CHAPTER 4.1.9 GROUND WATER RESOURCES

KANIYAKUMARI DISTRICT

INDEX

GROUND WATER REPORT OF KANIYAKUMARI DISTRICT

INRODUCTION :

In Tamil Nadu, the surface water resources are fully utilized by various stake holders. The demand of water is increasing day by day. So, groundwater resources play a vital role for additional demand by farmers and Industries and domestic usage leads to rapid development of groundwater. About 63% of available groundwater resources are now being used. However, the development is not uniform all over the State, and in certain districts of Tamil Nadu, intensive groundwater development had led to declining water levels, increasing trend of Over Exploited and Critical Firkas, saline water intrusion, etc.

ADMINISTRATIVE SET UP

The geographical extent of Kanyakumari District is 1,67,184 hectares(1671.84sq.km)Considering the total geographical area of Tamil Nadu State it is 1.5% This district has well laid out roads and railway lines connecting all major towns and outside the state. For administrative purpose, this district has been bifurcated into 4 Taluks,9 Blocks and 18 Firkas. The Following are the Co-ordinate of Kanyakumari District.

Kaniyakumari District is totally bifurcated into 18 Firkas.

Latitude : 8°05’30” - 8°34’ 30”

Longitude: 77°06’30”- 77°35’00”

1. HYDROGELOGY

(i) Major Geological formations:

Kanyakumari district is underlain by the peninsular gneissic terrain of India. Within the district, sediments of middle Miocene were also deposited and identified as the Warkalai sandstones. Also, the sands of recent origin are noticed along the coast. Rest of the district is underlain by the crystalline rocks of Archaean age.

a) Peninsular Gneiss

The peninsular gneisses occupy the largest area in the district. The general trend of the strike of this area is the N-NW to S-SE. Garnetiferoussillimanite, graphic gneiss and garnetbiotite gneiss are the two major groups identified in Kanyakumari district.

b) Charnockite

The Charnockite group of the rocks is well exposed around Padmanabhapuram, Aramboly south, Kulasegaram, Thuckalay and Rajakkamangalam areas. Charnockite group consists mainly of charnockite, pyroxene granulite and their associated migmatites. Charnockites are also exposed within the gneisses as bands and lenses. Granites and pegmatites are the derivations from the migmatites of the peninsular gneisses.

c) Warkalai sandstone

The warkalai beds of tertiary age are exposed as the cappings, southwest of Kuzhithurai near the coast and south of Kaliakkavilai and it is equivalent to the Cuddalore sandstone.

d) Alluvium

Sub-recent origin of calcareous limeshell is noticed near Kanyakumari. All along the west coast from Kanyakumari, Kollangodu the border of Kerala states. The area is covered by the thick lateritic soil dotted with a few rocky outcrops. Around Medukkeneal, Turapuram, Pudukadai area, the thickness of laterite increases with reddish brown in colour.

e) Beach sands

Lateral deposits or Bay deposits of sand, zircon, rutile, illemanite and garnet are very common phenomena along the entire sea coast of Kanyakumari district. Near Manavalakurichi monazite is seen in addition to the above deposits.

Drilling of bore holes:

The occurrence and movement of groundwater is restricted to open system of fractures, and joints in unweathered portion and also in the porous zones of weathered

formation. For investigation purposes, The State Ground and surface Water Resources Data Centre has drilled more than 28 bore holes spread-over the entire district. Bore holes in sedimentary area are very much limited because of limited extent of the sedimentary area.

Generally in hard rock regions the occurrence of weathered thickness is discontinuous both in space and depth. Hence the recharge of groundwater is influenced by the intensity of weathering.

In general, weathering thickness is higher in gneissic rock than that of charnockite. It varies from 10m to 35m below ground level.

Aquifer parameters:

In order to evaluate the characteristics of shallow phreatic aquifer, yield tests were conducted on selected open wells during the systematic hydro geological surveys and are presented in the table below. The yield of open wells varies from 150 to 200 m^3/day for a drawdown of 1 to 3 m with pumping period from 2 to 4 hours. From the yield tests, transmissitvity of shallow phreatic aquifer is within the range of 3 to 15 m^2/day and the specific yield is around 1 to 4 percent.

Location	**Specific capacity (lpm)**	**Transmittivitym^2/day**	**Specific yield %**
Cherupalur	6.31	3.946	0.84
Aramboli	28.7	12.80	4.23
Thovalai	28.5	15.92	1.97

(ii) Aquifer Systems:

Occurrence and storage of groundwater depend upon three factors viz., Geology, Topography and rainfall in the form of precipitation. Apart from Geology, wide variation in topographic profile and intensity of rainfall constitutes the prime factors

of groundwater recharge. Aquifers are part of the more complex hydro geological system and the behaviour of the entire system cannot be interpreted easily. In hard rock terrain the occurrence of Ground Water is limited to top weathered, fissured and fractured zone which extends to maximum 30 m on an average it is about 10-15 m in Kanyakumari District.

In Sedimentary formations, the presence of primary inter granular porosity enhances the transmitting capacity of groundwater where the yield will be appreciable. The sedimentary area which occupies the eastern part of the District along the coastal tract is more favourable for groundwater recharge. Ground Water occurs both in semi confined and confined conditions.

