.

Adopting the above water requirement norms for various non-agricultural water sectors, the present and projected demand has been estimated and summarized for Rajasthan below.

Planning Stage, Year	Non-Agricultural Water Demands, Mm^3/yr					
	Domestic (including Institutional)	Livestock	Wildlife	Power	Industrial	Total
2010	2,357.64	624.75	20.25	353.59	297.13	3,653.36
2020	3,671.33	663.99	20.64	897.16	376.28	5,629.40
2040	4,762.32	742.41	21.42	1,265.61	587.92	7,379.68
2060	5,477.81	821.62	22.22	1,722.18	918.66	8,962.49

Gross irrigation water demands have been computed by applying the factors of on-farm and off-farm irrigation efficiency to the net irrigation water demand for individual surface-water-irrigated projects CCA and areas outside the CCA of surface-water-irrigated projects in each block / micro-watershed, considering the type of water source. The data related to on-farm and off-farm efficiency for present situation has been taken as per existing condition of projects, while for future improved efficiency figures resulting from implementation of suggested rehabilitation and upgrading measures have been considered.

Water Resources

The State's water resources are categorised in following terms:

- SW: Surface water (stream flows) generated from within Rajasthan boundaries;
- ISW: Imported water delivered to Rajasthan from other states by means of several projects under relevant inter-state agreements;
- GW: Groundwater, in terms of Dynamic and Static availability (fresh as well as saline), while for planning purposes only fresh Dynamic groundwater has been considered for utilization.

The share of Rajasthan in out of State rivers as per various inter-State agreements is shown below.

River	Allocated Share		Date of Agreement	Parties to the Agreement
	Maf/yr	Mm^3/yr		
1. Canal/Feeder Import				
1.1 Ravi-Beas-Sutlej Systems				
Ravi Beas (pre-partition)	1.11	1,369	04.09.1920	British Govt., Nawab of Bhawalpur & Maharaja of Bikaner
Ravi Beas	8.60	10,608	31.12.1981	Haryana, Punjab & Rajasthan
Sutlej	1.41	1,739	13.01.1959	Punjab & Rajasthan
Sub-total	**11.12**	**13,716**		
1.2 Yamuna System	0.91	1,119	12.05.1994	Delhi, Himachal Pradesh, Haryana, Rajasthan & Uttar Pradesh
1.3 Narmada System	0.50	617	07.12.1979	Gujarat, Maharashtra Madhya Pradesh & Rajasthan
Total Canal/Feeder Import	**12.53**	**15,452**		
2. Shared River Basin				
Chambal	1.60	1,973		Madhya Pradesh & Rajasthan
Mahi	0.37	454	10.01.1966	Gujarat & Rajasthan
Total Shared River Basin	**1.97**	**2,427**		
3. River Tail (without formal agreement)				
Ghaggar	0.40	489		Spontaneous flows

In the earlier study by TAHAL-WAPCOS (1994-1998), surface water availability was evaluated with the help of the MRS model, which was developed by the Consultants at that stage. For the present study, the MRS model was replaced by SWAT model for hydrological modelling (Soil and Water Assessment Tool).

The SWAT is a distributed parameter and continuous time simulation model. It has been developed to predict the response of water and sediment yields to natural inputs as well as man-made interventions in un-gauged catchments. The model is (a) physically based, (b) uses readily available inputs, (c) computationally efficient

to operate and, (d) time-continuous and capable of simulating long periods to compute the effects of basin management changes.

Surface water availability within each basin, sub-basin and micro-watershed has been evaluated with the help of the model used for the analysis. Water availability for each basin, sub-basin and micro-watershed has been evaluated at 25%, 50%, 75% and 90% climatic dependability levels.

The methodology of village-wise dynamic groundwater resources assessment is based on application of GIS based analysis and adopting GEC (1997) methodology. The groundwater resources estimation methodology (GEC'97) which utilises water level fluctuation method is used based on concept of storage change due to differences between input and output components, where input refers to recharge from rainfall and other sources and output refer to ground water drainage and abstraction. The total fresh and saline dynamic groundwater resources of the State for year 2010 has been estimated as 10,613.84 and 3,621.99 Mm^3/yr. The Consultant also assessed the present (2010) groundwater draft based on village wise wells data collected from Tehsils, which works out to 15,200.86 Mm^3. Considering the net annual fresh dynamic groundwater availability and groundwater draft, the present (2010) stage of groundwater development has been estimated as 143.22%.

The static groundwater resources have been estimated by applying the following formula:
Static groundwater resources = effective potential zone area of the aquifer × utilizable saturated thickness × specific yield

Average depth of the basement and utilizable saturated thickness of the different hydrogeological formations have been adopted on the basis of the values as reported by the respective field hydrogeologist of the respective areas and used in the static groundwater assessment, year 2008. The static groundwater resources for the year 2010 have been calculated by adopting same criteria as indicated above. The total static ground water resources occurring below the lowest fluctuating levels of ground water as permanent resource are estimated at 32,914.18 Mm^3 for fresh areas and 29,725.51 Mm^3 for saline areas of the State.

The basin/sub-basin/micro-watershed wise values were calculated from village-wise assessed values using GIS, considering villages falling fully or partially (in such cases values were taken on area proportion basis) within the basin/sub-basin/micro-watershed.

The assessed mean annual surface water (including inter-State share of Rajasthan) and ground water availability is shown in following table.

Assessed Mean Annual Surface and Ground Water Availability (including inter-State share of Rajasthan)

S. No.	Basin	Mean Annual Virgin Water Yield within Rajasthan, Mm^3	Imported water to Rajasthan as per inter-State Share, Mm^3				Mean Annual Groundwater Resources, Mm^3			
			Received at Rajasthan Border for Agriculture Use	Conveyance Losses upto Rajasthan Border	Reserved for Non-Agriculture Use	Total	Dynamic		Static	
							Fresh	Saline	Fresh	Saline
1	Shekhawati	562.85				0.00	433.35	22.70	1,196.66	130.77
2	Ruparail	641.38	18.42	0.97		19.39	302.18	49.07	472.79	107.89
3	Banganga	754.83	32.08	1.69		33.77	525.76	147.19	813.57	280.35
4	Gambhir	700.89				0.00	428.21	29.78	478.18	56.82
5	Parbati	427.18				0.00	128.50	0.00	103.69	0.00
6	Sabi	348.09				0.00	429.89	6.93	698.56	13.69
7	Banas	5,097.26				0.00	2,282.73	107.65	1,808.90	90.42
8	Chambal	8,702.14	3,387.00			3,387.00	1,999.54	26.33	953.39	22.09
9	Mahi	3,720.25	699.62			699.62	604.88	0.00	108.82	0.00
10	Sabarmati	732.52				0.00	62.98	10.93	11.81	4.09
11	Luni	2,269.92	562.34	21.83	131.25	715.42	1,493.18	488.99	10,884.72	4,041.33
12	West Banas	222.14				0.00	69.63	4.26	7.44	0.89
13	Sukli	137.61				0.00	51.68	0.00	6.06	0.00
14	Other Nallahs of Jalore	51.42	165.33	6.42		171.75	115.28	0.00	705.82	0.00
15	Ghaggar	19.54	2,587.41 *	693.80	1,267.00	14,205.07	239.44	446.69	484.60	1,120.90
16	Outside Basin	990.60	9,656.86				1,446.61	2,281.47	14,179.17	23,856.27
State Total		**25,378.62**	**17,109.06**	**724.71**	**1,398.25**	**19,232.02**	**10,613.84**	**3,621.99**	**32,914.18**	**29,725.51**

* Including 489.07 Mm^3 of Ghaggar flood water.

