

**CHAPTER 4.1.9 GROUND WATER RESOURCES
RAMANATHAPURAM DISTRICT**

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GROUND WATER REPORT OF RAMANATHAPURAM DISTRICT

INTRODUCTION :

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 Ramanathapuram District is 4089.57 sq.km. Accounting for 3.14 percent of the geographical area of Tamil Nadu State. The district has well laid out roads and railway lines connecting all major towns within and outside the state. For administrative purpose, this district has been bifurcated into 7 Taluks, 11 Blocks and 38 Firkas. Ramanathapuram is a major town and district Headquarter (vide map No.1 and Table No. 1) Ramanathapuram District falls between the following co-ordinates:

Latitude : 09°06'00" - 09°54' 00"

Longitude: 78°13'00"- 79°26'00"

Ramanathapuram District is Totally bifurcated into 38 Firkas.

1. Hydrogeology

(i) Major Geological formations:

Geology

Geologically, the entire district is comprised of sedimentary formations of alluvium, tertiary except 1% of hard rock formations of Quartzite and gneissic formations.

Quaternary deposits occur at the top and they range in thickness from 30m to 160m from west to east. They consist of sand, silt, clay, calcareous sand stone fossiliferous sand stone, etc.,

Tertiary deposits occur below the Quaternaries and they range in thickness from 200-250 m. They consist of sandstone and mottled clay. Cretaceous formation underlain the tertiaries and the rock types include chiefly limestone.

The archaean basement rock is reported to occur at a depth varying from 1000m to 1700m from ground level as per the information obtained from ONGC. At Mandapam, the basement is met with at a depth of 1641m which is revealed from the bore hole drilled by ONGC.

Drilling of bore holes

The occurrence and movement of groundwater in hard rock formations are restricted to the porous zones of weathered formations and the open systems of fractures, fissures and joints. Generally, in hard rock regions, occurrence of weathered thickness is discontinuous both in space and depth. Hence recharge of groundwater in hard rock formations is influenced by the intensity and depth of weathering. The subsurface lithological condition and the aquifer characters can be ascertained by drilling exploratory boreholes and conducting pump tests.

The sedimentary tract of the River alluvium is restricted to either side of the river and the thickness of alluvium is estimated to be around 20-50m.

The State Ground and Surface Water Resources Data Centre, during the course of investigation has drilled more than 197 boreholes spread over the entire district.

Aquifer parameters

a) Hard rock

The thickness of aquifer in this district is highly erratic and varies between 10m and 40m below ground level. The intergranular porosity is essentially depending upon the intensity and degree of weathering and fracture development in the bed rock. No boreholes have been drilled in hard rock formations.

b) River alluvium: Sedimentary area

The river alluvium occurs as a major patch in Ramanathapuram district. The ranges of parameter values for alluvium are furnished below.

Parameters	Range
Well yield in LPM	315-1080 lpm
Transmissivity (T) m ² /day	210-1500 m ² /day
Permeability (K) m/day	20-50 m/day
Depth range in m	20-30 m

c) Coastal alluvium

The coastal alluvium occurs as the entire coastal track of Ramanathapuram district. The range of parameter values for coastal sand are furnished below.

Parameters	Range
Well yield in LPM	650-2200lpm
Transmissivity (T) m ² /day	350-2500 m ² /day
Permeability (K) m/day	45-95 m/day
Depth range in m	30-50 m

(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 Bentonite 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 Villupuram 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) Notes on existing water level scenario:

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 Ramanathapuram District, totally 110 observation wells and 14 piezometers, totally 124 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 Ramanathapuram District, during the pre monsoon, the water level generally in declining trend ranges from G.L. to 15m. The depth of well below GroundLevel 12.0m are become dry during hot 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) Long term trend of water level:

The long term fluctuations of water levels range from G.L. to 14.0m in many parts of the Ramanathapuram District. The analysis reveals that the water level has gone down in the north, west and central parts of the Ramanathapuram 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 sector 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 Ramanathapuram District.

(iii) Existing network of Monitoring wells:

In Ramanathapuram District, the existing network of monitoring wells is 124 wells, 110 wells are observation wells and 14 wells are piezometers. These wells are observed for every month water level.

