

KALLAR BASIN

Introduction

The following are the earlier studies that had been carried out in Kallar river basin:

- Water Resources Assessment and Management strategies for Kallar basin-prepared by Institute for Water Studies.
- “Urban Environment of Thoothukudi” status report by Chennai, Institute of Development studies and V.O. Chidambaram college, Thoothukudi.
- Report on Hydrology of Kallar basin by Planning & Designs Division, PWD, Madurai.
- Revised hydrology of Korampallam (UpparOdai) basin by PWD, Planning and design division, Tirunelveli.
- Short notes on “Surplus details of Korampallam surplus course, KattabommanAnicut and Eppodum-Venrananicut” by Thoothukudi Division, PWD.
- “Crop water requirement and irrigation scheduling” – A guide for Tamil Nadu by Dr.S.Subramanian& Dr. Kulandaivelu.

The Kallar river basin is located in Thoothukudi district. There are two rivers in this basin, the Kallarriver in the northern part and Korampallamaru in the southern part. In between these two rivers, there are some small streams originating from Chalikulam reserved forest area and are draining towards southeast, and all the streams constitute the Chalikulamaru. This basin is surrounded by Vaippar basin on the north, Tamiraparani basin on the west and south and the Gulf of Mannar on the east.

The Kallar basin falls in parts of Survey of India sheets 58 G, 58 H, 58 K and 57 L and it lies between the following co-ordinates: North Latitude 8°41’00” – 9°10’30”, East Longitude 77°48’00” – 78°15’00” covering an area of 1509 sq.km. The base map of Kallar is shown in Figure 1.

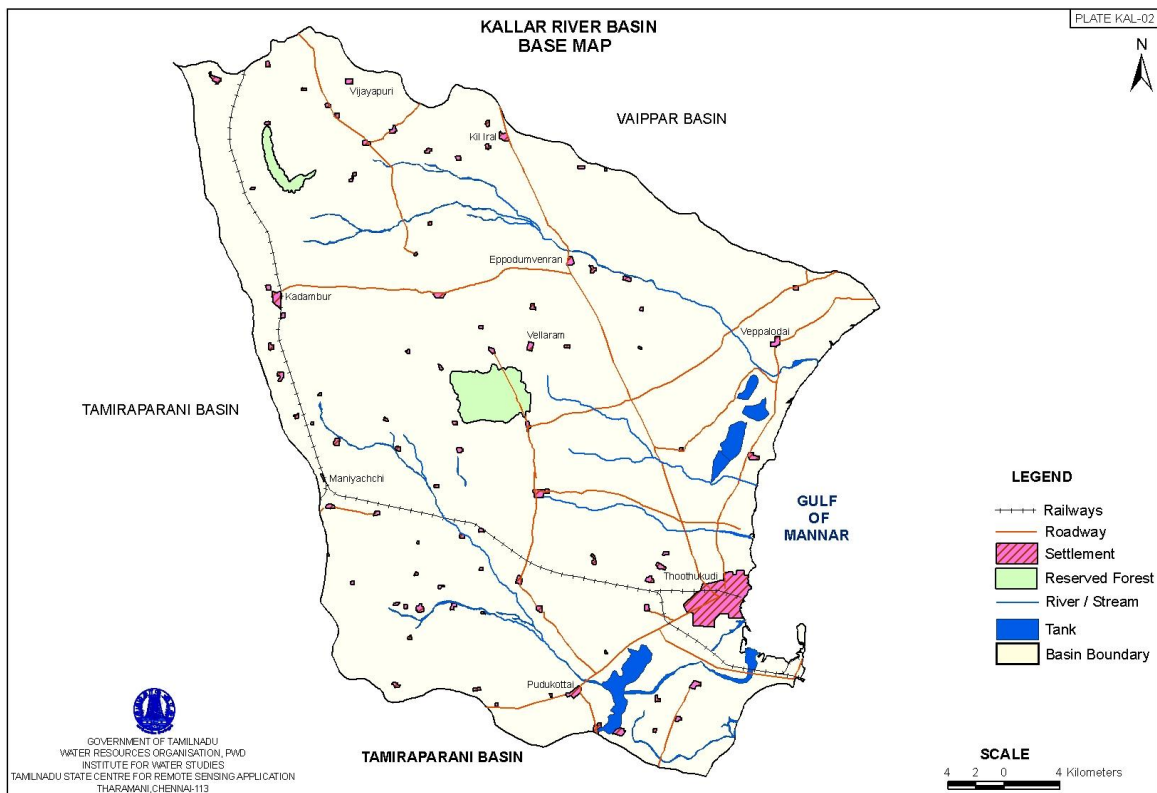


Figure 1 Base Map of Kallar River Basin

Physiography

The Kallar basin lies in the eastern parts of the Thoothukudi district and covers an area of 1509 sq.km. The rivers namely Kallar (Malattarodai), Korampallamaru (Upparodai) and Chalikulamaru form the Kallar river basin. The topography of the Kallar basin is plain with gentle slope towards southeast. The slope is interrupted by the presence of local outcrops or low-ridged hills, rocky knobs, boulders and stony waste.

There are two big tanks in the basin viz., Eppothumventran tank located in Kallar (Malattarodai) sub basin and Korampallam tank which received water from Tamiraparaniriver, from North main canal of SrivaikundamAnicut. It also received water from wild streams from Ottanatham.

Coastal plain extends from Panaiyur and Kallurani villages in the north to Kuliankarisal and Pullivadi village in the south and this area is mainly covered by fairly dense scrub, open dense scrub and saltpans. Two major salt factories are located in Kallar basin, one is Veppalodai in the north and the other is Tuticorin salt factory in the south. The other important salt factories are Arasadi, Alankaratettu and Pullivadi.

Drainage:

Two rivers namely Kallar (or Malattar) and Korampallamaru (Uppodai) are the main rivers draining in this basin. Besides, a small stream Chalikulamaru also drains in the middle portion of Kallar basin i.e. between Kallar and Korampallamaru. Hence the Kallar river basin can be studied

under three sub basins namely Kallar sub basin, Chalikulamaru sub basin and Karampallamaru sub basin. These three individuals sub basins are grouped together for water resources planning activities and they are called as Kallar river basin. The drainage map of the Kallar river is shown in figure 2.