Status of Irrigation Projects in Rajasthan

There are 24 major, 84 medium and 3,331 minor irrigation projects having live storage capacity of 6259.94 Mm^3, 2133.53 Mm^3 and 3448.92 Mm^3, respectively in 16 basins of Rajasthan (including Outside basin).

The high pressure on surface water, particularly upstream of existing catchment locations (storage reservoirs) seriously affected their purpose. During the course of this study, the Consultants have carried out detailed study of catchment areas of Major, Medium and Minor Irrigation Projects and studied the impact of WHSs on the project inflows.

It is observed that only 14 Major/Medium projects were found surplus namely Gambhiri of Banas Basin; Abhaypura, Bhimlat, Galwaniya, Gopalpura, Gudha, Harish Chandra Sagar, Jawahar Sagar, Parwan Lift, Parwan Pickup Weir, Parwati Pickup Wei and Ummed Sagar of Chambal Basin; Jakham and Surwania of Mahi Basin. Rest of the projects are classified as deficient as per above mentioned criteria. Within the deficient projects Ramgarh Dam, Kalakh Bund, Mata ji ka Khera, Chandra Bhaga, Phool Sagar Jalia, Girolia, Bisalpura are the ones which are badly affected due to upstream interventions.

Improvement Plans

The financial crunch in the last few decades has however resulted in ever deteriorating condition of most irrigation projects. Poor maintenance and water management have led to increasing water losses and reduction in irrigation system efficiencies as against their design norms.

There are 114 major and medium irrigation projects (considering Bhimlat-Abheypura as one and including canal projects having imported surface water). Out of the 114 Projects, 42 major and medium projects are under rehabilitation under RWSRP and performances of these projects show that they do not require further rehabilitation. For the projects which were commissioned recently, it has been observed that there is no requirement for rehabilitation and modernization due to area is not fully developed or open for irrigation. Therefore, the remaining project for which water is stored in reservoir at regular interval and is being used for irrigation are considered as projects for rehabilitation and studied in detail. Based on the detailed study of selected 35 projects, considering socio economic viability criteria, the Consultants have suggested rehabilitation for 25 Major/Medium Irrigation Projects.

Development Plans

According to surplus water availability assessment carried out on micro watershed level as per State Water policy, various plans/projects to utilize the surplus water were studied by the Consultants, keeping in view the minimum environmental flow requirements as per the norms of MoEF and socio economic viability criteria. Accordingly, new projects have been identified in Parbati basin, Banas basin, Chambal basin, and Mahi basin, keeping in view priority of drinking water requirements in scarcity areas.

Summary of Proposed Projects

S. No.	Project Code	Project Name	Latitude	Longitude	Basin	Sub-basin	Micro-watershed	Type of Project	Gross Capacity, Mm^3	CCA, ha	Estimated Cost, Million Rs.	Remarks
1	PAR-1	Artificial Groundwater Recharge Project	26˚42'04.414"	77˚43'10.501"	Parbati	Parbati	PAR MWS 002	WHS	9.28	-	46.05	15 percolation tanks & 57 cross-stream structures for groundwater recharge
2	BAN-1	Isarda Project	26˚06'35.604"	76˚00'25.020"	Banas	Banas	BAN MWS 002	Major	304.97	-	3,060.00	Drinking Water project
3	CHM-1	Parwan Project	24˚35'45.420"	76˚31'06.960"	Chambal	Kali Sindh	CHM MWS 039	Major	490.00	131,400	22,711.80	Multi-purpose project
4	CHM-2	Kali Sindh	24˚29'52.188"	76˚13'14.268"	Chambal	Kali Sindh	CHM MWS 035	Major	148.00	14,478	14,150.99	Multi-purpose project
5	CHM-3	Indira Lift	26˚00'12.420"	76˚49'08.148"	Chambal	Chambal Downstream	CHM MWS 005	Major	353.85	104,845	5,773.67	Drinking cum Irrigation Project
6	CHM-4	Dhaulpur Lift	26˚39'42.264"	77˚55'52.212"	Chambal	Chambal Downstream	CHM MWS 009	Major	74.70	34,465	1,279.50	Drinking cum Irrigation Project
7	CHM-5	Chambal-Panchna Lift	26˚15'32.159"	77˚14'23.657"	Chambal	Chambal Downstream	CHM MWS 005	Major	28.01	3,135	2,820.00	Inter-basin transfer for Drinking cum Irrigation purpose
8	CHM-6	Chambal to Jaisamand (Alwar) Lift	26˚39'29.638"	77˚54'02.812"	Chambal	Chambal Downstream	CHM MWS 010	Major	107.22	40,950	5,654.20	Inter-basin transfer for Irrigation purpose
9	CHM-7	Manohar Thana	24˚13'06.744"	76˚48'28.944"	Chambal	Kali Sindh	CHM MWS 042	Medium	84.76	14,049	2,471.13	Drinking cum Irrigation Project
10	CHM-8	Rajgarh Project	24˚14'48.000"	75˚53'15.000"	Chambal	Kali Sindh	CHM MWS 023	Medium	58.91	6,827	2,033.82	Drinking cum Irrigation Project
11	CHM-9	Mej to Ramgarh and Isarda Lift Scheme	25˚34'27.844"	76˚07'58.412"	Chambal	Mej	CHM MWS 052	Medium	317.59	60,080	19,829.54	Inter-basin transfer for Drinking cum Irrigation purpose
12	CHM-10	Hatiyadeh	25˚15'56.844"	76˚42'21.204"	Chambal	Parwati	CHM MWS 058	Medium	46.97	6,885	1,646.59	Drinking cum Irrigation Project
13	CHM-11	Andheri	24˚34'36.768"	76˚47'28.716"	Chambal	Parwati	CHM MWS 055	Medium	45.29	7,700	1,358.18	Drinking cum Irrigation Project
14	CHM-12	Pipalda Lift	25˚54'37.728"	76˚38'50.064"	Chambal	Chambal Downstream	CHM MWS 007	Medium	23.26	12,930	919.60	Drinking cum Irrigation Project
15	CHM-13	Bor Band	24˚10'28.992"	76˚31'38.460"	Chambal	Kali Sindh	CHM MWS 029	Minor	0.67	133	26.83	Irrigation project