(iii) Drilling:

The drilling types are different according to the formation of the terrain. In general, DTH rigs are used in Hard rock formations for drilling a borewell at a depth ranges from 30m to 200m, according to the extension of joints, fractures, lineaments, etc in an area. In Sedimentary formations, rotary rigs with different rotors used according to the Tube well's diameter. The Bento novate clay is used in rotary rigs to avoid the collapse of the Tube well. The sedimentary tube wells are drilled up to a depth of 30m to 300m depending on the area, yield,etc. In alluvial formations, the hand rotary used for drilling tube wells ranges from 10m to 15m.In river beds, infiltration tube wells used for extraction of groundwater.

In Hard rock, the well designing is simple. The upper top soil and highly weathered zone is cased with PVC pipe and the remaining weathered, Fissured, Jointed portion is left as it is. In Kanyakumari District, the weathered zone ranges from 1.0m to 12.0m. In Granitic gneiss area, the highly weathered portion will be more up to 15m but in charnockite area, the weathered zone will extend up to 8.0m to 10.m only. In Sedimentary area, the well construction depends on the occurrence of sand thickness in the referred area. The logger is also used in the construction to identify the area of good quality of water.

2. GROUNDWATER REGIME MONITORING:

(i) <u>Notes on existing water level scenario</u>:

The water level is being monitored by State Ground & Surface Water

Resources Data Centre from 1971 onwards from a network of 1746 observation wells (shallow open wells) located all over the State. The water level readings are observed in the first week of every month by the field officers. In Kanyakumari District,33 observation wells and 16 piezometers,totally 49 wells are monitoring on Monthly basis. The Central Ground Water Board also monitors the water level from 900 numbers of wells spread all over the State. They observe water level four times in a year. (i.e January, May, August and November). The collected water level data are uploaded in GWDES software and database is maintained regularly for analysing the water level trend with rainfall. From the Monitoring network of wells, the selected representative wells are taken for Resource Estimation computations.

In Kanyakumari District, during the pre monsoon, the water level generally in declining trend ranges from G.L. to 15m. The depth of well below Ground Level ranges from 10.0m to 12.0m are become dry during summer season like May, June, July. In the post monsoon, the water level generally in upward trend due to rainfall and it may reach the Ground Level also. The water level trend maps for pre and post monsoons are included as Annexure- I & II.

(ii) <u>Long term trend of water level</u>:

The long term fluctuations of water levels range from G.L. to 14.0m in many parts of the Kanyakumari District. The analysis reveals that the water level has gone down in the north, west and central parts of the Kanyakumari District. The inference taken from the annual fluctuation is due to lack of rainfall which in turn affects the groundwater levels in phreatic aquifer. The seasonal fluctuation study reveals that due to necessity for development of ground water for different sectored needs and due to failure of monsoons, the water level has gone down. The hydrograph of observation wells water level trend from 2005 to 2017 enclosed as Annexure – III and water level trend from 2000 to 2017 of Piezometers enclosed as Annexure – IV for Kanyakumari District.

(iii) Existing network of Monitoring wells:

In Kanyakumari District, the existing network of monitoring wells is 49 wells, 33 wells are observation wells and 16 wells are piezometers. These wells are observed for every month water level.

Kanyakumari District: Observation Wells - Location and Co-ordinates

Well No	District	Tahsil / Taluk	Block / Mandal	Village	Latitude	Longitude
509001	Kanyakumari	Agatheeswaram	Agatheeswaram	Padmanabhanputhur	08°10'30"	77°29'59"
509002	Kanyakumari	Agatheeswaram	Rajakkamangalam	Keelaputheri	08°12'35"	77°26'09"
509003	Kanyakumari	Kalgulam	Thovalai	Kodandur	10°27'59"	77°26'09" 76°11'03"
509004	Kanyakumari	Kalgulam	Thiruvattar	Thiruvattar	08°19'45"	77°16'13"
509005	Kanyakumari	Thovalai	Tovalai	Chenbagaramanputhur	08°14'53"	77°29'31"
509006	Kanyakumari	Thovalai	Thovalai	Thazhakudi	08°13'48"	77°27'26"
509007	Kanyakumari	Thovalai	Thovalai	Azhagiyapandiapuram -1	08°18'54"	77°25'58"
509008	Kanyakumari	Thovalai	Thovalai	Azhagiyapandiapuram -2	08°18'33"	77°26'58"
509009	Kanyakumari	Vilavangode	Melpuram	Kalial	08°25'02"	77°15'07"
93035	Kanyakumari	Kalkulam	Thiruvattar	Kochuthuparai	08°25'00"	77°13'00"
93036	Kanyakumari	Thovala	Thovala	Thadikarakonan	08°19'32"	77°25'02"
93036 A	Kanyakumari	Thovala	Thovala	Thadikarakonan	08°19'48"	77°24'45"
93037	Kanyakumari	Kalkulam	Thukkalai	Ponthanpilavilai	08°15'35"	77°15'10"
93037A	Kanyakumari	Kalkulam	Thukkalai	Ponthanpilavilai	08°15'20"	77°18'15"
93038	Kanyakumari	Thovala	Thovala	Boothapandi	08°15'35"	77°26'43"
93038A	Kanyakumari	Thovala	Thovala	Boothapandi	08°15'25"	77°26'15"