Ramanathapuram District: Observation Wells - Location and Co-ordinates

Well No	District	Tahsil / Taluk	Block / Mandal	Village	Latitude	Longitude
506001	Ramanathapuram			Mallal	09°19'59"	78°42'41"
506002	Ramanathapuram			M.karisalkualm	09°13'09"	78°26'48"
506003	Ramanathapuram			Keelamundal(mariyur)	-	-

506004	Ramanathapuram			Sathar Kovil(valinokkam)	08°46'50"	77°44'24"
506005	Ramanathapuram			Keelaseluvanur	09°12'04"	78°34'19"
506006	Ramanathapuram			Pasumpon	09°21'12"	78°50'53"
506007	Ramanathapuram			Eluvanur	09°30'04"	78°21'42"
506008	Ramanathapuram			Keelaramanathi	09°24'11"	78°18'27"
506009	Ramanathapuram			Peraiyur	09°21'24"	78°26'53"
506010	Ramanathapuram			Authankottankudi	-	-
506011	Ramanathapuram			Klamsembur	-	-
506012	Ramanathapuram			Orivayal	09°14'01"	78°32'57"
506013	Ramanathapuram			Thaduthalankotta i	09°33'49"	78°22'51"
506014	Ramanathapuram			Vengattankurichi	-	-
506015	Ramanathapuram			Puliyankulam	09°53'02"	78°10'50"
506016	Ramanathapuram			S.kodikulam	09°21'37"	78°41'49"
506017	Ramanathapuram			Mavilangai	11°07'25"	78°45'20"
506018	Ramanathapuram			Thaniyapuli	-	-
506019	Ramanathapuram			Ariyankottai	9°33'59"	78°47'43"
506020	Ramanathapuram			Kattivayal	9°50'05"	79°00'34"
506021	Ramanathapuram			Keezhakottai	9°25'25"	78°40'37"
506022	Ramanathapuram			Kttivayal	-	-
506023	Ramanathapuram			Kulathur	10°35'08"	79°07'25"
506024	Ramanathapuram			Nallirukkai	09°18'11"	78°42'01"
506025	Ramanathapuram			Kombuthi	09°16'01"	78°44'13"

506026	Ramanathapuram			Pullanthai	09°13'53"	78°44'25"
506027	Ramanathapuram			Kanjerankudi	-	-
506028	Ramanathapuram			Panjanthangi	-	-
506029	Ramanathapuram			Kuthakottai	-	-
506030	Ramanathapuram			Kalimankundu	09°15'56"	78°51'59"
506031	Ramanathapuram			Raja Sooriyamadai	09°19'58"	78°40'60"
506032	Ramanathapuram			Kusavankudi	-	-
506033	Ramanathapuram			Vellamarichikatti	09°19'32"	78°45'43"
506034	Ramanathapuram			Kalugoorani	-	-
506035	Ramanathapuram			Kumbaram	09°18'10"	78°56'35"
506036	Ramanathapuram			Pudumadam	09°16'38"	78°59'38"
506037	Ramanathapuram			Aathankarai	09°11'13"	78°06'59"
506038	Ramanathapuram			Therbhogi	09°23'29"	78°55'38"
506039	Ramanathapuram			Peruvayal South	09°27'31"	78°51'97"
506040	Ramanathapuram			Naranamagalam	09°31'35"	78°51'57"
506041	Ramanathapuram			Vaniyavallam	09°23'47"	78°41'17"
506042	Ramanathapuram			Ponmari	-	-
506043	Ramanathapuram			Raja Singa Mangalam	09°38'19"	78°50'27"
506044	Ramanathapuram			Sholandur	09°34'56"	78°51'22"
506045	Ramanathapuram			Varavanai	10°44'52"	78°13'28"
506046	Ramanathapuram			Nilamazhagiyam angalam	-	-