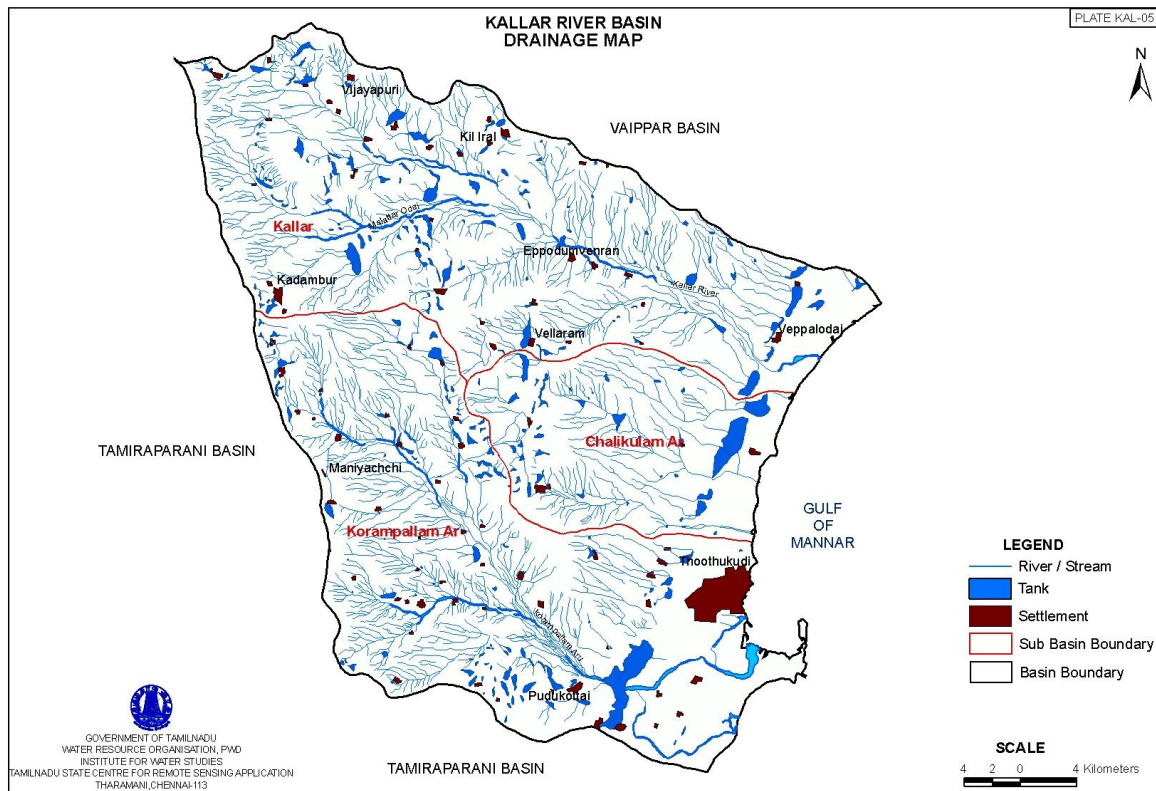


Figure 2 Drainage Map of Kallar River Basin

Relief

The entire basin lies in Thoothukudi district. The rivers namely Kallar (or Malattar) and KorampallamAru (or Upparodai) are the two important rivers draining this basin. The maximum elevation is 253m at the southern part of Kurumalai, hillock, south of Kovilpatti and Kurumalai reserve forest at the north western part of basin, the entire remaining part is gradually sloping from west to east with an elevation of 100 to 20 m MSL. The relief map is shown in figure 3.

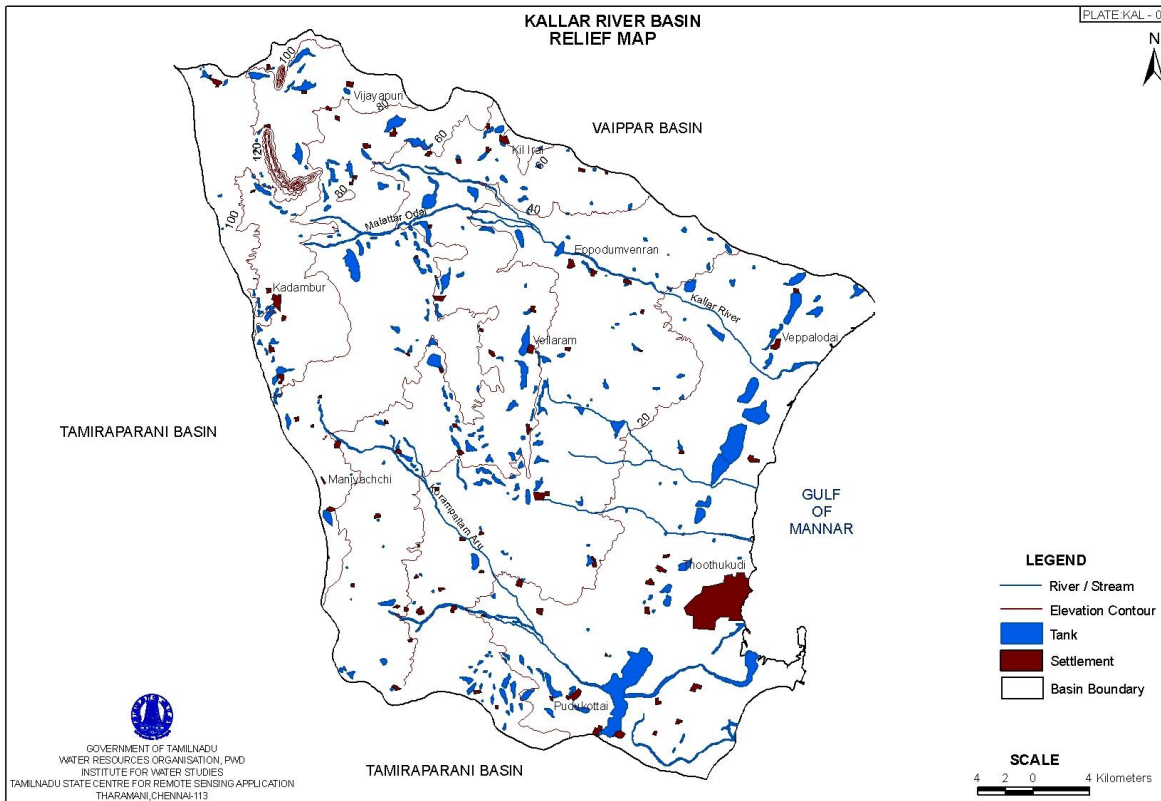


Figure 3 Relief Map of Kallar River Basin

Geology

Major parts of Kallar basin area is traversed by Garnetiferous biotite gneiss. Besides, charnockite occupies a small pocket in and around Ottapidaram. Narrow linear bands of quartzite and pink granite trending N-S direction find a place amidst the country rock. Lime stones of calc granulite as linear patches also found on the east and northern parts of Ottapidaram. This rock occur as xenoliths within country rock.