93042	Kanyakumari	Agastheeswaram	Agastheeswaram	Puthankudiyiruppu	08°09'25"	77°26'50"
93043	Kanyakumari	Agastheeswaram	Agastheeswaram	Variyur	08°08'15"	77°33'55"
93044	Kanyakumari	Vilavancode	Munchirai	Munchirai	08°16'42"	77°10'40"
93045	Kanyakumari	Vilavancode	Melpuram	Kaliyakkavilai	08°19'45"	77°12'00"
93046	Kanyakumari	Vilavancode	Melpuram	Marthandam	08°18'22"	77°13'50"
93047	Kanyakumari	Vilavancode	Melpuram	Mulucode	08°21'25"	77°13'50"
93048	Kanyakumari	Kalkulam	Thukkalai	Kattathurai	08°17'00"	77°16'22"
93049	Kanyakumari	Vilavancode	Killiyur	Karungal	08°14'45"	77°14'25"
93049A	Kanyakumari	Vilavangode	Killiyur	Karungal	08°13'20"	77°14'30"
93050	Kanyakumari	Kalkulam	Kurunthancode	Colachel	08°10'50"	77°15'55"
93051	Kanyakumari	Kalkulam	Kurunthancode	Mondaymarket	08°11'50"	77°18'10"
93052	Kanyakumari	Kalkulam	Kurunthancode	Manavalakurichi	08°08'35"	77°19'05"
93052A	Kanyakumari	Kalkulam	Kurunthancode	Manavalakurichi	08°18'30"	77°18'30"
93053	Kanyakumari	Agastheeswaram	Rajakkamangalam	Rajakkamangalam	08°07'50"	77°22'00"
93054	Kanyakumari	Agastheeswaram	Rajakkamangalam	Kurusadi	08°10'00"	77°25'10"
93055 A	Kanyakumari	Agastheeswaram	Rajakkamagalam	Madhusudhanapuram	08°06'45"	77°27'15"
93056	Kanyakumari	Agastheeswaram	Agastheeswaram	Agastheeswaram	08°05'50"	77°31'10"
93056A	Kanyakumari	Agastheeswaram	Agastheeswaram	Agastheeswaram	08°19'32"	77°25'02"
93057	Kanyakumari	Agastheeswaram	Agastheeswaram	Mylaudy	08°09'10"	77°30'15"
93058	Kanyakumari	Thovala	Thovala	Aralvoimozhi	08°14'45"	77°31'15"
93059	Kanyakumari	Kalkulam	Kurunthancode	Villukuri	08°13'20"	77°21'10"

Kanyakumari District - Piezometers - Location and Co-ordinates

Well no	District	Tashil/Taluk	Block/Mandal	Village	Latitude	Longitude
AWLR 92014	Kanyakumari	Thovalai		Aralvoimozhi	8.247222	77.538056
AWLR 92103	Kanyakumari	Kalgulam		Mulagumoodu	8.250833	77.289722
29001D	Kanyakumari	Agastheeswaram	Agastheeswaram	Agastheeswaram	8.102778	77.525000
29002D	Kanyakumari	Agastheeswaramn	Agastheeswaram	Allivilai	8.130278	77.556944
29003D	Kanyakumari	Thovala	Thovala	Aralvoimozhi	8.251389	77.523889
29004D	Kanyakumari	Thovala	Thovala	Boothapandi	8.262222	77.447778
29005D	Kanyakumari	Agastheeswaram	Agastheeswaram	Bagavathipuram	8.148056	77.558611
29006D	Kanyakumari	Agastheeswaram	Agastheeswaram	Mylaudy(west)	8.153056	77.500833
29007D	Kanyakumari	Thovala	Thovala	Thadikkarankonam	8.329167	77.414444
29008D	Kanyakumari	Agastheeswaram	Agastheeswaram	Varioor	8.148056	77.567500
29009D	Kanyakumari	Kalkulam	Kurunthancode	Villukuri	8.223333	77.351944
29010D	Kanyakumari	Kalkulam	Kurunthancode	Veyyanur	8.286667	77.270833
29011D	Kanyakumari	Kalkulam	Thiruvattar	Mukilankarai	8.304444	77.314167
29012D	Kanyakumari	Vilavancode	Melpuram	Puliyursalai	8.420833	77.196667
29013D	Kanyakumari	Kalkulam	Thiruvattar	Thirparappu	8.394167	77.261389
29014D	Kanyakumari	Agatheeswaram	Rajakamangalam	Nagercoil (veppamoodu)	8.179444	77.426944

(iv) Data Constraints:

The following are constraints in collecting the water level data in the field and validating the data are:

1) The water level data are collected on the monthly basis in the referred observation wells and piezometers. The collected data is not sufficient quantity for analyzing purpose due to drying of wells, Wells abounded by various reasons, lack of selecting the alternate wells, lack of open wells available for monitoring purpose due to increased usage of bore wells in the villages, Panchayats, etc. In many villages, the water supply schemes implemented by overhead tank supply or mini

energised pumps and the existing open wells are not used generally by the villagers and moreover, they filled with garbage.

2) The number of bore wells should be increased for monitoring purpose.
3) The site selection of new bore wells should be based on the Geological methods.
4) Strengthening the network of monitoring wells by closing the gaps in the network.
5) Maintenance cost should be allotted to maintain the bore wells on the periodical basis to maintain the quality as well as yield.
6) Installation of Automatic water level recorders in the sensitive and more water level fluctuation in the bore wells will helpful to monitor the extensive depletion of groundwater areas.
7) Upgrading the measuring instruments will helpful to take accurate reading of water levels in the field.
8) Upgrading the soft ware will helpful to minimize the errors and increasing the accuracy of data.
9) Erecting the Telemetric water level recorders in the over exploited Firkas will helpful to monitor the over extraction of groundwater.

10)Lack of manpower and transporting vehicles are also major problems for data collection in the field in proper time.