506047	Ramanathapuram			Peruvakottai	10°34'05"	79°25'60"
506048	Ramanathapuram			Thamodaranpattinam	09°47'33"	79°04'03"
506049	Ramanathapuram			Thiruvadi Midiyur	10°59'50"	79°27'08"
506050	Ramanathapuram			Thiruvettriur	09°42'30"	78°57'01"
506051	Ramanathapuram			Anjukottai	09°49'04"	78°56'14"
506052	Ramanathapuram			Melakottai	10°32'10"	77°34'03"
83119	Ramanathapuram	Mudukulathur	Mudukulathur	Mudukulathur	09°21'00"	78°31'00"
83119A	Ramanathapuram	Mudukulathur	Mudukulathur	Mudukulathur	09°20'00"	78°31'00"
83120B	Ramanathapuram	Kadaladi	Kadaladi	Sikkal	09°15'00"	78°39'00"
83121	Ramanathapuram	Kamudhi	Kamudhi	Kamudhi	09°25'00"	78°21'00"
83121A	Ramanathapuram	Kamudhi	Kamudhi	Kamudhi	09°24'50"	78°22'00"
83121B	Ramanathapuram	Kamudhi	Kamudhi	Kamudhi	09°24'50"	78°22'00"
83128 C	Ramanathapuram	Paramakudi	Paramakudi	Paramakudi	09°32'06"	78°35'51"
83128B	Ramanathapuram	Paramakudi	Paramakudi	Paramakudi	09°32'40"	78°35'40"
83130 C	Ramanathapuram	Paramakudi	Paramakudi	Kamudhakkudi	09°34'08"	78°32'33"
83130B	Ramanathapuram	Paramakudi	Paramakudi	Kamudhakkudi	09°33'00"	78°31'00"
83132A	Ramanathapuram	Paramakudi	Thiruppulani	Thiruppulani	09°19'00"	78°44'00"
83132B	Ramanathapuram	Paramakudi	Thiruppulani	Thiruppulani	09°19'00"	78°44'00"
83133A	Ramanathapuram	Ramanathapuram	Thiuppulani	Kilakkarai	09°13'00"	78°47'00"
83133B	Ramanathapuram	Ramanathapuram	Thiruppulani	Keelakkarai	09°13'00"	78°47'00"
83134A	Ramanathapuram	Ramanathapuram	Ramanathapuram	Ramanathapuram	09°22'15"	78°49'50"
83135	Ramanathapuram	Ramanathapuram	Mandabam	Mandapam	09°17'00"	79°10'00"
83136A	Ramanathapuram	Ramanathapuram	Mandabam	Devipattinam	09°28'00"	78°34'00"

83138A	Ramanathapuram	Thiruvadanai	Thiruvadanai	Thiruvegampattu	09°50'00"	78°46'00"
83139B	Ramanathapuram	Thiruvadanai	Thiruvadanai	Thiruvadanai	09°47'00"	78°56'00"
83140C	Ramanathapuram	Thiruvadanai	Thiruvadanai	Thondi	09°42'00"	79°01'05"
83141 B	Ramanathapuram	Thiruvadanai	R.s.mangalam	R.s.mangalam	09°38'14"	78°50'22"
83141A	Ramanathapuram	Thiruvadanai	R.S.Mangalam	R.S. Mangalam	09°40'05"	78°54'58"
83149A	Ramanathapuram	Rameswaram	Mandabam	Rameswaram	09°17'00"	79°16'25"
83152	Ramanathapuram	Thiruvadanai	Thiruvadanai	Oriyur	09°50'47"	79°03'04"
83264	Ramanathapuram	Thiruvadanai	Thiruvadanai	Kayankadu	09°49'55"	78°46'35"
83267	Ramanathapuram	Thiruvadanai	R.S.Mangalam	Chattramkudi	09°36'46"	78°55'42"
83272A	Ramanathapuram	Paramakudi	Paramakudi	Parthibanoor	09°35'00"	78°27'00"
83276	Ramanathapuram	Paramakudi	Bogalur	Bogalur	09°24'25"	78°42'40"
83277	Ramanathapuram	Paramakudi	Bogalur	Viravanendal	09°24'35"	78°46'00"
83279A	Ramanathapuram	Ramanathapuram	Mandabam	Chittarkottai	09°25'40"	78°54'00"
83279B	Ramanathapuram	Ramanathapuram	Mandabam	Chittarkottai	09°25'40"	78°54'00"
83280	Ramanathapuram	Ramanathapuram	Ramanathapuram	Valantaravai	09°20'10"	78°54'50"
83281A	Ramanathapuram	Ramanathapuram	Mandabam	Sembadayarkulam	09°20'00"	78°45'00"
83282	Ramanathapuram	Ramanathapuram	Ramanathapuram	Uchipuli	09°18'30"	79°01'10"
83283	Ramanathapuram	Ramanathapuram	Mandabam	Idayarvalasai	09°10'45"	79°06'50"
83284	Ramanathapuram	Rameswaram	Mandabam	Pamban	09°16'45"	79°12'50"
83285A	Ramanathapuram	Ramanathapuram	Thiruppulani	Regunathapuram	09°16'00"	78°54'30"
83286	Ramanathapuram	Ramanathapuram	Thiruppulani	Uttarakosamangali	09°18'50"	78°44'25"
83287A	Ramanathapuram	Mudukulathur	Mudukulathur	Mattiyarendal	09°19'50"	78°40'20"