In the coastal tracts, dunes of white sand and red ‘teri’ sands of recent origin parallel to the coast are found. The red coloured ‘teri’ sands form small dunes rising to an average height of 15m from the adjoining plains. The sand also occurs as a thin capping over the Sub-Recent (Quaternary) sandstone and limestone at places. The alluvium is confined to a very narrow belt on the bank of the rivers of Kallar river & Korampallamaru. This consists of brownish black to reddish brown sandy clay with a small proportion of silt. The geology with lineament map is shown below. The frequency of lineaments is more in the area covering in between Ettaiyapuram, Veppalodai, Mel Arasadi and Ottapidaram. The NW-SE and NNW-SSE trending lineaments are predominantly traversing in these areas. East-West trending lineaments are cutting across the above two sets of lineaments and developed more number of lineament intersection points. The geology and lineament map generated in the GIS environ show positive ways to develop groundwater in this semi-arid dry belt of Kallar.

More number of lineaments is noticed in pink granite patches, swarms of calc granite and quartzite are concentrated in this highly disturbed zone. The depth of the fractured zone extend upto 50m but in four isolated portion the fractured zone is touched at a depth of 50m. In Maniyachi, Ottainattam, Tottanpattai, Pungavarnattam, Arnikkulam, Tattaparai and further down upto Melvagaikulam, the fractured zones may be encountered upto a depth of 50m.

Western part of Ottapidaram and Ettaiyapuram is showing N-S, EW and ENE-WSW trending lineaments. These lineaments are less in numbers and displaced. North –South trending lineaments are showing parallelism to the linear pink granite occurring in the middle part of basin area. The intersections of lineaments with pink granites and quartzites, geological contact with lineament intersection points are very good ground water potential zones. But in such zones the quality varying good to saline in the eastern part and coastal areas. The garnetiferous biotite gneiss is covering 80% of the total area of the basin and 95% total area of the hard rock. Wherever the calc granite /crystalline limestone and quartzite formations are contacting the garnetiferous gneiss, such contacts zone can be taken for groundwater exploration in the first order of priority.

Lineament –drainage course: major river courses are controlled by the NW-SE, E-W and WNW-ESE lineaments. These streams are filling the secondary aquifers and recharge groundwater.

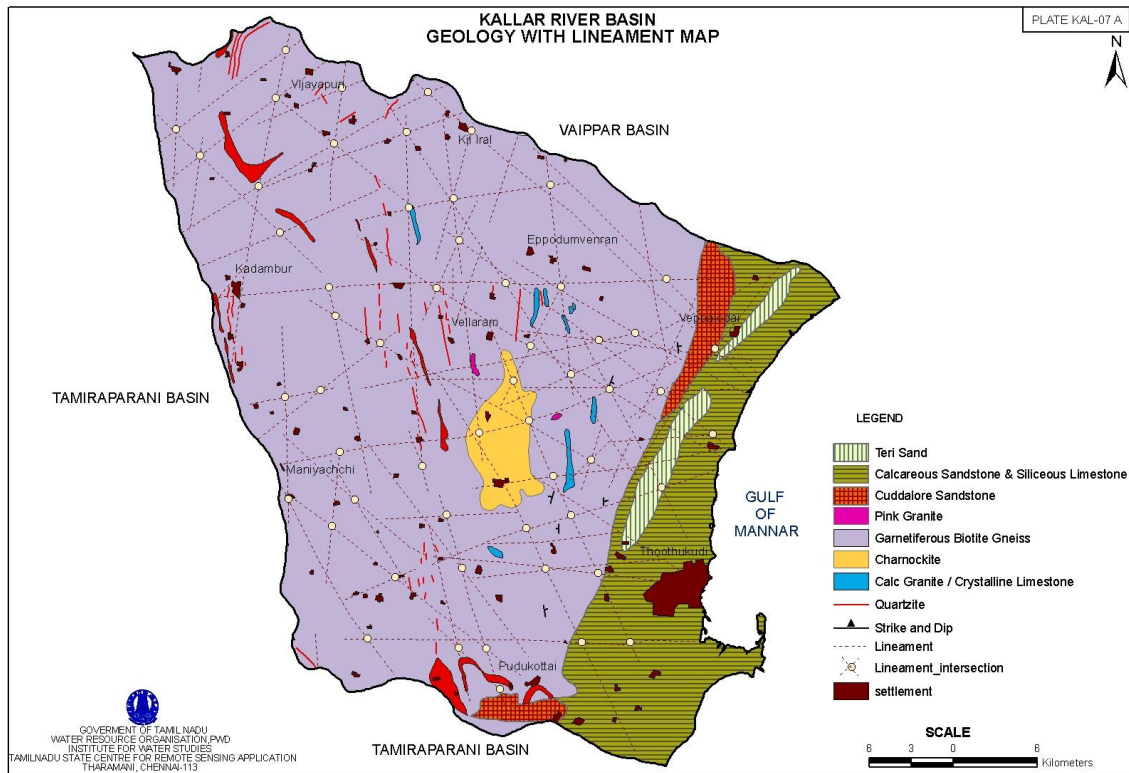


Figure 4 Geology with Lineament Map of Kallar River Basin

Hydrogeology:

Ground water occurs under water table conditions in the weathered and fractured zones of gneisses and charnockites. The weathered zone is found to occur upto 40m below ground level. The depth of wells in the hard rock area generally ranges from 6 to 20 m and the water levels in this area vary from 3m to 5m, during winter and in summer the level goes down from 15m to 18m from ground level. The wells in hard rock area are sustainable for pumping 3 to 5 hours in a day in winter months and about 2 hours of pumping in summer months.

The sandstones of Tertiary formation is very hard and compact in nature and do not appear to be a good aquifers. Groundwater occurs under water table conditions. Occasionally continuous pumping is reported in certain pockets with yield ranges from 400 to 500 lpm in normal monsoon period.

Alluvium is restricted and occurs along the river courses only. In the alluvial area, groundwater occurs in phreatic conditions and in the coastal alluvium the groundwater occurs under perched water table conditions. The average depth of the well is about 8m. The ground water level during winter in the wells generally reaches to ground level and in summer it goes down upto 7m from ground level.