3. DYNAMIC GROUND WATER RESOURCES:

The State Ground and Surface Water Resources Data Centre has estimated the ground water resources of Tamil Nadu periodically in co-ordination with the Central Ground Water Board, Government of India , Ministry of Water Resources, Chennai, based on the Methodology evolved by the Ground Water Resources Estimation Committee, 1997 (GEC 97).

Groundwater potential assessment is a dynamic one and not static. While assessing an area, the following factors can be considered such as Geology, Total Irrigated Area, Total Number of Wells used for Irrigation, Water Level Data for the past five years, Average Rainfall, Total Recharge, Irrigation methods adopted in the area, Cropping pattern details, Seepage factor, Specific yield, Geological conditions prevailing in that area, Recharge through Artificial recharge structures, etc.

Groundwater potential assessment proposal should be presented for approval in the Central and State Level Working Group Committees and then, presented for final approval in the Central Level Committee as well as State Level Committees.

The Ground Water Potential Assessments as on January 1992 and January 1997 were done in the State, taking the Panchayat Union Block as an Assessment Unit and the entire State **was categorized as Dark, Grey and White areas**. The Blocks with more than 85% to 100% ground water development (extraction) were categorized as “Dark Blocks” and the blocks with ground water development between 65% to 85% were categorized as “Grey Blocks” and blocks with less than 65% ground water development were categorized as “White Blocks”.

Subsequently, the **Ground Water Potential Assessment was done as on March 2003 and as on March 2009.** In these assessments, the Panchayat Union Blocks in Tamil Nadu were **categorized as Over-Exploited, Critical, Semi-Critical, Safe and Saline instead of Dark, Grey and White blocks.** The Blocks with more than 100% extraction were categorized as “Over Exploited Blocks”, the blocks with 90% to 100% extraction as “Critical Blocks”, the blocks with 65% to 90% extraction as “Semi Critical Blocks”, the blocks with less than 65% extraction as “Safe Blocks” and the bad quality blocks were categorized as “Saline Blocks”. No schemes should be formulated in over exploited and critical blocks - “Notified Blocks – A category – (Stage of Groundwater extraction is 90% and above)”.

The re-estimation of groundwater resources in the State as on March 2011 and as on March 2013 can be assessed in Micro Level basis. In these assessments, the assessing unit is Firka (Unit of Taluk) and **categorized as Over-Exploited, Critical, Semi-Critical, Safe, and Saline Firkas.** As on March 2013 assessment, in the Kanyakumari District

Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2013, Out of 1139 Firkas in the State, 358 Firkas are categorized as “Over Exploited Firkas”, 105 Firkas are categorized as “Critical Firkas”, 212 Firkas are categorized as “Semi Critical Firkas”, 429 Firkas are categorized as “Safe Firkas” and 35 Firkas are categorized as “Saline Firkas”.

In Kanyakumari District, when compared to last assessment as on March 2011,only one Firka migrated to Semi Critical category, out of 18 Firkas, other Firkas are in the “Safe Firkas” as in March 2011 assessment.

Methodology adopted for Estimation of Ground Water Potential :

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

In each assessment unit, hilly areas having slope more than 20% are deleted from the total area to get the area suitable for recharge. Further, areas where the quality of ground water is beyond the usable limits should be identified and handled separately. The remaining area after deleting the hilly area and separating the area with poor ground water quality is to be delineated into command and non-command areas. Ground water assessment in command and non-command areas are done separately for monsoon and non-monsoon seasons.

The rainfall recharge during monsoon season computed by Water Level Fluctuation (WLF) method is compared with recharge figures from Rainfall Infiltration Factor (RIF) method. In case the difference between the two sets of data are more than 20% then RIF figure is considered, otherwise monsoon recharge from WLF is adopted. While adopting the rainfall recharge figures, weight age is to be given to WLF method over adhoc norms method of RIF. Hence, wherever the difference between RIF & WLF is more than 20%, data have to be scrutinized and corrected accordingly.

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

The total annual ground water recharge of the area is the sum-total of monsoon and non-monsoon recharge. An allowance is kept for natural discharge in the non-monsoon season by deducting 5 to 10 % of total annual ground water recharge.

The balance ground water available accounts for existing ground water withdrawal for various uses and potential for future development. This quantity is termed as Net Ground Water Availability.

Net Ground Water Availability = Annual Ground Water Recharge - Natural discharge during non-monsoon season.

GEC'97 methodology has recommended norms for various parameters being used in ground water recharge estimation. These norms vary depending upon water bearing formations and agroclimatic conditions. While norms for specific yield and recharge from rainfall values are to be adopted within the guidelines of GEC'97, in case of other parameters like seepage from canals, return flow from irrigation, recharge from tanks & ponds, water conservation structures, results of specific case studies may replace the adhoc norms.

The Gross yearly ground water draft is to be calculated for Irrigation, Domestic and Industrial uses. The gross ground water draft would include the ground water extraction from all existing ground water structures during monsoon as well as during non-monsoon period. While the number of ground water structures should preferably be based on latest well census, the average unit draft from different types of structures should be based on specific studies or adhoc norms given in GEC'97 report.

The stage of Ground water Development is defined by

$$\text{Stage of Ground water Development (\%)} = \frac{\text{Existing Gross Ground water Draft for all uses}}{\text{Net annual Ground Water Availability}} \times 100$$

The units of assessment are categorized for ground water development based on two criteria – a) stage of ground water development and b) long-term trend of pre and post monsoon water levels. Four categories are - Safe areas which have ground water potential for development; Semi-critical areas where cautious ground water development

is recommended; Critical areas; Over -exploited areas where there should be intensive monitoring and evaluation and future ground water development be linked with water conservation measures.