S. No.	Project Code	Project Name	Latitude	Longitude	Basin	Sub-basin	Micro-watershed	Type of Project	Gross Capacity, Mm^3	CCA, ha	Estimated Cost, Million Rs.	Remarks
16	CHM-14	Guradia	24˚24'38.052"	76˚04'33.312"	Chambal	Kali Sindh	CHM MWS 026	Minor	4.49	1,509	232.67	Irrigation project
17	CHM-15	Rizone	24˚21'30.744"	76˚16'46.308"	Chambal	Kali Sindh	CHM MWS 035	Minor	0.63	129	25.52	Irrigation project
18	CHM-16	Anwa	24˚55'43.212"	76˚06'34.884"	Chambal	Kali Sindh	CHM MWS 033	Minor	0.76	187	35.32	Irrigation project
19	CHM-17	Bherupura	24˚49'34.608"	76˚25'33.780"	Chambal	Kali Sindh	CHM MWS 038	Minor	1.05	150	40.36	Irrigation project
20	CHM-18	Sathoor Mata	25˚26'38.364"	75˚31'06.204"	Chambal	Mej	CHM MWS 053	Minor	0.71	209	44.62	Irrigation project
21	CHM-19	Bada Nayagaon	25˚30'35.244"	75˚30'15.480"	Chambal	Mej	CHM MWS 053	Minor	5.96	606	237.13	Irrigation project
22	CHM-20	Radi	25˚08'42.396"	76˚52'06.636"	Chambal	Parwati	CHM MWS 060	Minor	4.92	901	229.83	Irrigation project
23	CHM-21	Neveli	25˚09'19.368"	77˚07'05.736"	Chambal	Parwati	CHM MWS 059	Minor	3.93	614	159.26	Irrigation project
24	CHM-22	Dohri	26˚09'03.960"	76˚55'38.604"	Chambal	Chambal Downstream	CHM MWS 005	Minor	8.11	1,002	239.70	Irrigation project
25	CHM-23	Gopal Sagar	26˚20'59.568"	77˚13'38.604"	Chambal	Chambal Downstream	CHM MWS 010	Minor	1.39	198	52.26	Irrigation project
26	CHM-24	Ram Sagar	26˚22'58.188"	77˚19'01.308"	Chambal	Chambal Downstream	CHM MWS 010	Minor	1.67	238	62.94	Irrigation project
27	CHM-25	Krishna Sagar	26˚16'14.988"	77˚06'15.156"	Chambal	Chambal Downstream	CHM MWS 005	Minor	7.07	1,012	264.66	Irrigation project
28	MAI-1	Anas to Jaisamand, Rajsamand, Meja & Bisalpur	23˚26'19.277"	74˚02'36.075"	Mahi	Anas	MAI MWS 001	Major	670.00	51,000	36,813.00	Inter-basin transfer for Drinking cum Irrigation purpose
29	MAI-2	Jakham to Jaisamand Dam (Udaipur)	23˚38'10.739"	74˚31'12.543"	Mahi	Mahi	MAI MWS 024	Major	132.00	8,000	730.47	Drinking cum Irrigation Project
30	MAI-3	Handa Khera	24˚01'33.096"	74˚21'53.424"	Mahi	Jakham	MAI MWS 011	Minor	13.97	1,998	527.49	Irrigation project
31	MAI-4	Tidiya Deh	23˚14'11.868"	74˚19'49.188"	Mahi	Anas	MAI MWS 004	Minor	2.70	347	76.55	Irrigation project
32	MAI-5	Moti-Tambi	23˚17'18.000"	74˚09'16.000"	Mahi	Anas	MAI MWS 002	Minor	2.52	232	98.59	Irrigation project
33	MAI-6	Dam at Anas River	23˚20'27.794"	74˚14'00.748"	Mahi	Anas	MAI MWS 002	Medium	63.12	-	1,560.32	Supplement to Mahi command

Water Supply and Demand Balance

According to the document State Water Policy (SWP), February 2010, State Water Resources Planning Department, Rajasthan, Jaipur, water allocation priorities for water resources management and planning purposes, are as follows:

human drinking water
livestock drinking water
other domestic, commercial and municipal water uses
agriculture
power generation
environmental and ecological
industrial
non-consumptive uses, such as cultural, leisure and tourist uses

The SWP also states that any departure from the above priorities will require consideration on a case-by-case basis.

The above water allocation priorities were followed while carrying out water supply and demand balance block-wise and micro watershed wise, which were aggregated to arrive at district level and basin/sub-basin level analysis. The analysis of district level results which presents the current and future unmet demand of the domestic, livestock, wildlife, industrial and power plant uses is presented below. It points out which blocks in each district have shortages along with plans to fill gaps and associated estimated cost.

District-wise Analysis of Supply Coverage of Non-agricultural Demand

S. No.	District	Supply coverage of the non-agricultural demand	Plans to fill gap with estimated cost
1	Ajmer	Although there is no non-agricultural unmet demand at present (year 2010), shortages will appear in the Peesangan block, where the Ajmer town is located, for future planning stages. Other smaller shortages will also occur from planning stage 2040 in Jawaja and Kishangarh blocks. The maximum non-agricultural unmet demand of the district is 60 Mm^3/yr.	It is proposed to transfer 300 Mm^3/yr water from Anas River in Mahi Basin to Berach River in Banas Basin to augment the Bisalpur Dam. The project also includes augmentation of Jaisamand Dam (Udaipur), Rajsamand Dam (Rajsamand) and Meja Dam (Bhilwara). The total estimated cost of the project is Rs. 3681.30 Crores.
2	Alwar	Although there is no non-agricultural unmet demand at present, small shortages appear in the Alwar town starting from planning stage 2040. The maximum non-agricultural unmet demand of the district is 19 Mm^3/yr.	It is proposed to transfer 21.16 Mm^3/yr water from Chambal River to augment the existing Jaisamand Bund (Alwar). The project also includes enroute requirement of Dhaulpur, Bharatpur and Alwar Districts. The total estimated cost of the project is Rs. 565.42 Crores.
3	Banswara	For all planning stages and dependability levels, there is no unmet demand for non-agricultural uses, except for the power plant in the Chhoti Sarvan block for a dependability level of 90% in 2060.	Inter-state agreement with Gujarat should be reviewed for additional utilization of water in Rajasthan from Mahi Bajaj Sagar Dam.
4	Baran	There is no non-agricultural unmet demand	These power plants future demands are to

S. No.	District	Supply coverage of the non-agricultural demand	Plans to fill gap with estimated cost
		except for Kawai and Chhabra power plants in future planning stages.	be met from proposed Parwan Major Irrigation Project. The estimated cost of Parwan Major Irrigation Project is Rs. 2271.10 Crores.
5	Barmer	There is currently a non-agricultural unmet demand in the majority of the blocks. This unmet demand reaches a maximum of about 104 Mm^3/yr for a dependability level of 90% in 2060.	The gaps will be fulfilled after completion of ongoing projects: 1) Barmer Lift Canal Water Supply Project Phase-I for providing drinking water supply to Barmer city, 412 villages of Barmer and 161 villages of Jaisalmer district from Indira Gandhi Main Canal with an estimated cost of Rs. 688.66 Crores, and 2) Pokaran Phalsoond Balotra Lift Water Supply Project for providing drinking water to Pokaran (in Jaisalmer district), Balotra and Siwana towns and 580 villages of Barmer and Jaisalmer districts from Indira Gandhi Main Canal with an estimated cost Rs.1444.20 Crores; and proposed project- Barmer Lift Project Phase-II to provide drinking water to 691 villages of Barmer district with an estimated cost of Rs. 797.75 Crores.
6	Bharatpur	There is no non-agricultural unmet demand, except for wildlife in the Keoladeo National Park.	There is an ongoing project to supply water to Keoladeo National Park from Goverdhan Drain which will fill this gap. The estimated cost of the project is Rs. 56.04 Crores. Also, there is an ongoing project - Chambal Dhaulpur Bharatpur Water Supply Project - to supply water to 945 villages in Bharatpur district and 96 villages in Dhaulpur district apart from urban towns of Dhaulpur (partial), Bharatpur, Kumher, Deeg, Nagar and Kaman. The estimated cost of the project is Rs. 477.99 Crores. This project will further strengthen the water supply scenario in Bharatpur district.
7	Bhilwara	Shortages appear for future planning stages in the Suwana block, where the Bhilwara town is located. In addition, the demand of the planned power plant in Mandalgarh block cannot be satisfied for all dependability levels. Thus, the maximum non-agricultural unmet demand of the district is 65 Mm^3/yr or 35 Mm^3/yr depending if the planned power plant is considered or not.	This gap shall be closed once the Chambal Bhilwara Water Supply Project is completed. The estimated cost of the project is Rs. 727.82 Crores. There is another proposed project aimed at transferring 84.0 Mm^3/yr water from Anas River (Mahi basin) to Meja Dam (Bhilwara). The project also includes augmentation of Jaisamand Dam (Udaipur), Rajsamand Dam (Rajsamand) and Bisalpur Dam (Tonk). The total estimated cost of the project is Rs. 3681.30 Crores. This will further augment the water availability in Bhilwara district.
8	Bikaner	There is no non-agricultural unmet demand.	-
9	Bundi	There is no non-agricultural unmet demand.	-