Geomorphology

The following three major landforms have been identified based on the genesis and morphological characteristics. (Figure 5)

- I. Denudational landform
- II. Fluvial landform
- III. Coastal land form

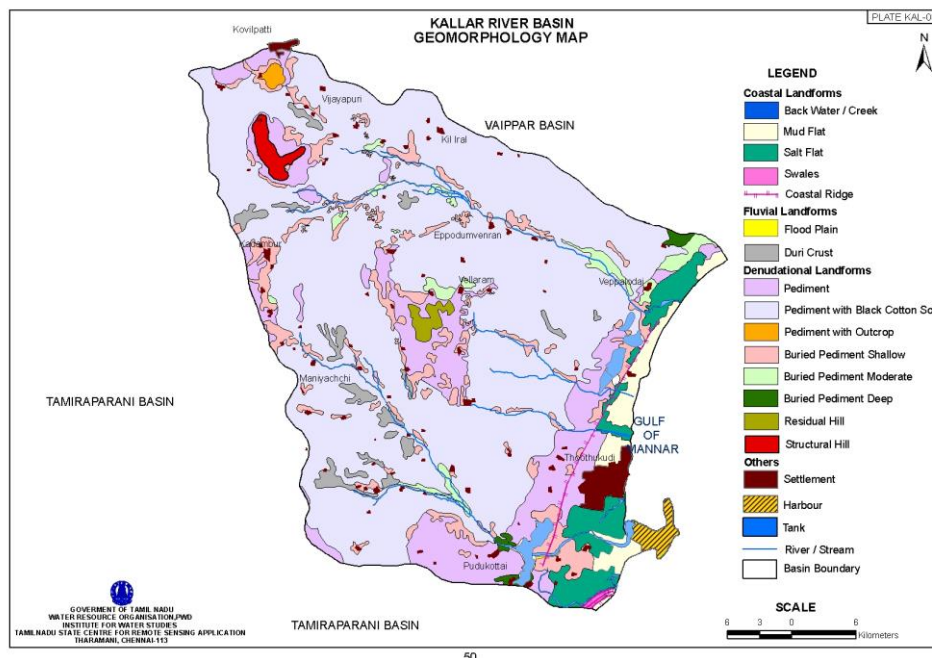


Figure 5 Geomorphology Map of Kallar River Basin

The geomorphology map was superimposed with lineament layer and a geomorphology with lineament was generated. By integrating these two themes area suitable for making groundwater structures are derived in conjunction with lineament and lineament intersection points.

Favorable groundwater structures:

1. Deep bore well – Lineament intersection
2. Dug cum borewell- Lineament /Geomorphic unit.

The groundwater potential in Kallar basin limited in extent is moderate to poor and limited in extent. These potential zones are distributed sporadically and show limited landuse development. But in rest of the total area rainfed crops like maize, corn and other pulses are grown during the monsoon period.

Landuse map

The landuse map is given in the figure 6 below.

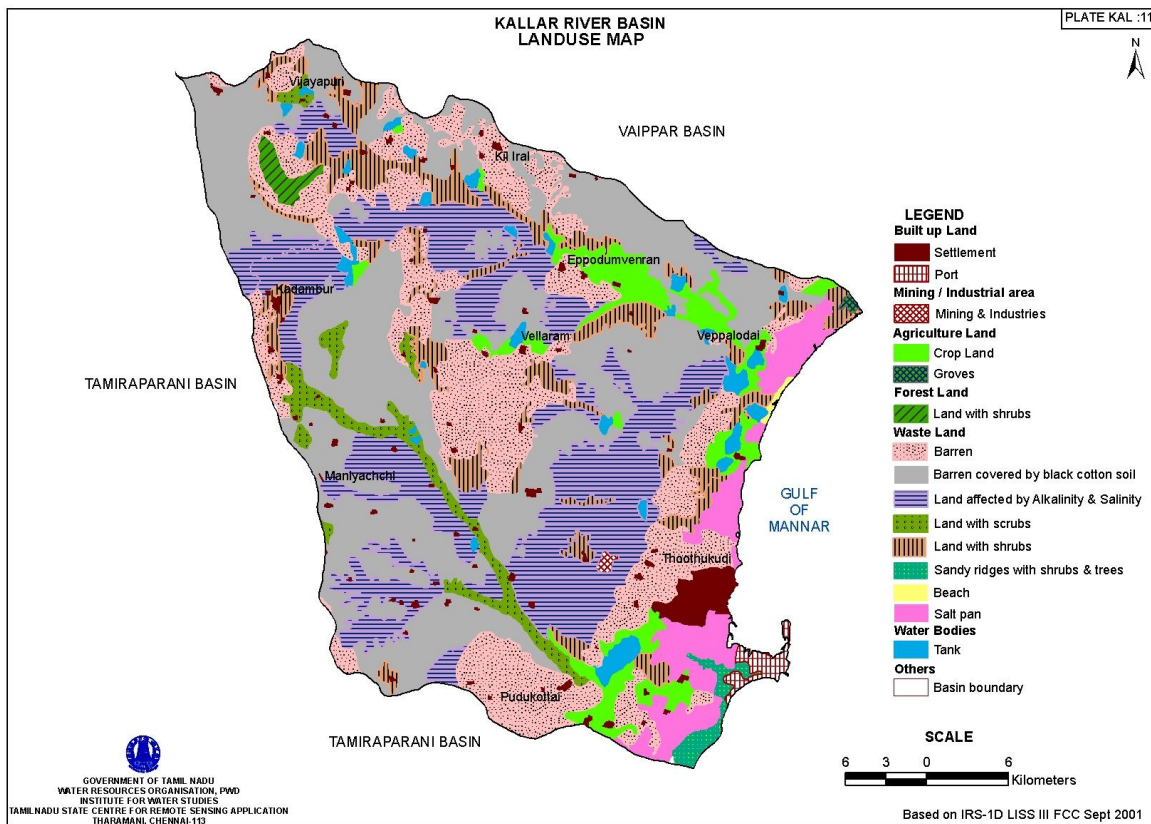


Figure 6 Landuse Map of Kallar River Basin

Soils

The soils of the Kallar Basin have been shown in Plate KAL. No 15. The predominant soil types found in this river basin are Inceptisols, Alfisol, Entisol and Vertisol. Due to different stage of weathering of parent material, the above soil types are met within combination.

In general, based on the analysis of data, it is inferred that the weathered rock aquifer of this basin exists upto a depth of 20 to 40 m below ground level, fractured rock aquifer occurs upto a depth of 40 to 70 m below ground level. In sedimentary region the resistivity of the formation is low from 50 to 70 m

below ground level, may be due to the sedimentary intercalated with saline water. The weathering / fracturing or both seems to be more in the gneissic region than charnockitic region, may be due to weak zones resulting from fault zone, shears zones, folds, lineaments etc.