The criteria for categorization of assessment units are as follows:

S. No.	Stage of Groundwater Development	Significant Long term Decline		Categorization
		Pre-monsoon	Post -monsoon	
1.	<=70%	No	No	SAFE
		Yes / No	No / Yes	To be re-assessed
		Yes	Yes	To be re-assessed
2.	>70% and <=90%	No	No	To be re-assessed
		Yes / No	No / Yes	SEMI – CRITICAL
		Yes	Yes	SEMI – CRITICAL
3.	>90 and <=100%	No	No	To be re-assessed
		Yes / No	No / Yes	CRITICAL
		Yes	Yes	CRITICAL
4.	>100%	No	No	To be re-assessed
		Yes / No	No / Yes	OVER- EXPLOITED
		Yes	Yes	OVER- EXPLOITED

Note:' *To be re-assessed' means that data is to be checked and reviewed. If the ground water resources assessment and the trend of long term water levels contradict each other. This anomalous situations requires a review of the ground water resource computations, as well as the reliability of water level data.*

The long term ground water level data should preferably be for a period of 10 years. The significant water level decline may be taken in consideration between 10 to 20 cm/ year depending upon the local hydro geological conditions.

Dynamic Ground Water Resources Estimation of TamilNadu As on March 2013

District Summary

(in ha.m)

KANIYAKUMARI DISTRICT							
Sl.No (District)	**District**	**Net Annual Ground Water Availability**	**Existing Gross Ground Water Draft for Irrigation**	**Existing Gross Ground Water Draft for domestic and industrial water supply**	**Existing Gross Ground Water Draft for All uses (4+5)**	**Stage of Ground Water Development {(6/3)*100} %**	**No of Over Exploited Firkas**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	KANNIYAKUMARI	23,958.61	3,192.99	1,059.93	4,252.92	18	Nil

Firka Wise Summary

(in ha.m)

KANIYAKUMARI DISTRICT							
Sl.No	**Assessment Unit (Firka)**	**Net Annual Ground Water Availability**	**Existing Gross Ground Water Draft for Irrigation**	**Existing Gross Ground Water Draft for domestic and industrial water supply**	**Existing Gross Ground Water Draft for All uses (4+5)**	**Stage of Ground Water Development {(6/3)*100} %**	**Category of the Firka**
1	ARUMANAI	622.07	12.60	47.78	60.38	10	SAFE
2	AZHAIPANDIPURAM	1,709.32	-	30.76	30.76	2	SAFE
3	BHOOTHAPANDY	1,796.10	81.00	15.67	96.67	5	SAFE
4	COLACHEL	1,254.22	268.75	47.69	316.44	25	SAFE
5	EDAICODE	674.18	-	39.07	39.07	6	SAFE
6	KANNIYAKUMARI	1,374.72	324.60	43.01	367.61	27	SAFE

7	KULASEKARAM	1,143.92	27.00	7.67	34.67	3	SAFE

KANIYAKUMARI DISTRICT

Sl.No	Assessment Unit (Firka)	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses (4+5)	Stage of Ground Water Development {(6/3)*100} %	Category of the Firka
8	KURUNTHENCODE	1,672.71	103.69	39.34	143.03	9	SAFE
9	MIDALAM	874.60	76.30	49.28	125.58	14	SAFE
10	NAGERCOIL	1,498.30	545.80	87.81	633.61	42	SAFE
11	PAINKULAM	790.77	50.70	182.65	233.35	30	SAFE
12	RAJAKKAMANGALAM	1,379.76	1,110.30	105.45	1,215.75	88	SEMI CRITICAL
13	SUCHINDRAM	2,863.86	238.70	19.72	258.42	9	SAFE
14	THIRUVATTAR	1,083.20	6.00	89.55	95.55	9	SAFE
15	THIRUVITHANCODE	1,001.27	31.50	67.62	99.12	10	SAFE
16	THOVALAI	1,650.57	225.75	21.48	247.23	15	SAFE
17	THUCKALAY	1,805.96	20.40	24.96	45.36	3	SAFE
18	VILAVANCODE	763.06	69.90	140.41	210.31	28	SAFE
TOTAL		**23,958.61**	**3,192.99**	**1,059.93**	**4,252.92**	**18**	

4. Groundwater quality issues:

The rainfall is the main source for the availability of water both in surface and sub surface. The quantum of rainfall varies every year depending upon the monsoon. However, the extraction of surface and sub surface water is increasing year by year. It leads to environmental impact on the water sources like depletion of water level, deterioration of water quality. It makes the demand for the quantification of available water and also its quality for various purposes like agriculture, industries, drinking and domestic purposes.

For the present assessment, the value of Total Dissolved Solids (TDS) have been considered for demarcation of good / bad quality areas. For this purpose, the TDS

value of less than or equal to 2000 mg/l have been considered as good quality and the value more than 2000 mg/l have been considered as bad quality areas.

The presence of fluoride in natural Ground Water is having its merits and demerits depending upon the concentration. Presence of fluoride <1.0 mg/l in drinking water reduces dental diseases whereas higher level > 1.50 mg/l will affect the health and causes dental fluoridise. Nitrate is noted significantly in Ground Water due to use of chemical fertilizer for agriculture and other local pollution rocks and soils are also contributing nitrate to Ground Water. Arsenic is another poisonous heavy metal in Ground Water. The allowable limits for drinking purposes are 0.05 mg/l.