83288	Ramanathapuram	Mudukulathur	Mudukulathur	Teriruveli	09°19'25"	78°37'55"
83288A	Ramanathapuram	Mudhukulathur	Mudhukulathur	Teriruveli	09°19'27"	78°37'56"
83289	Ramanathapuram	Kadaladi	Kadaladi	Idambadal	09°15'00"	78°41'10"
83289A	Ramanathapuram	Kadaladi	Kadaladi	Idambadal	09°15'00"	78°41'10"
83290A	Ramanathapuram	Kadaladi	Kadaladi	Ervadi	09°13'45"	78°42'25"
83291	Ramanathapuram	Kadaladi	Kadaladi	Terkumookkaiyur	09°07'45"	78°28'50"
83292A	Ramanathapuram	Mudukulathur	Mudukulathur	Vilangulathur	09°23'35"	78°32'05"
83297A	Ramanathapuram	Kamudhi	Kamudhi	Sengappadai	09°21'40"	78°25'45"
83298A	Ramanathapuram	Kamudhi	Kamudhi	Kovilankulam	09°16'15"	78°25'00"
83299	Ramanathapuram	Kadaladi	Kadaladi	Vadakkunarippaiyur	09°07'30"	78°25'00"
83300	Ramanathapuram	Kadaladi	Kadaladi	Sevalpatti	09°08'00"	78°21'25"
83301A	Ramanathapuram	Kadaladi	Kadaladi	Thirumalugandan kottai	09°11'40"	78°20'45"
83302A	Ramanathapuram	Kamudhi	Kamudhi	Perunali	09°15'15"	78°19'15"
83303A	Ramanathapuram	Kamudhi	Kamudhi	N.Balasubramani apuram	09°24'20"	78°16'10"
83304	Ramanathapuram	Kamudhi	Kamudhi	Kilramanadhi	09°24'25"	78°18'25"
83304 A	Ramanathapuram	Kamudhi	Kamudhi	Kilaramanadhi	09°24'23"	78°18'39"
83305A	Ramanathapuram	Kamudhi	Kamudhi	Mandalamanickam	09°27'40"	78°28'25"
83307	Ramanathapuram	Rameswaram	Mandapam	Jadayutheertham	09°14'00"	79°20'00"
83308A	Ramanathapuram	Rameswaram	Mandapam	Thangachimadam	09°17'00"	79°15'15"

Ramanathapuram District - Piezometers - Location and Co-ordinates

Well no	District	Tashi/Taluk	Block/Mandal	Village	Latitude	Longitude
26001	Ramanthapuram	Tiruvadanai	Tiruvadanai	Tiruppakottai	9.891667	78.883333
26002	Ramanathapuram	Thiruvadanai	Thiruvadanai	Visumbur	9.900556	78.946111
26003	Ramanthapuram	Tiruvadanai	Tiruvadanai	Pandukudi	9.806111	78.946111
26004	Ramanthapuram	Tiruvadanai	R.s.mangalam	Ayangudi	9.718056	78.820833
26005	Ramanathapuram	Mudukulathur	Mudukulathur	Vallakulam Perumal Koil	9.493056	78.536111
26006	Ramanathapuram	Paramakudi	Paramakudi	Parthibanur	9.583333	78.455556
26007	Ramanathapuram	Paramakudi	Paramakudi	Manjur	9.466667	78.650000
26008	Ramanathapuram	Paramakudi	Bogalur	Chadrakudi	9.402778	78.686111
26009	Ramanathapuram	Paramakudi	Nainarkoil	S.v.mangalam	9.497222	78.758333
26010	Ramanathapuram	Mudukulathur	Mudukulathur	Mudukulathur	9.344444	78.516667
26011	Ramanathapuram	Ramanathapuram	Thirupullani	Thirupullani	9.291667	78.809722
26012	Ramanathapuram	Mudukulathur	Kadaladi	Sayalkudi	9.169444	78.447222
26013	Ramanathapuram	Kamudhi	Kamudhi	Pondampuli	9.237500	78.358333
26016 EX	Ramanathapuram			Nallangudi	9.346389	78.805556

(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 help to monitor the extensive depletion of groundwater areas.
 - 7) Upgrading the measuring instruments will help to take accurate reading of water levels in the field.
 - 8) Upgrading the software will help to minimize the errors and increase the accuracy of data.
 - 9) Erecting the Telemetric water level recorders in the over-exploited Firkas will help 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 Ramanathapuram 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”.