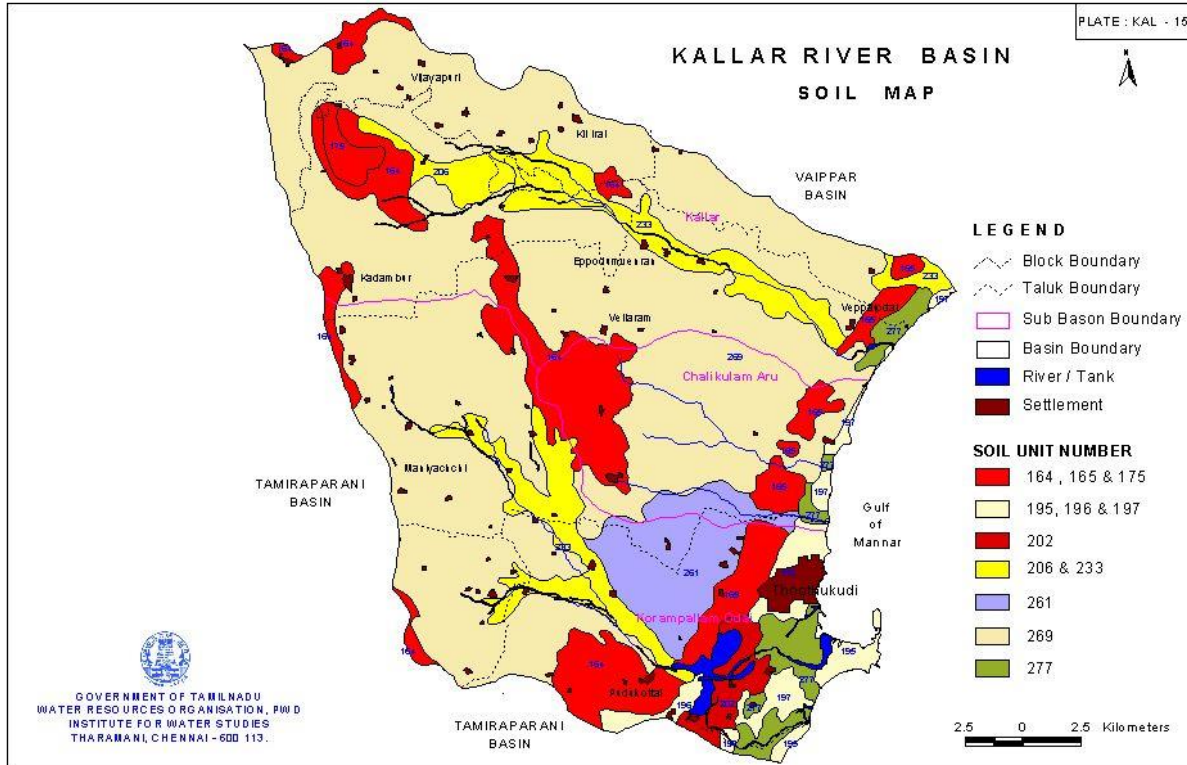


Figure 7 Soil Map of Kallar River Basin

In the regions where the depth to bedrock is shallow, dugwell would be the better structure for augmenting groundwater especially in the hard rock regions. In the areas where the depth to bedrock is at moderate or at deeper depth, borewell would be the suitable structure for tapping groundwater. This is common for both sedimentary and hard rock areas.

Population Size: Urban and Rural

The Kallar basin covers approximately 33% of the area of Thoothukudi district. The total Urban and Rural population for the basin are 0.266 Million and 0.254 Million respectively. The basin is divided into three Sub basins. The Sub basin wise population is given below. The Urban and Rural Population as per census 2001 in Million

Table 1 Population details of Kallar River Basin

Sl. No.	Name of the sub basin	Urban population	Rural population	Total population
1	Chalikulam Aru	0.014	0.014	0.028
2	Kallar	0.000	0.041	0.041
3	Korampallam Odai	0.252	0.199	0.451
TOTAL		0.266	0.254	0.520

Population Density

The basin population density is the highest in Korampallam Odai (737 Persons per sq.km) and the lowest is in Kallar (62 Persons per sq.km) as shown in the following table. The average population density for the entire basin is 345 persons / sq.km which is well below the State average of 480 persons / sq.km

Table 2 Population density of Kallar River Basin

Sl.No	Name of the Sub basin	Area (Sq.km)	Total Population in Million	Density Person/ sq.km
1	Chalikulam Aru	233	0.028	121
2	Kallar	664	0.041	62
3	Korampallam Odai	612	0.451	737
Average population density for the basin				345

Hydrometeorology

The Kallar basin has an area of 1509 sq.km. spread over in Thoothukudi District. There are 14 non-recording rain gauge stations in the basin. The various agencies are maintaining these rain gauge stations, and the numbers of rain gauge stations maintained by each agency are listed below:

Table 3 Rain gauge Stations Maintained by Various Departments in Kallar River Basin

S. No.	Name of the Agency	Numbers
1	GW	8

The annual rainfall for 75% dependability is given in table 4.

Table 4 Annual Dependable Rainfall in Kallar River Basin

Sl. No.	Raingauge Stations	25%	50%	75%	90%
1	Chalikulam Aru	29.02	19.02	9.99	4.18
2	Kallar	101.19	73.86	54.27	41.74
3	Korampallam Odai	106.17	73.52	58.56	31.09

Table 5 Aridity Index (I_a) for Climatic Classification

S. No.	Name of Stations	Annual Ave. Precipitation P mm	PET mm	Total deficit P-PET mm	I _a Aridity Index (%)	Classification
1	Kovilpatti	736.91	1643.00	-906.09	-55.15	Semi-Arid
2	Kovilpatti(Agri)	732.05	1643.00	-910.95	-55.44	Semi-Arid
3	Ottapidaram	524.93	1643.00	-1118.07	-68.05	Arid
4	Sathankulam	706.66	1643.00	-936.34	-56.99	Semi-Arid
5	Srivaikundam	655.81	1643.00	-987.19	-60.08	Semi-Arid
6	Thoothukudi	603.32	1643.00	-1039.68	-63.28	Semi-Arid
7	Tiruchendur	762.42	1643.00	-880.58	-53.60	Semi-Arid
8	Vilathikulam	562.30	1643.00	-1080.70	-65.78	Semi-Arid

Climate

The weather station considered is furnished below:

Name of the weather station	Maintained by
Keelaeral	PWD

The climatological values of this river basin are given in the following Table.