In Kanyakumari District, the quality of Ground Water generally ranges from moderate to good quality both in the shallow dug well and bore wells except in & around the Kazhuveli tank, where the water quality is poor due to seawater intrusion in the lagoons during high tide seasons, the production of salt and Aquaculture farming.

5. Groundwater issues and challenges:

The groundwater quantity and quality are to be highlighted and may be analyzed in terms of :

(i)Problems posed by nature:

In terms of Quantitative aspects, nowadays, rainfall may more within the short period of duration. Due to this aspect, recharge is less and runoff will be more. The availability of groundwater is less due to over extraction than recharge. The Percentage of OE/Critical Firkas increased due to this reason. Increasing the artificial recharge structures in the proper areas may avoid the depletion of groundwater especially in OE/Critical Firkas.

(ii) Problems caused by anthropogenic activities:

The problems caused due to intensive groundwater extraction, intensive surface water irrigation, intensive mining activities, growing urban complexes and industrial establishments will lead to drastic depletion in groundwater resources only. Proper alternative recharge structures must be established.

(iii) Problems caused by socio-economic condition:

The land holdings of farmers may be different from another. One farmer having more than 5 Acres has less expense than a farmer having one acre. The free electric supply to all farmers have chance to extract more groundwater. To avoid this, proper guidance will be given to the farmers for the usage of groundwater.

(iv) Administrative issues:

To control, regulate and manage the Ground Water Resources in the State, there is no groundwater act, now in force. But, the **Chennai Metropolitan Area Ground Water (Regulation) Act, 1987** is in force and it extends to Chennai City and notified 302 revenue villages in Kanchipuram and Thiruvallur Districts, only.

The rest of Tamilnadu, **G.O.(Ms).No.142, Public Works (R2) Department, dated: 23.07.2014** and **G.O.(Ms).No.113, Public Works (R2) Dept , Dt:09.06.2016** are regulate and manage the groundwater resources. The Government of Tamil Nadu had enacted the **Tamil Nadu Ground Water (Development and Management) Act, 2003**. However, this **Act was repealed on 14.09.2013**, in order to enact a comprehensive law to develop and manage the groundwater in the changed scenario in the State.

The pricing policy for groundwater users is also an important strategy in controlling the illegal extraction of groundwater by taking from lorries,etc. The unused dug wells and bore wells can be used as artificial recharge structures will be good concept in recharging the ground water.

6. Groundwater Management and Regulations:

(i) <u>Statute/Law/Policy/Regulations if any</u>:

The Central Ground Water Authority has been constituted to regulate, control, development and management of ground water resources for whole country based on overall situation prevailing in India. But, the ground water conditions are varying from State to State. **Ground Water is a State subject and the State Government has every right to protect and regulate their own precious ground water resources according to the prevailing conditions in the State.**

The Tamil Nadu Government had enacted **"The Tamil Nadu Ground Water (Development and Management) Act, 2003"** which was subsequently **repealed in 2013**, so as to bring out an effective management Act considering the present scenario. **As an interim measure, for regulating the exploitation of ground water, the Government have issued G.O. (Ms) No.142,PWD dated 23.07.2014 for regulations for management of ground water for safe guarding the scarce groundwater resources in Tamil Nadu State.** In the absence of an Act, the

Government executes this Government order to control, regulate and manage the Ground Water Resources while taking into consideration of the future of the State and its people.

The State Ground and Surface Water Resources Data Centre has estimated the Ground Water resources of Tamil Nadu State periodically in co-ordination with the Central Ground Water Board, Government of India, SECR, Chennai, based on the Methodology evolved by Ground Water Resources Estimation Committee, 1997 (GEC 97).

Accordingly, **the Ground Water Potential Assessment done as on January 1992 and as on January 1997 on the basis of Panchayat Union Blocks as assessment units** in Tamil Nadu and **categorized as Dark, Grey and White areas.** The Blocks with more than 85% to 100% ground water development were categorized as “Dark Blocks” and the blocks with ground water development between 65% to 85% were categorized as “Grey Blocks” and less than 65% ground water development were categorized as “White Blocks” and the Government approved the categorisation and released as Government order and G.O.No:326, PW (R2) Dept, dated: 23.11.1993. It was in effect up to the next assessment done as on March 2003.

Subsequently, **the Ground Water Potential Assessment done as on March 2003**, **categorized the blocks as Over Exploited, Critical, Semi Critical, Safe, Saline instead of Dark, Grey and White blocks**. The Blocks with more than 100% were categorized as “Over Exploited Blocks”, the blocks in between 90% to 100% as “Critical Blocks”, the blocks in between 65% to 90% as “Semi Critical Blocks” and less than 65% as “Safe Blocks” and the bad quality blocks were categorized as “Saline Blocks” and the same was approved by the Government and released as G.O.No:51, PW (R2) Dept, dated: 11.02.2004. It was in effect up to the next assessment done as on March 2009.

The Next **Ground Water Potential Assessment done as on March 2009**, and the same was approved by the Government and **released as G.O.No:52,PW(R2) Dept, dated: 02.03.2012.**

As per G.O.No.52,PW(R2) Dept, dated: 02.03.2012 and G.O. (Ms) No.142,PW(R2)Dept dated 23.07.2014, the State Government have authorized

and empowered the Chief Engineer, State Ground and Surface Water Resources Data Centre, Chennai for issuing permission or license or No Objection Certificate/renewal for drawal and transportation of Ground Water based on the hydro geological conditions to the New Industries, Packaged Drinking Water Companies, Infrastructures and Mining projects, etc except the areas to which the Chennai Metropolitan Area Ground Water (Regulation) Act,1987 extends.