S. No.	District	Supply coverage of the non-agricultural demand	Plans to fill gap with estimated cost
10	Chittaurgarh	There is no domestic and livestock unmet demand but there are some shortages for the industry and power plant in the Chittaurgarh block.	There are gaps of small amount which can be fulfilled with proper water management.
11	Churu	There is non-agricultural unmet demand in the Sujangarh block, starting from planning stage 2040. For a dependability level of 90% in 2060, it reaches an amount of about 10 Mm^3/yr, out of which 7 Mm^3/yr affect the domestic demand.	A project named Aapni Yojana Phase-II is under consideration to cover 444 villages of Churu district and Jhunjhunu district and 6 towns of Churu district from Sahwa Lift Canal which takes off from Indira Gandhi Main Canal as source with an estimated cost of Rs. 1330.00 Crores. The shortages will be fulfilled after completion of this scheme.
12	Dausa	There is no non-agricultural unmet demand.	-
13	Dhaulpur	There is no non-agricultural unmet demand.	Also, there is an ongoing project - Chambal Dhaulpur Bharatpur Water Supply Project - to supply water to 945 villages in Bharatpur district and 96 villages in Dhaulpur district apart from urban towns of Dhaulpur (partial), Bharatpur, Kumher, Deeg, Nagar and Kaman. The estimated cost of the project is Rs. 477.99 Crores. This project will further strengthen the water supply scenario in Bharatpur district.
14	Dungarpur	There is no non-agricultural unmet demand.	-
15	Ganganagar	There is no non-agricultural unmet demand.	-
16	Hanumangarh	There is no non-agricultural unmet demand.	-
17	Jaipur	The present shortage for Jaipur City will keep increasing to reach a maximum of 240 Mm^3/yr, 370 Mm^3/yr and 450 Mm^3/yr of unmet demand, in 2020, 2040 and 2060 respectively for a dependability level of 90%. At planning stage 2040 and 2060, shortages will even occur for a dependability level of 25% reaching an amount of 35 Mm^3/yr and 120 Mm^3/yr respectively. The maximum total unmet demand for non-agricultural uses in Jaipur district is about 680 Mm^3/yr.	There is a proposed project, Isarda Dam, on Banas River downstream of Bisalpur dam to cater for future water supply to Jaipur city. The proposed gross storage capacity of the dam is 305 Mm^3 and the estimated cost is Rs. 306 Crores. There is another proposed project aimed at transferring of surplus water from Mej River (Chambal basin) near Lakheri in Bundi district to the Ramgarh dam in Jaipur district and Isarda Dam in Tonk district and enroute dams. The proposal envisages pumping of 317.59 Mm^3/yr of flood water from Mej River during the monsoon period into the Ramgarh Dam (28.0 Mm^3/yr), Isarda Dam (173.67 Mm^3/yr) and enroute dams. The estimated cost of project is Rs. 2137.86 Crores. It is also proposed to transfer 300 Mm^3/yr water from Anas River in Mahi Basin to Berach River in Banas Basin to augment the Bisalpur Dam. The project also includes augmentation of Jaisamand Dam (Udaipur), Rajsamand Dam (Rajsamand) and Meja Dam (Bhilwara). The total estimated cost of

S. No.	District	Supply coverage of the non-agricultural demand	Plans to fill gap with estimated cost
			the project is Rs. 3681.30 Crores Hence, to meet the huge demand of Jaipur city in future, the above projects should be implemented on priority.
18	Jaisalmer	There is some non-agricultural unmet demand starting from planning stage 2040, which reaches an amount of about 11 Mm^3/yr for a dependability level of 90% in 2060 and which is mainly located in the Sankra block.	The gaps will be fulfilled after completion of ongoing projects: 1) Barmer Lift Canal Water Supply Project Phase-I for providing drinking water supply to Barmer city, 412 villages of Barmer and 161 villages of Jaisalmer district from Indira Gandhi Main Canal with an estimated cost of Rs. 688.66 Crores, and 2) Pokaran Phalsoond Balotra Lift Water Supply Project for providing drinking water to Pokaran (in Jaisalmer district), Balotra and Siwana towns and 580 villages of Barmer and Jaisalmer districts from Indira Gandhi Main Canal with an estimated cost Rs.1444.20 Crores.
19	Jalore	There is no non-agricultural unmet demand.	-
20	Jhalawar	There is no non-agricultural unmet demand, except for the Kalisindh power plant, which is only a planned power plant and can be met after completion of Kalisindh project.	Completion of Kalisindh project with an estimated cost of Rs. 1415.10 Crores
21	Jhunjhunu	There are no domestic shortages for any dependability level and planning stage but unmet demand appear in the industrial sector of Khetri and Jhunjhunun blocks for planning stage 2040 and 2060. The maximum non-agricultural unmet demand of the district is 20 Mm^3/yr.	A project named Aapni Yojana Phase-II is under consideration to cover 444 villages of Churu district and Jhunjhunu district and 6 towns of Churu district from Sahwa Lift Canal which takes off from Indira Gandhi Main Canal as source with an estimated cost of Rs. 1330.00 Crores. With this scheme and proper water management, additional water will be available for industrial sector.
22	Jodhpur	There is no non-agricultural unmet demand.	-
23	Karauli	There is no non-agricultural unmet demand.	There is an ongoing project to cover 926 villages and four towns of Sawai Madhopur and Karauli district with an estimated cost of Rs. 468.18 Crores. This will further strengthen the drinking water supply scenario in Karauli district.
24	Kota	There is no non-agricultural unmet demand.	-
25	Nagaur	There is no non-agricultural unmet demand.	There as an ongoing project - Nagaur Lift Water Supply Project for 5 towns and 502 villages of Nagaur district. The estimated cost of project is Rs. 761.00 Crores.
26	Pali	There is some non-agricultural unmet demand, mainly located in the Pali block but also in the Rohat block. The maximum non-agricultural unmet demand of the district reaches an amount of about 35 Mm^3/yr for a dependability level of 90% in 2060, out of which 25 Mm^3/yr for domestic use.	There is an ongoing project to save water losses in open canal from Jawai dam to provide safe drinking water to additional 531 villages and 10 towns of Pali district by converting the existing canal system into pipeline from Jawai dam with an estimated cost of Rs. 634.79 Crores. Thus the