Table 7 Climatological Parameters

S. No	Climatological Parameter	Keelaeral
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1	Average monthly temperature Maximum. in. ° Celsius	31.91
2	Average monthly temperature Minimum. in. ° Celsius	26.20
3	Average mean temperature in ° Celsius	29.06
4	Average relative humidity in %	72.44
5	Average wind velocity in km/hour	6.79
6	Average Sunshine hours / day	6.70

Table 8 Reference Evapotranspiration (mm/month) - Average

Reference Evapotranspiration (mm/month)												Average
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
169	173	166	141	130	107	113	118	111	129	135	151	136.9

Surface Water Potential

River Systems

Kallar (also known as Malattar) and KorampallamAru (or Upparodai) are the two rivers draining in this basin. Besides, a small stream, Chalikulam Aru also drains in the middle portion of Kallar basin i.e., between Kallar and Korampallam Aru. Hence the Kallar river basin can be studied under three sub basins namely Kallar sub basin, Chalikulam Aru sub basin and Korampallam Aru sub basin.

Surface Water Data

Eppodhum vendran tank is a major tank in Kallar river basin. Kallar river has only seasonal flow during Northeast and Southwest monsoon period. As the river has only intermittent flow it has got only tank irrigation. There is no major reservoir in this basin.

Out flow to sea

Kallar basin is drought prone. Gauging for one year at Kattabomman anicut across Kallar indicates a flow of 10.34 MCM.

Table 9 Raingauge stations considered for analysis

Sl. No.	Name of subbasins	Subbasin area (sq.km.)	Raingauge stations
1	Kallar	664	Kovilpatti Revenue, Kovilpatti Agri, Vilathikulam
2	Korampallam Aru	612	Sathankulam, Srivaikundam, Thoothukudi, Thiruchendur
3	Chalikulam Aru	233	Ottapidaram

Total	1509	
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Table 10 75% Dependable Surface Water Potential for the Kallar River Basin

Sl. No.	Name of Sub basin	75% Dependable Surface Water Potential in Mcum			
		SW	NE	NM	Annual
1.	Kallar	12.23	30.33	11.71	54.27
2.	Chalikulam Aru	0.52	8.79	0.68	9.99
3.	Korampallam Aru	3.14	39.34	16.08	58.56
Total		15.89	78.46	28.47	122.82
South West Monsoon Potential		15.89 (or) 16 Mcum			
North East Monsoon Potential		78.46 (or) 79 Mcum			
Non Monsoon Potential		28.47 (or) 28 Mcum			
Annual Potential		122.82 (or) 123 Mcum			

Surface Water Potential of Kallar Basin is 123 Mcum.

The Existing Surface Water Supply Systems

In the Kallar Basin, the surface water is drawn for usage from tanks. The tanks are classified as System tanks and Non system tanks.

The non-system tanks use surface water of the direct runoff from their own catchment. Whereas the system tanks are filled from the canal flow diverted by the anicuts across the river apart from the direct runoff from their own catchment.

Anicuts Details

There are eight anicuts in the Kallar sub basin, namely Ketchilapuram, Sivanthipatti, T.Duraiyoor, Athikinar, Kattabomman right and Kattabomman left, Pattinamaruthur and Melaarasadi. The KorampallamAru sub basin has four anicuts namely Araikulam I, Araikulam II, Perurani and Alantha.