Subsequently, the next **Ground Water Resources Assessment of the State was completed as on March 2011** and taking **Firka as an assessment unit** in the State of Tamil Nadu. Based on the above assessment, **the Government had approved and issued G.O.(Ms).No.113, Public Works (R2) Dept , Dt:09.06.2016** for categorisation of the Firkas in the State as Over Exploited, Critical, Semi-Critical and Safe Firkas. All the Over Exploited and Critical Firkas are notified as **"A" Category** (where the stage of ground water extraction is 90% and Above) and all the Semi Critical and Safe Firkas are notified as **"B" Category** (where the stage of ground water extraction is below 89%). In this Government Order, the Government had directed that **no Schemes should be formulated in the "A" Category Firkas and in "B" Category Firkas, all the Schemes should be formulated through State Ground and Surface Water Resources Data Centre by issuing No Objection Certificate for Ground Water Clearance.**

The term "Schemes" excludes Energisation of Agricultural pump sets by the Tamil Nadu Electricity Board. The present order may also exclude the Ground Water drawal for a). Domestic purpose by individual household, b). Domestic Infrastructure project (Housing), c).Government's Drinking Water Supply Schemes and d). non water based industries, (i.e.- the industries which do not require and use water, either as raw material or for other processing). However, the domestic use of water by this non water based industries will be permitted by the Chief Engineer / State Ground and Surface Water Resources Data Centre based on hydro geological conditions. (i.e. NOC from Chief Engineer, State Ground and Surface Water Resources Data Centre, Water Resources Department, Chennai). The list of non water based industries will be issued by the Industries Department of Government of Tamil Nadu separately.

Appropriate rain water harvesting and Artificial recharge schemes should be carried out in the categories viz , Over exploited , Critical , Semi Critical and

Safe blocks of Tamil Nadu. While carrying out the above schemes, priority should be given to marginal quality and bad quality areas so as to avoid further deterioration.

All the schemes and proposals based on Ground Water will have to adhere to the Government orders and conditions. The Chief Engineer, State Ground and Surface Water Resources Data Centre had received the Government approval on Groundwater Assessment as on March 2011.

Regarding granting permission/ License for transportation of ground water for water suppliers/ private water tankers for selling the water on commercial basis, the State Ground and Surface Water Resources Data Centre, Public Works Department is not issuing any No Objection Certificate.

The Chief Engineer, SG&SWRDC have empowered to issue the NOC for drawal of Ground Water is up to 1 Million Gallons per day. Beyond this, the firms should get an approval in Water Utilisation Committee for drawal of both Surface and Ground Water resources in Tamil Nadu.

(ii) <u>Suggestions for improvement of groundwater governance</u>.

Groundwater is recognized as a common pool resource. The use of groundwater by anybody should in no way cause adverse impacts on realization of other person's fundamental right to safe water for life. Access to groundwater without any discrimination, equitable distribution, and sustainable use considering the needs of future generations are considered. Right to water for life is the first priority and then to agriculture, and eco system needs. The precautionary principle and the polluter pay principle only to conserve and recharge groundwater.

The responsibility of the State for ensuring every person's right to safe water even when water service is delegated to a private agency. Groundwater is not amenable to ownership by the State, communities or persons and the State is the public trustee of groundwater. It also deals elaborately on groundwater protection and groundwater security plans.

The Groundwater Act should incorporate legal pronouncement on groundwater such as the public, trust doctrine and recognition of the right to groundwater. It addresses the deficiencies in the present legal frame

work in dealing with over exploitation and includes the improvements to the control mechanism to ensure the qualitative and quantitative sustainability of groundwater resources. It proposes to strengthen the regulating powers of Panchayat and Municipal bodies related to Ground water in line with articles 243G and 243W of the constitution.

The Pricing of Ground Water for irrigation, Industrial and domestic purposes and collecting fees by water users association should be left to the State decision.

(iii) <u>Institutions governing/managing/monitoring the resources and Institutional structure, gaps if any</u> :

While framing the Groundwater Act, the recommendation for the constitution of (1) Gram Panchayat Groundwater Sub-Committee, (2) Block Panchayat Groundwater Management, (3) Ward Groundwater Committee, (4) Municipal Water Management Committee, (5) District Ground Water Council and (6) State Ground Water Advisory Council to control and manage Ground water should be considered.

- The constitution of aforesaid committees is completely based on administrative boundaries such as village, block, ward, municipality, district etc. But, with respect to water resources control and management issues and conflicts, the boundary should be based on river basins to have efficient monitoring and management of water resources. The Government of India, in all issues related to water resources considered only the basin boundary concept. Hence, the institutional frame work has to be revised so as to have the jurisdiction of the committees with respect to basin / watershed concept. Further, Government of India, MoWR, RD &GR advocates time and again integrated water resources management. The above institutional frame work separately for groundwater is not in line with that.
- Further, it has also provided for many committees, viz., Gram Panchayat Groundwater Sub-Committee, Village Water and Sanitation Committee, Ward Committee, Municipal Committee, Block level Committee, District level Committee and State level Committee. For managing surface water resource water users association already exists. Too many committees at village / ward level would

jeopardize the very purpose of managing the Groundwater resources efficiently and may invite lot of conflicts.