S. No.	District	Supply coverage of the non-agricultural demand	Plans to fill gap with estimated cost
			shortages can be fulfilled by conservation of water being lost in open canal flow through seepage, evaporation and pilferage.
27	Pratapgarh	There is no non-agricultural unmet demand.	-
28	Rajsamand	There are small shortages, located in Bhim, Railmagra and Rajsamand blocks. For planning stage 2020, small shortages of less than 3 Mm^3 appear in the industrial sector and then there is also an unmet demand as regards domestic and livestock uses. The maximum non-agricultural unmet demand of the district is 28 Mm^3/yr, out of which ~ 5 Mm^3/yr for domestic use.	There is a proposed project aimed at transferring 98.5 Mm^3/yr water from Anas River (Mahi basin) to Rajsamand Dam (Rajsamand). The project also includes augmentation of Jaisamand Dam (Udaipur), Meja Dam (Bhilwara) and Bisalpur Dam (Tonk). The total estimated cost of the project is Rs. 3681.30 Crores. This will further augment the water availability in Rajsamand district.
29	Sawai Madhopur	There is no major problem of shortages.	There is an ongoing project to cover 926 villages and four towns of Sawai Madhopur and Karauli district with an estimated cost of Rs. 468.18 Crores. This will further strengthen the drinking water supply scenario in Sawai Madhopur district.
30	Sikar	There are shortages in the Piprali block, where the Sikar town is located, for planning stage 2040 and 2060. The maximum non-agricultural unmet demand of the district is 28 Mm^3/yr.	There is a proposal, Fatehpur-Laxmangarh Project, to provide safe drinking water to the 3 towns (Fatehpur, Laxmangarh and Ramgarh) and 286 villages of Sikar district with IGNP as source. The estimated cost of the project is Rs. 832.00 Crores. To solve the shortage problem of Piprali block this proposal should include supply to Sikar town and villages of Piprali block also.
31	Sirohi	There is no non-agricultural unmet demand.	-
32	Tonk	There is no non-agricultural unmet demand.	-
33	Udaipur	There are shortages, mainly in the Girwa block, where the Udaipur City is located. The demand is entirely met only for a dependability level of 25% and 50% at present and for a dependability level of 25% in planning stage 2020. The maximum total unmet demand for non-agricultural uses in Udaipur district is 115 Mm^3/yr, out of which about 50 Mm^3/yr of domestic unmet demand in Udaipur City.	There is an ongoing project Dewas Stage-II which consists of construction of two dams (total storage capacity 10.97 Mm^3) near Akodra and Madri villages of Jhadol and Girwa tehsils, respectively of Udaipur district to augment drinking water supply to Udaipur city. The estimated cost of the project is Rs. 379.19 Crores. The Dewas Stage-III is proposed near village Nathiyathal, under this a dam of 13.08 Mm^3 and a 11.05 km long tunnel is to be constructed. Near village Ambawa is proposed the last and fourth Stage of the project in which a dam with a capacity of 15.26 Mm^3 and a tunnel 4.30 km long will be built. The estimated cost of the project is Rs. 568.15 Crores. Also a proposed project aimed at transferring 140.05 Mm^3/yr water from Anas River (Mahi basin) to Jaisamand Dam (Udaipur). The project also includes

S. No.	District	Supply coverage of the non-agricultural demand	Plans to fill gap with estimated cost
			augmentation of Rajsamand Dam (Rajsamand), Meja Dam (Bhilwara) and Bisalpur Dam (Tonk). The total estimated cost of the project is Rs. 3681.30 Crores. This will further augment the water availability in Udaipur district. There is another proposed project to transfer 131.93 Mm^3/yr water from Jakham Dam to Jaisamand Dam (Udaipur), which will further strengthen the water supply scenario in Udaipur district. The total estimated cost of project is Rs. 85.82 Crores.

Conclusion and Recommendations

During the course of Study on Planning of Water Resources of Rajasthan State the Consultant has prepared and submitted following Reports on various aspects of the Study:

One Inception Report
Seven Preliminary Reports
Eight Draft Final Reports
Nine Final Reports (including this report)
One Report on Training

The various aspects covered under Nine Final Reports depicted by its title are as follows:

Final Report No.	Title
4.1	Agroclimatic Zone-wise Hydrology and Weather
4.2	Basin / Sub- basin-wise Surface and Groundwater Availability
4.3	Detailed Study on Catchment Areas
4.4	Groundwater Study by Agroclimatic Zones
4.5	Water Pollution
4.6	Water Supply and Demand by Districts
4.7	Identification of New Projects in Water Surplus Basins
4.8	Identification of Projects to be Rehabilitated
4.9	Integrated State Water Resources Plan

Each Final Report (4.1 to 4.8) has been prepared in detailed manner with supporting data and includes specific Conclusions and Recommendations related to the subject matter covered in them. Further, each report includes an Action Plan based on Recommendations: enlisting Recommendations, Proposed Actions, Anticipated Value Addition and Responsible Department for taking action.

A combined Action Plan based on all such recommendations including associated estimated cost is presented as follows:

Action Plan based on Recommendations

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
A.	**Hydro-meteorological Aspects**		
1	Installation of new Rain - Gauge stations	It is proposed to install 103 nos. new Rain Gauge stations, and upgrade/rehabilitate 13 nos. existing Rain Gauge stations. Out of 103 nos. new Rain Gauge stations (8+21) 29 nos. are self-recording and 74 nos. are Non-self recoding. 13 nos. existing Rain Gauge stations are also self-recording, which are proposed for upgradation or rehabilitation.	16.14
2	Installation of new Dam Observation Stations	It is proposed to install water level recorders at 83 dams and canals, covering 12 river basins. On dams two types of water level recorder (WLR), i.e. Shaft Encoder type and Bubbler type WLRs are proposed. At each location Automatic Weather Station (AWS) is also proposed.	87.18
3	Installation of new River Gauge & Discharge (G&D) sites	It is proposed to install 53 (19 + 34) new River Gauge & Discharge (G&D) sites in various basins/sub-basins. Out of the 34 new sites proposed, 21 sites can be taken up on first priority, than another 10 sites on second priority and remaining 3 sites on third priority.	28.49
4	Improvement in existing River Gauge & Discharge (G&D) sites	Considering the present status of existing River Gauge & Discharge sites, various actions are proposed to improve the existing condition of site like update the cross-section data, replacement of instruments, etc.	3.27
5	Suitability of new G&D site location	The tentative locations of new G&D sites have been given, however, following points may be kept in mind before selecting the location: • The cross section of the stream needs to be fixed and known. When the system is installed e.g. under a bridge (having fixed concrete side walls), it is easy to calculate the cross section for different water levels. Therefore installation near or on/under such a fixed structure (bridge, lock, etc.) has great advantages. • The section of the river/stream where measurements are to take place should be preferably straight approximately 50 m before the measuring point (this to make the flow as uniform as possible). • There should be no major boulders or large objects upstream of measurement location (same reason as above). • There should be no aquatic growth at the measurement location. • The stream should not overflow its banks for any water level. • The stream section should not be too wide because for a very wide section we could only measure the highest flows. The river cross-section at gauging site should be stable. • Protected site; when the location where the system is protected against theft or damage (by people or	-