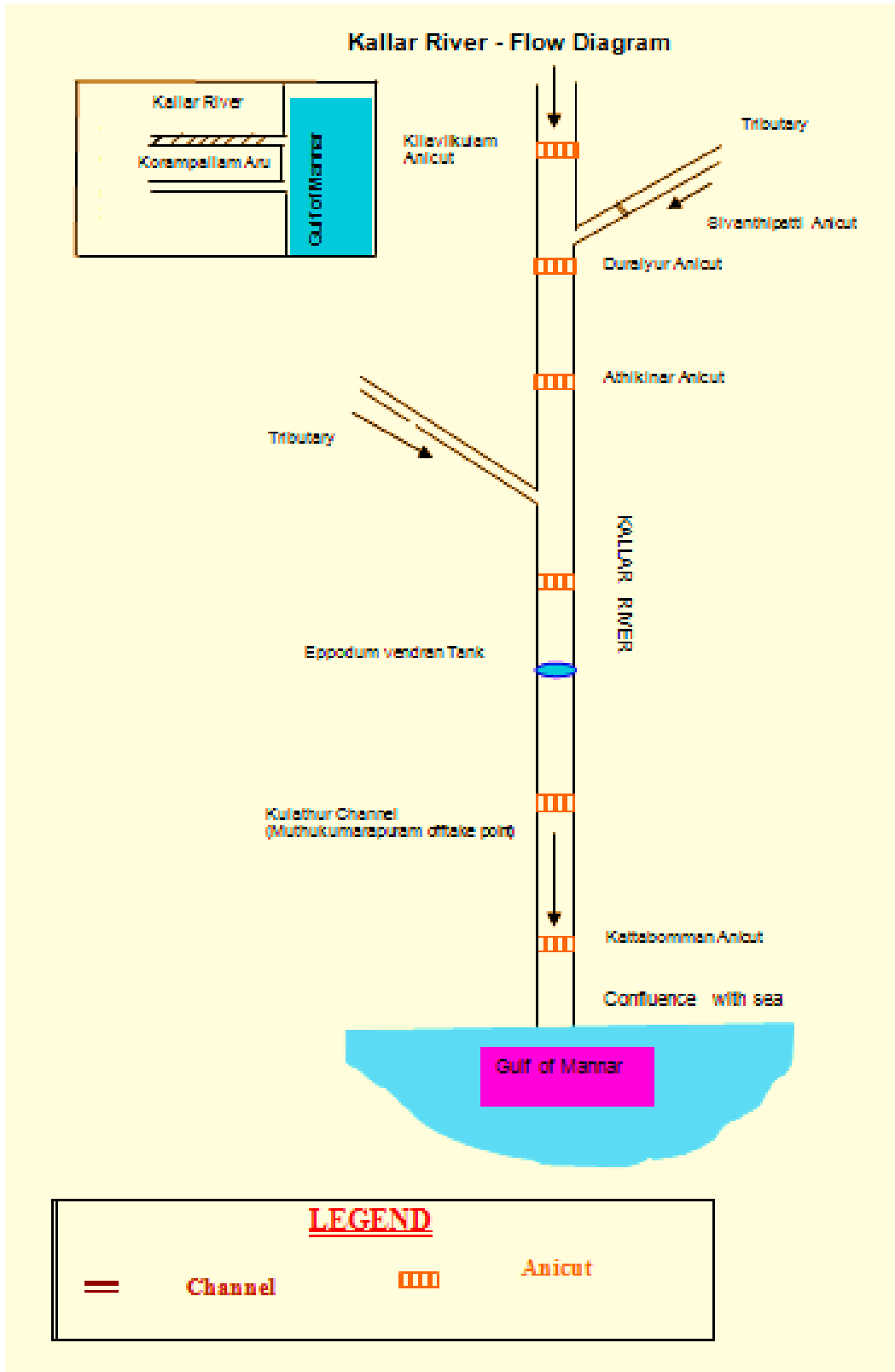


Figure 8 Flow Diagram of Kallar River

Korampallam Aru - Flow Diagram

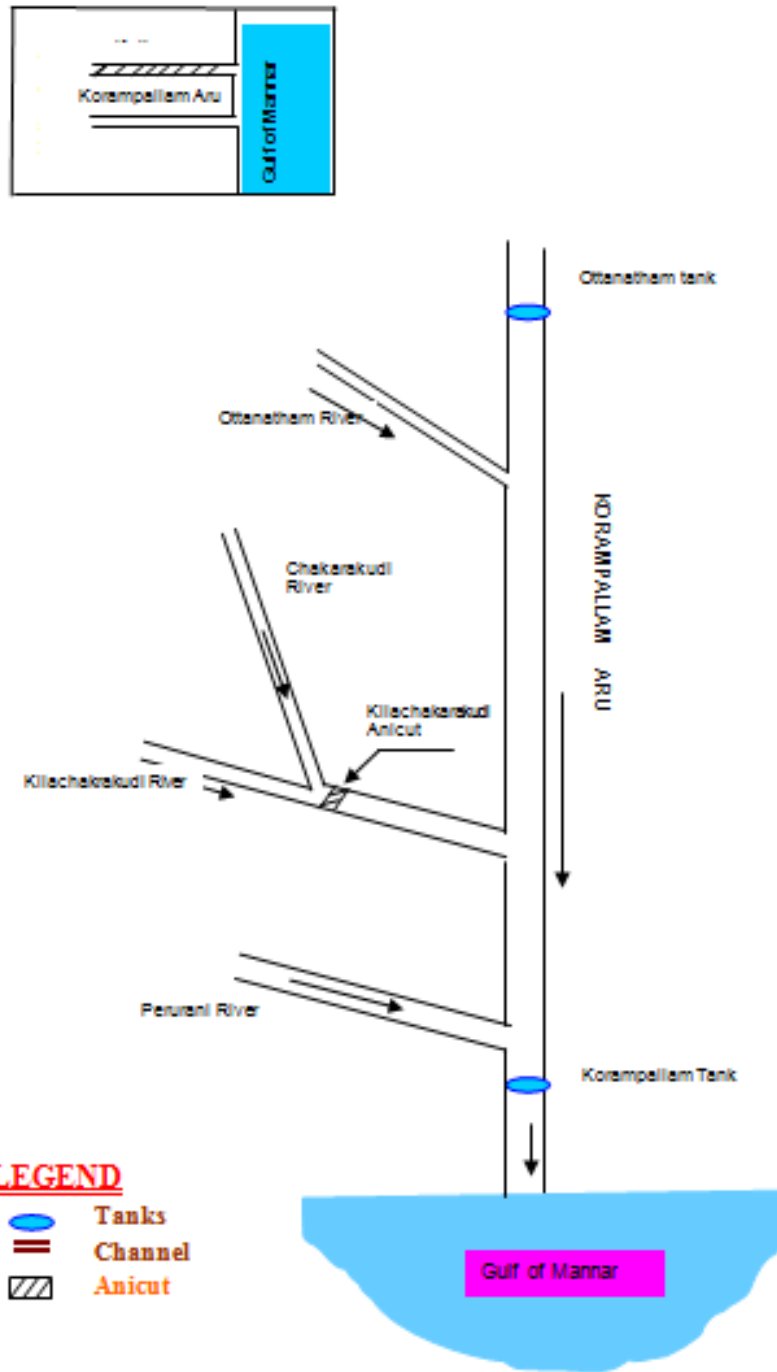


Figure 9 River flow Diagram of KorampallamAru

Table 11 Details of Anicut

Sl.No.	Name of the anicut	Length of Channel (m)	Channel fed tanks	Ayacut (acres)
Kallar sub basin				
1	Ketchilapuram	780	Kilavipatti	112.02
2	Sivanthipatti	2750	Erachi	45.45
3	Thuraiyoor	2500	Semmaputhur	154.25
4	Athikinar	1900	Athikinar	318.00
5	Kattaboman (Left)	1000	Kalmedu (Therku and Vadakku)	443.80
6	Kattaboman (Right)	300	Pattinamaruthur, Tharuvaikulam (new)	700.22
7	Pattinamaruthur	4000	Pattinamaruthur	299.80
8	Melaarasaradi	1000	Tharuvaikulam (old)	388.00
KorampallamAru sub basin				
1	Araikulam I	8000	Ottapidaram (Periyaru), Mandalkulam	248.00
2	Araikulam II	5000	Puthupachaiammankulam, Sevalkulam, Pulikulam	217.23
3	Peruarni	1350	Lakkankulam, Periyakulam, Pooradikulam, Peikulam, Karisalkulam, Padambakulam	262.77
4	Alantha	4400	Sambakulam, Ulakudi, Erukkankulam	204.87

There are about 199 tanks in this basin including the isolated tanks by which 4146 ha are being irrigated. Out of the above, 15 are system tanks and 184 are non-system tanks. The total storage capacity of these tanks is 43.41 Mcum. In KorampallamAru sub basin, the Korampallam tank is the last tank having an ayacut of 578.51 ha. In addition to the drainage from its own catchment, it receives water from the adjacent basin from the perennial river Tamiraparani through North Main Channel of Srivaikundamanicut. The 50% of the requirement of water for this ayacut can be assumed as met through this diversion which works out to 6.59 Mcum at 44% irrigation efficiency. The list of tanks in the basin is given in Appendix 4.4 & 4.5 of Volume II.