(iv) <u>Areas of people/private participation if any</u>:

The participation of people or private parties in the groundwater management is not suggestible, acceptable one and more chances of making litigations in the society and has unnecessary law and order problems may arise.

7. Tools and Methods

(i) Water Level and quality measurements through wells, piezometers, DWLR with telemetry, ground water elevation.

In general, water levels in the observation wells and piezometers can be taken manually by measuring tape. This is the simple, cost effective, good accuracy and less maintenance method. Water Levels are observed above the Measuring point.

Monitoring water level in DWLR with telemetry is costly, high maintenance, good accuracy, get the data immediately on desktop, easy to analysis purpose.

The water quality generally is analysed in the Chemical Lab only by collecting water samples in Pre Monsoon and post Monsoon period in the field. Sometimes, instant kits are used for analyzing the TDS and Ph level in the water.

(ii) Metering water supply to confirm contribution from groundwater.

Metering the water supply is essential one to monitor the overall usage of groundwater by different sectors. Flow meter must be fixed in every extraction structure and it has to be monitored periodically by Government officials.

8. Performance Indicators:

(i) Bench Marks/ Norms/ Standards and deviation from the norms/bench marks/ standards currently.

The Ground Water resources of State periodically estimated in co-ordination with the Central Ground Water Board, Government of India, SECR, Chennai, based on the Norms evolved by Ground Water Resources Estimation Committee, 1997 (GEC 97).

The ground water potential assessment can be assessed based on the bench marks such as Average Rainfall, Total recharged Area, Monthly Water Level Data, Total no of wells in the area, Irrigation methods adopted, Cropping pattern details,

Geological conditions prevailing in that area, Specific yield, Seepage factor, Constructed Artificial recharge structures, etc and various calculations methods, etc, have to be considered.

Status of various Performance Indicators

(ii) Percentage of over exploited ,critical, Semi critical , Safe and Saline/Poor quality Firkas/area units

- Trend of over exploited and critical Firkas to total Firkas as per pervious assessment. (2009 Assessment Vs 2011 Assessment)

  The Ground Water Potential Assessment as on March 2009, Out of 22 blocks in Kanyakumari District, 9 blocks are categorized as Safe blocks.

  The next Ground Water Resources Assessment of the State was done as on March 2011 and taking Firka as an assessment unit. In Kanyakumari District, totally 18 Firkas, all 18 Firkas are categorized as Safe Firkas.

  Instead of taking Block as an assessment, Firka can be taken as assessment unit is to concentrate the assessment in micro level. For Eg, a block contains more than three to four Firkas. In this block, two Firkas may have good groundwater potential than other two Firkas but it may to categorize as Over Exploited. To avoid this, assessment done on the basis of Firkas for the benefit of farmers to the implementation of schemes related to Irrigation.

  The percentage of over exploited and critical Firkas has been increased by changing the concept from Block to Firka assessment. The total percentage of over exploited and critical Blocks for 2009 Assessment is Nil, but, the total percentage of over exploited and critical Firkas as on March 2011 Assessment is Nil, in the Kanyakumari District.

- **Trend of over exploited and critical Firkas to total Firkas as per latest assessment**

  The percentage of over exploited and critical Firkas has been decreased in 2013 latest assessment when compared to 2011 assessment is NIL.

- **<u>Existing state of groundwater resources as compared to previous assessment</u> (2013 Vs 2011 assessment).**

Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2013, Out of 18 Firkas in the District, 17 Firkas are categorized as “Safe Firkas” and one Firka is categorized as “Semi Critical Firka”.

Based on the Estimation of Ground Water Resources of Kanyakumari District as on March 2011, all 18 Firkas are categorized as “Safe Firkas”.

When compared to last assessment as on March 2011, the “Safe Firkas” comes down from 18 to 17 Firkas, One Firka moves to the Semi Critical category.

S.No	Categorisation	No of Firkas	
		2011	2013
1	Over Exploited	Nil	Nil
2	Critical	Nil	Nil
3	Semi Critical	Nil	01
4	Safe	18	17
5	Saline	Nil	Nil
TOTAL		18	18

(iii) Water Level(Well hydrographs and water level trends – pre and post monsoon such as declining trend/rising trend,etc).

(iv) Comparison of area irrigated from groundwater resources (Current assessment 2013 to previous assessment 2011).

S.No	Description	2011 Assessment	2013 Assessment
1	Area Irrigated from ground water resources(In hm)	6538.07	6505.06

(v) No. of groundwater abstraction structures (existing no. over the year and trends).

S.No	Description	2011 Assessment	2013 Assessment
1	No of groundwater abstraction structures for Irrigation	1,71,071 Wells	1,70,983 Wells

(vi) **Trend in water quality** (no of habitations affected with groundwater contamination like As, F, Salinity etc. Change in contamination level over the years.

(vii) **Source augmentation (Groundwater)**

- **Area covered with infrastructure for recharging groundwater:**

The proper artificial recharge structures has to be constructed based on local geological conditions in the areas of existing infrastructure for recharging groundwater according to their extraction needs.

- **GW recharge plan to combat adversaries:**

Groundwater recharge plans has to be strictly followed by with of implementing the groundwater laws to combat adversaries.

9. Reforms undertaken/being undertaken/proposed if any.

10. Road Map of activities/tasks proposed for better governance with timelines and agencies responsible for each task/activity.