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
		animals) this is preferred.	
6	Data measurement and storage	The following is proposed for proper data management and storage: • River cross-sections details where G&D site is installed should be measured and updated atleast once in 5 years. This will reduce the error in measuring the stream flow to a large extent. • Discharge rating curve should be generated/updated for all gauging sites to assess the volume of water passed through a particular site. • All defunct and faulty instruments may be either replaced or upgraded. • Measurements may be taken at regular interval and stored in standardized digital data formats. This data be digitized, quality checked and stored in electronic form at a central place. • If an existing gauge site has unstable cross-section it may be shifted to nearby location with stable cross-section.	-
Sub-Total			**135.08**
B. Existing Major and Medium Projects			
1	Monitoring of Project catchments	• The WHS should only be constructed in catchments of existing projects where the yield is surplus, that too after considering its effect on downstream dam. • The encroachments on river beds should be checked. • Any sort of development in the catchment should be monitored and checked such as illegal groundwater extraction, change in cropping intensity, number of additional WHS constructed, etc.	-
2	Proper recording of Reservoir operation data	• Reservoir operation data like date of release of water, its quantity etc should be monitored and data should be securitized and stored electronically for easy access and use. • Volume of water spilled should be properly measured. • There should be a mechanism to accurately measure inflow to the dams by proper water accounting or by installing a discharge site. A standardized format should be developed to keep record of all water balance components (inflow, releases, spills, evaporation etc.) at reservoir as it is monitored and stored in projects like Jakham Dam, Kota Barrage, Jawahar Sagar Dam etc. • Evaporation at each reservoir site should be measured by installing Evaporation pan. • Gauge-Capacity curve for the reservoir should be updated.	-
Sub-Total			**-**

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
C.	**Groundwater**		
1	Monitor groundwater levels, groundwater quality and groundwater development in the State	• Observe the groundwater levels and groundwater quality on regular basis (4 times in a year) with groundwater monitoring network and study their trend. • The assessment to monitor the ground water development and use is done at an interval of 4 years. It would be desirable if assessments are also made regularly on annual basis also for controlled use of annually available groundwater.	-
2	Improve the database of specific yield for the benefit of refining estimates of dynamic groundwater recharge	Execute a field survey for conducting pumping tests on wells in each district. Also to conduct pumping tests on every new piezometer being installed.	-
3	Examine additional methods for evaluating groundwater recharge	Chloride mass balance and Chlorine-36 isotope methods for estimating long-term average rates of deep percolation may be experimented as alternative method. A two year study to test applicability of two methods at two different sites may be desirable. Such methods are ideal for arid and desert areas.	
4	Improvement of Groundwater monitoring network	• Additional 2745 monitoring wells should be installed and the existing 1351 duplicate ones or very close ones should be closed based on the recommendations of the optimization study of groundwater monitoring network in the report. • Out of the existing 3518 dug wells considered under optimization study, 827 are proposed to be excluded from groundwater monitoring network, hence there is a need to replace the remaining 2691 dug well monitoring stations with piezometers. • As per the water table decline trend, 128, 124 and 44 piezometers are likely to go dry in 2020, 2040 and 2060, which shall need replacement in future.	823.50 807.30
5	Monitor the presence of pesticides in the groundwater in areas of intensive agriculture/command areas activity, especially in locations faced with problems of high nitrate levels	• Undertake well planned/designed studies towards assessment of non-point source contamination of alluvial aquifer systems to begin with in areas where increasing trends of nitrate levels are observed. Setting up key monitoring wells exclusively for monitoring and surveillance of pesticides in groundwater, as well as monitoring the increasing trends of nitrates and fluoride level in groundwater of various aquifers. • Design specific studies to determine the effects of land uses on groundwater quality. Suggested sites can include: (a) Urban storm water disposal and the other (b) Over cultivation areas associated with application of fertilizers and pesticides.	-
6	Conduct new exploratory drilling	• Exploratory drilling in the recommended areas/locations • Exploratory drilling of deep aquifers	48.50

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
		• Pumping test should be made mandatory for every newly drilled well in the State	
7	Outflow of groundwater resources	Conservation / exploitation of groundwater flowing to adjoining country.	-
8	Restructuring and capacity building of Groundwater Department	• Conduct study on restructuring and capacity building of Groundwater Department, involving institutional capacity building, infrastructure capacity building and professional capacity building. • Creation of GIS Cell • Creation of Recharge Cell • Creation of Legal Cell	-
9	Better understanding, higher awareness and sustainable development of the groundwater resources by the farmers	Develop outreach and translate the dynamics of groundwater to farmers, group of farmers & WUAs to create understanding, awareness and sustainable development of the groundwater resources.	-
10	Adopt on-farm water management (OFWM) practices	State should make use of Resource Conservation Technologies such as laser land leveling, ditch and furrow methods of irrigation using tensiometer for affecting crop-water use, on-farm pond development including crop-diversification through micro-irrigation based system particularly in over-exploited and critical blocks with a view to developing water use efficiencies.	-
11	Control on illegal drilling of wells and control on groundwater exploitation	• Registration of rigs to control illegal drilling of wells. • To frame a Groundwater Act to control the exploitation of groundwater.	-
12	Data upgradation	Creation of an online system of various groundwater data entry at district level linked with the GIS Cell for an upgraded and updated data bank.	-
13	Improve, detailed and frequent monitoring of stressed aquifer systems	• Set-up key observation-wells in stressed aquifers where stage of ground water abstraction is much higher than dynamic annual groundwater availability. • Installation of 1197 digital automatic water level recorder as well as water quality monitoring system in a phased manner to enable obtaining continuous & real- time record of levels and water quality. • At least 5 key wells need to be installed on each of the 19 mapped major aquifer units in the state, to begin with.	179.55
14	Promote Resource Conservation and Managed Aquifer Recharging measures towards improving water availability	• The proposed Recharge Cell under RGWD as one of its wing to discharge intended recharging work/ operation on continuing basis. • Designating ground water conservation areas (GCAs) in over- stressed aquifers where area-specific and design specific recharging measures be employed keeping in view the climatic- geomorphological and topographic set-up • Percolation ponds with recharge shafts	-

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
		• Recharging ephemeral stream bed areas through construction of cascading barriers and check dams • Promoting and upscaling farmers dug well recharge programme as well as arresting run-off at Aravalli Ridge-toe areas through specially dug lengthy stretches of trenches back-filled with boulders & gravels • Recharge shafts and roof top rain water harvesting measures to augment local ground water in Urban and Institutional areas. • Managed Aquifer Recharge programme may take benefit and develop convergence with Revised Master Plan for Recharging Ground Water (2013) prepared by CGWB, in which the areas feasible for recharge and types of structures to be constructed are given for consideration and implementation by State Government of Rajasthan	
15	Reduction of groundwater demand in over-exploited areas	Use of modern irrigation practices and technologies (pressurized irrigation) to reduce groundwater extraction for which subsidies are provided by GoR and irrigation during hours of low potential evaporation.	-
16	Use of Fresh Static resources as contingency measures only	• Static resource (fresh) should not be mined but used only as contingency measures to be pressed into service and use only during drought periods • It is suggested if some groundwater sanctuary High Production wells could be constructed as regimes for supply in periods of distress & dire scarcity to serve as "Groundwater Sanctuary Parks"	-
17	Improve Quality of water supply to villages having non-potable water and link them to surface water schemes	A time based priority program to provide safe-drinking water based on principles of scientific source locations and well construction in convergence with Ministry of Drinking Water and Supply, Government of India, shall help improve the health and hygiene status of people inhabiting such areas.	-
18	Utilization of saline groundwater	• Drinking water stations for livestock should be raised based on tube well water supply from marginally saline groundwater resource areas. • Desalination and appropriate use of brackish water can be considered with donor assistance under bilateral corporation programme • Conduct experiments for developing use of brackish/saline groundwater for raising salt-tolerant crops where huge quantities of saline groundwater resides in shallow and deep aquifer systems	-
19	Execute a programme on Repair, Renovation and Restoration of all village ponds & tanks	To be taken up on a time-bound programme which may have convergence with MNREGA and RKVY Scheme of Ministry of Agriculture, Government of India including desilting of ponds and or constructing recharge shafts around such ponds particularly at intake points to help recharge groundwater locally.	-
20	Utilization of urban storm water	Arresting of Urban run-off and its use for horticulture, other non-drinking water uses and groundwater recharge is proposed based on "Modular Rain Water Tank Technology" which can capture huge quantity of Urban-run-off/ highway- run-off.	-
Sub-Total			**1,858.85**