Table 12 Detailed Tank list by Hatkins

Name of the tank & No	Registered ayacut in ha	Capacity in Mcum	Water spread area in ha	No.of fillings
1) Athikinar Tank	128.70	0.36	39.22	1.90
2) Athilodai Tank	56.82	1.00	43.65	0.29
3) Avarankulam (Keelamodiman)	52.01	0.62	46.71	0.54
4) Bommiyarpuram	64.45	0.57	54.09	-
5) Epppodumvendran Tank	164.05	3.53	259.60	2.00
6) Kandasamiyapuram Tank	43.76	0.66	41.03	2.76
7) Kannakottai Tank	85.44	0.55	68.24	0.28
8) Karisalkulam (Duraiyur)	66.03	0.44	65.69	2.00
9) Karisalkulam (Vellaram)	59.09	0.92	66.50	0.43
10) Kilaripatti Tank	45.34	0.53	56.83	1.00
11) Kilmodiman Tank	87.11	1.04	69.96	0.23
12) Kolathur (South)	63.26	-	7.40	1.06
13) Kollamparambukulam	160.08	0.72	103.07	2.00
14) Ottanatham Tank	43.72	0.33	27.17	2.00
15) Ottapidaram Big Tank	40.64	1.04	70.55	2.50
16) Panchathangi Tank	80.34	0.51	70.33	1.39
17) Pattanamarudur Tank	84.58	1.73	150.03	0.61
18) Peethapuram Tank	73.39	0.84	55.30	1.12
19) Periyannatham Tank	41.71	0.80	65.62	0.93
20) SevalkulamKarisalkulam	62.43	0.88	65.69	0.61
21) Tharuvaikulam old Tank (Mappillainaickankulam)	98.93	1.79	169.96	0.88

22) Therkkukalmedukulam	133.44	2.14	167.85	0.78
23) Thoravaikulam New Tank	170.03	2.03	238.51	0.46
24) Valampatti Tank	98.74	0.82	99.24	2.00

Inter basin transfer of water

Water is diverted from Tamiraparani Basin through North Main Channel taking off from Srivaikundam Anicut, the last anicut across Tamiraparani river for thermal power generation etc. and the quantity of water diverted is 10.78 MCM.

Groundwater potential

Occurrence of groundwater in the three sub basins of Kallar River Basin

Kallar sub basin

The predominant rock types found in this river basin is Archaean formations include quartzite, Garnetiferousbiotitegneiss, Charnockite, pink granites traversed by pegmatite and quartz veins . There are three observationwells in this sub basin. The winter water level varies from 3.00 to 7.50 m and the summer water level ranges from 4.50 to 9.00 m below ground level.

Chalikulam sub basin.

The formation includes Calcareous sand stone and shell lime along the coastal part of the basin. Black and red soils are found in the sub basin. Alluvium is found in the river courses. The winter water level varies from 3.50 to 10.00 m and the summer water level varies from 4.50 m to 12.50 m below ground level.

Korampallam sub basin

The rock types found in this river basin is Archaean formations which include quartzite, Garnetiferousbiotite gneiss, Charnockite, pink granites traversed by pegmatite and quartz veins . The sub basin has an area extent of 612 sq km. The winter water level varies from 3.00 to 8.50 m and the summer water level ranges from 4.50 to 11.50 m below ground level.

The groundwater parameters of the hard rock and sedimentary area of the kallar river basin is given in the table 13 and 14.

Table 13 Aquifer parameters in Hard Rock Area

S. No.	Parameter	Minimum value	Maximum value
1.	Specific Capacity	1.20 lpm/m draw down	118 lpm/m draw down
2.	Transmissivity (T) value	0.45 m ² /day	338 m ² /day
3.	Storativity (S) value	2.60x 10 ⁻⁵	3.60 x10 ⁻⁵
4.	Yield	60.00 lpm	180 lpm

Table 14 Aquifer parameters in Sedimentary Area

S. No.	Parameter	Minimum value	Maximum value
1.	Specific Capacity	159 lpm/m draw down	1892 lpm/m draw down
2.	Transmissivity (T) value	323 m ² /day	1937 m ² /day
3.	Storativity (S) value	1.13 x 10 ⁻⁵	2.975 x10 ⁻⁵
4.	Yield	61.00 lpm	1273 lpm

INDUSTRIAL WATER DEMAND

WATER DEMAND CALCULATION FOR SMALL, MEDIUM AND LARGE INDUSTRIES BASED ON INDUSTRY CENSUS AS TAKEN FROM IWS

Type of industry	Average Rate of Water consumption as given in IWS m ³ /day	2010		2017		2020		2030		2040		2050	
		No. of industry as per IWS	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand
Small scale industry	2.5	542	0.49	929	0.85	1170	1.07	2526	2.3	5454	4.98	11775	10.74
Medium & Large scale industry	2500	24	21.9	41	37.41	52	47.45	112	102.2	242	220.83	521	475.41
Total Demand in M.Cum			22.39		38.26		48.52		104.5		225.81		486.15

TABLE 16 – DOMESTIC WATER DEMAND

Year		Population	Demand		
2011	Corporation	372408	50.28	MLD	MCM
	Municipalty	0	0.00		
	Town panch	4155	0.29		
	Rural	236710	9.47		
2017	Corporation	419392	56.62	67.18	24.52
	Municipalty	0	0.00		
	Town panch	4679	0.33		
	Rural	255784	10.23		
2020	Corporation	445062	60.08	71.07	25.94
	Municipalty	0	0.00		
	Town panch	4966	0.35		
	Rural	265890	10.64		
2030	Corporation	542528	73.24	85.77	31.30
	Municipalty	0	0.00		
	Town panch	6053	0.42		
	Rural	302549	12.10		
2040	Corporation	661339	89.28	103.57	37.80
	Municipalty	0	0.00		
	Town panch	7379	0.52		
	Rural	344263	13.77		

Water Balance

Table 22 WATER POTENTIAL AND DEMAND

Sl. No	Name of the basin	Area of the basin (in Sq.Km)	No. of Sub basins	Year	Demand of water in various sectors (MCM)						Water availability (MCM)					Surplus / Deficit in Mcum
					Irrigation	Domestics	Industries	Live stocks	Others	Total	Surface water potential	Ground water potential	Quantity of recycled water from Sewage	Quantity of water from desilting	Total	
1	Kallar	1509.00	3	2017	100.20	24.52	38.26	11.67	0.00	174.65	128.00	57.00	247.56	---	432.56	257.91
				2020	100.20	25.94	48.52	11.53	0.00	186.19	128.00	57.00	247.56	---	432.56	246.37
				2030	100.20	31.30	104.5	11.28	0.00	247.28	128.00	57.00	247.56	---	432.56	185.28
				2040	100.20	37.80	225.81	11.27	0.00	375.08	128.00	57.00	247.56	---	432.56	57.48