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
D. Water Pollution			
1	Reduce Domestic Pollution in Urban and Rural areas	Urban • Establishment of sewage collection and treatment facilities in all the Class-I cities and Class-II towns, and subsequently in the lower category of the towns in the State, with adequate resources available for effective O&M • New Residential Developments to have their own fully functional sewage treatment systems and recycling and reuse systems • Building byelaws to be amended and made mandatory for new townships, flat schemes, colonies for opting dual piping system for flushing from treated wastewater • Watering of parks and gardens should be done by treated sewage water and surplus, if any, to be used for irrigation • Development of guidelines and regulation for septage management Rural • Sanitation in rural areas to prevent pollution of small waterbodies, Tubewell, Handpumps, etc.	14,010.0 (for 2010) + 4,870.00 (additional for 2020) + 7,810.00 (additional for 2040) + 5,480.00 (additional for 2060)
2	Reduce Industrial Pollution	• Establishment of Effluent collection and treatment facilities in all large and medium industries and CETPs for clusters of small scale industries in the State, with adequate resources available for effective O&M Large Scale Industries • Concept of '0' outflow should be strictly followed • Treatment of effluent should be mandatory • Recycling of treated effluent Small Scale Industries • All the small scale industries in clusters to be shifted to identified industrial areas • All the small scale industries in residential areas to be shifted to identified industrial areas • All such industries should be connected to Common Effluent Treatment Plants	-
3	Reduce Pollution from Non-point Sources	• Establishment of adequate and effective toilets for urban / rural poor • Establishment of effective garbage collection, transport, treatment and disposal facilities in all the	-

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
		Class-I cities and Class-II towns, and subsequently in the lower category of the towns in the State, with adequate resources available for effective O&M • Effective biomedical wastes and hazardous waste collection and disposal • Reduce agriculture pollution from Fertilizers/ Pesticides • Promotion of Organic Farming	
4	Ensure Clean Water in the rivers and their Tributaries	• Establish a network of water quality monitoring • Establish online monitoring on important rivers	-
5	Ensure environmental flows in the rivers, their tributaries and lakes/wetlands	Water resources augmentation in the different rivers and lakes/wetlands including various measures of water conservation in agriculture, domestic and industrial use, rainwater harvesting, reuse of wastewater	-
6	Ensure ecological integrity of the rivers, their tributaries and lakes/wetlands	Establish a sound scientific network of ecological assessment of rivers and lakes/wetlands health in the State including structural and functional components of ecosystem	-
7	Monitoring of Water Pollution and functioning of various treatment systems	• Regular monitoring of compliance of norms • Vigilance monitoring of compliance of norms	-
Sub-Total			**32,170.00**
E. Improvement Plans			
1	Rehabilitation of 25 Major / Medium Irrigation Projects listed below: Arwar, Bassi, Bilas, Chandrabhaga, Chandsain, Dheel, Dindoli, Dugari, Galwania, Jaisamand (Udaipur), Jakham, Kalisil, Khari, Kothari, Lassadia, Madhosagar, Mahi Bajaj Sagar, Mataji Ka Khera, Meja, Murlia, Rajsamand, Sardar Samand, Ummed Sagar, Vallabhnagar, Wagan	Preparation of Detailed Project Reports for Rehabilitation of the listed 25 Major / Medium projects on priority.	2,867.39
2	Improvement in Reservoir operation database and measurement of evaporation losses.	Regular records of storages, water drawls for irrigation, crop grown in command areas, evaporation, seepage losses and spillage should be kept. In all the projects losses through evaporation should be measured regularly.	-
3	Reservoirs should be resurveyed to assure	The elevation-area-capacity curves of reservoirs are not updated and may give wrong information on	-

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
	latest area-capacity at various levels in order to consider the impact of siltation in reservoirs.	water availability, hence the reservoirs for Major / Medium dams should be resurveyed through latest techniques (like sonar survey) and the updated elevation-area-capacity curves / tables should be prepared and in future should be updated periodically.	
4	Formation of Water Users Associations.	WUAs (Water Users Associations) should be formed in all projects and encouraged to be actively involved in water allocation and distribution as well as proper outlets should be designed in order to ensure equity in respect of head, middle and tail reaches.	-
5	Promotion of Night irrigation to reduce field losses through evaporation	Night irrigation should be promoted to assure saving on operational loses below the outlets and improve upon field efficiency.	-
6	Lining of field channels	Lining of field channels through WUAs. If conversion to pressurized irrigation is opted then lining of field channels is not required.	-
7	Conjunctive use of water	Conjunctive use of water especially in command areas where water logging is observed and likely to occur. Also pressurized irrigation should be promoted in such areas.	-
8	Adoption of modern irrigation techniques	Looking at the scarcity of water and reduced inflows to dams, it is recommended to adopt modern irrigation techniques i.e. conversion from flood irrigation to pressurized irrigation in existing as well as new projects and also in groundwater irrigated areas to control over-exploitation. For surface water irrigated areas, conversion from flood irrigation to pressurized irrigation will result in increase in irrigated area. However, the areas irrigated by groundwater should not be increased, so that it will reduce the groundwater pumping and will stabilize the ground water levels in long term. GoR is also promoting pressurized irrigation and providing subsidy for it. A combined subsidy of 50% is provided by the Central and State Governments (Central: 40%, State: 10%) for sprinkler and drip irrigation systems. The Government of Rajasthan has taken an initiative to provide 20% additional subsidy for drip irrigation system.	-
Sub-Total			**2,867.39**
F. Development Plans			
1	Implementation of proposed projects.	• Preparation of Detailed Project Reports (DPR) of the 33 proposed projects. The proposed projects include Major/ Medium/ Minor storage projects, inter-basin transfer projects and artificial recharge projects. Also, most of the proposed projects consider component of drinking water demand of nearby town and villages. • Implementation of these proposed projects after approval of respective DPRs.	125,212.60
2	Catchment Treatment to reduce	The life span of a reservoir is greatly reduced due to erosion in the catchment area. Adequate preventive	-

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
	sedimentation of reservoirs and increase inflows	measures are thus needed for the treatment of catchment of reservoirs for its stabilization against future erosion including proper cross-drainage etc.	
3	Watershed Development	Integrated use, regulation and development of water and land resources of each watershed with emphasis on soil and water conservation.	-
4	Holistic approach in water resources planning and management	At present, there is no holistic approach and each department of Rajasthan is working without taking into account concern of other relevant department on various water related issues. There should be one department for planning i.e. SWRPD. Restructuring of SWRPD and RGWD is a must to meet the future challenges, which is necessary to implement state water policy action plan, community participation, proper data collection, enforcing legal issues, etc.	-
Sub-Total			**125,212.60**
G. Specific Plans/Projects to Fill Gaps (Some projects common with Development Plans)			
1	Supplement inflow to Bisalpur Dam	Study various options of supplementing inflow to Bisalpur Dam from Mahi and Chambal rivers, preparation of Detailed Project Reports and Implementation of selected option.	-
2	Supplement inflow to Jaisamand Dam (Alwar)	Study various options of supplementing inflow to Jaisamand Dam (Alwar) from Chambal river, preparation of Detailed Project Reports and Implementation of selected option.	-
3	Supplement inflow to Jaisamand Dam (Udaipur)	Study various options of supplementing inflow to Jaisamand Dam (Udaipur) from Anas river and Jakham Dam, preparation of Detailed Project Reports and Implementation of selected option.	-
4	Supplement inflow to Rajsamand Dam (Rajsamand)	Study various options of supplementing inflow to Rajsamand Dam (Rajsamand) from Anas river, preparation of Detailed Project Reports and Implementation of selected option.	-
5	Supplement inflow to Meja Dam (Bhilwara)	Study various options of supplementing inflow to Meja Dam (Bhilwara) from Anas river, preparation of Detailed Project Reports and Implementation of selected option.	-
6	Supplement inflow to Ramgarh Dam (Jaipur)	Study various options of supplementing inflow to Ramgarh Dam (Jaipur) from Mej river, preparation of Detailed Project Reports and Implementation of selected option.	-
7	Construction of Isarda Dam	Preparation of Detailed Project Report for construction of Isarda Dam including its water availability.	-
8	Construction of Kalisindh Dam Phase II	Further necessary action for construction of Kalisindh Dam Stage II.	-
9	Construction of proposed Parwan Major Irrigation Project	Preparation of Detailed Project Report for construction of Parwan Major Irrigation Project including its water availability.	-
10	Construction of Dewas Stage III and IV	Preparation of Detailed Project Report for construction of Dewas Stage III and IV and diversion of water to lakes of Udaipur city.	5,681.50
11	Timely completion of ongoing water supply	1. Barmer Lift Canal Water Supply Project Phase I (Source of water: IGNP)	6,886.60

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
	projects	2. Pokaran Phalsoond Balotra Lift Water Supply Project (Source of water: IGNP)	14,442.00
		3. Chambal-Dhaulpur-Bharatpur Water Supply Project (Source of water: Chambal River)	4,779.90
		4. Chambal Bhilwara Water Supply Project (Source of water: Chambal River)	7,278.20
		5. Chambal-Sawai Madhopur-Nadoti Water Supply Project (Source of water: Chambal River)	4,681.80
		6. Nagaur Lift Water Supply Project (Source of water: IGNP)	7,610.00
		7. Jawai-Pali pipeline project (Source of water: Jawai Dam)	6,347.90
		8. Water supply to Keoladeo National Park (Source of water: Goverdhan Drain)	560.40
12	Implementation of some proposed drinking water supply projects on priority	9. Barmer Lift Project Phase II (Source of water: IGNP)	7,977.50
		10. Aapni Yojana Phase II (Source of water: IGNP)	13,300.00
		11. Fatehpur-Laxmangarh Project (Source of water: IGNP) Note: This project should also include supply to Sikar town and villages of Piprali block of Sikar district	8,320.00
13	Reduction in distribution losses of piped drinking water supply schemes	Rehabilitation of piped drinking water supply distribution system considering the following studies: 1) Benchmarking of Urban water supply schemes of Rajasthan (by SMEC) 2) Benchmarking of Rural water supply schemes of Rajasthan (by Ramky Enviro Engineers Ltd.)	-
14	Review of Inter-State matters	Inter-State agreements of Rajasthan with Gujarat, Haryana and Punjab should be reviewed for additional utilization of water from outside Rajasthan.	-
15	Catchment Treatment to reduce sedimentation of reservoirs	The life span of a reservoir is greatly reduced due to erosion and other development like construction of roads etc. in the catchment area. Adequate preventive measures are thus needed for the treatment of catchment of reservoirs for its stabilization against future erosion and proper cross-drainage.	-
16	Utilization of water stored in abandoned mine-pits	There is a lot of water stored in abandoned mine-pits in Rajasthan. Further studies on feasibility of its utilization should be carried out.	-
17	Utilization of National Highway and State Highway storm-runoff	Study on feasibility of utilization of National Highway and State Highway storm-runoff by diverting it to nearby areas/waterbodies should be carried out.	-

S. No.	Recommendations	Proposed Actions	Estimated Cost, Million Rs. (at 2010 price level)
18	Utilization of treated brackish groundwater	Treated brackish groundwater of Matasukh mines is being supplied to villages of Jayal Block of Nagaur District. Similar options should be studied in future.	-
19	Utilization of Ghaggar flood water	Study on feasibility of harvesting of Ghaggar flood water draining to Pakistan and its use for augmenting groundwater resources should be carried out.	-
20	Utilization of surplus imported water during rainy season	Study on feasibility of utilization of surplus water in IGNP, Bhakra and Gang Canal System during rainy season, if any, for artificial recharge.	-
21	Master Plan for Artificial Groundwater Recharge	Master Plan for artificial recharge through available surplus internal surface water and imported canal water should be prepared since more than 60% of the irrigated area is through groundwater, which is facing significantly declining water levels.	-
22	Artificial Groundwater Recharge and Waste Water Reuse in Urban Areas	Study on "Artificial Groundwater Recharge and Waste Water Reuse for Jaipur City" was carried out by ANTEA International of France. Similar studies/work should be carried out for other big cities of Rajasthan. Follow up of all such studies to be done by respective departments.	-
23	Follow up of recent studies carried out in Rajasthan related to water sector	Follow up of Groundwater study and related software developed by ROLTA and Study on Benchmarking of Irrigation Projects by WAPCOS and any other study related to water sector.	-
24	Impact assessment of new structures	For any new structures, anicut etc. the impact assessment for downstream water bodies to be mandatorily worked out.	-
25	Investigations and Studies to find out reasons for reduced inflow to Pushkar Lake and other similar cases	Further investigations and studies should be carried out to find out the reasons for reduced inflows to Pushkar Lake and other similar cases and accordingly preventive measures should be taken.	-
26	Reduction in evaporation losses from small water harvesting structures	In order to reduce evaporation losses from small rain water harvesting structures, the water should be lifted after the month of March and stored in tankas to meet the drinking water requirement during summer or construct recharge shaft to recharge groundwater and ensure that water recharges by March: as the evaporation is about 50-60% of annual evaporation during the summer months.	-
27	Holistic approach in water resources planning and management	At present, there is no holistic approach and each department of Rajasthan is working without taking into account concern of other relevant department on various water related issues. There should be one department for planning i.e. SWRPD. Restructuring of SWRPD and RGWD is a must to meet the future challenges, which is necessary to implement state water policy action plan, community participation, proper data collection, enforcing legal issues, etc.	-
Sub-Total			**87,865.60**
Total			**250,109.52**