When compared to last assessment as on March 2011, the “Over Exploited Firkas” comes down from 374 to 358 Firkas, the “Critical Firkas” increased from 48 to 105 Firkas, the “Semi Critical Firkas” comes down marginally from 235 to 212 Firkas, the “Safe Firkas” comes down marginally from 437 to 429 Firkas and the “Saline Firkas” remains same as 35 Firkas. The alteration of Firkas are due to the construction of Artificial Recharge structures such as Check Dams, Recharge Wells, Recharge shafts, percolation ponds; etc was constructed in the “Over Exploited Firkas” by various departments.

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)

RAMANATHAPURAM 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	CHENNAI	1,496.90	0.00	2,768.26	2,768.26	185	20

Firka Wise Summary

(in ha.m)

RAMANATHAPURAM 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	AANANDHUR	1,905.93	27.90	31.52	59.42	3	SAFE
2	AAPPANUR	1,713.26	64.50	65.76	130.26	8	SAFE
3	ABIRAMAM	2,169.83	328.00	50.10	378.10	17	SAFE
4	BOGALUR	2,184.03	243.30	55.79	299.09	14	SAFE
5	DEVIPATTINAM	2,499.62	93.00	65.92	158.92	6	SAFE
6	KADALADI	-	-	-	-	--	SALINE
7	KAKKUR	1,051.06	37.74	31.53	69.27	7	SAFE

RAMANATHAPURAM 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	KAMUTHI EAST	1,262.70	64.80	46.13	110.93	9	SAFE
9	KAMUTHI WEST	1,755.71	340.43	65.43	405.85	23	SAFE
10	KEELAKKARAI	1,274.59	424.80	36.73	461.53	36	SAFE
11	KEELATHUVAL	1,147.93	103.60	45.81	149.41	13	SAFE
12	KILIYUR	1,998.82	123.50	33.94	157.44	8	SAFE
13	KOVILANKULAM	1,379.09	446.85	21.58	468.43	34	SAFE
14	MANDAPAM	1,175.60	722.40	59.71	782.11	67	SAFE
15	MANGALAKUDI	-	-	-	-	--	SALINE
16	MANJUR	1,795.81	124.50	39.02	163.52	9	SAFE
17	MELACHELVANUR	-	-	-	-	--	SALINE
18	MELAKODUMALUR	1,122.28	25.00	36.85	61.85	6	SAFE
19	MUDUKULATHUR NORTH	1,588.84	38.00	25.79	63.79	4	SAFE
20	MUDUKULATHUR SOUTH	-	-	-	-	--	SALINE
21	NAINARKOIL	2,367.76	142.20	38.19	180.39	8	SAFE
22	PARAMAKUDI	2,233.82	246.40	61.85	308.25	14	SAFE
23	PARTHIPANOR	4,018.72	271.20	73.13	344.33	9	SAFE
24	PERUNAAZHI	877.34	90.23	28.93	119.15	14	SAFE
25	PERUNKULAM	1,399.18	1,003.50	81.66	1,085.16	78	SEMI CRITICAL
26	PULLUR	2,443.84	36.53	51.97	88.49	4	SAFE
27	R.S.MANGALAM	2,176.63	30.55	36.66	67.21	3	SAFE
28	RAMANATHAPURAM	1,517.69	196.80	80.84	277.64	18	SAFE
29	RAMESWARAM	586.44	244.00	47.31	291.31	50	SAFE
30	S.THARAIKUDI	-	-	-	-	--	SALINE
31	SAYALKUDI	-	-	-	-	--	SALINE

32	SHOLANDHUR	2,969.48	33.52	49.87	83.39	3	SAFE
33	SIKKAL	-	-	-	-	--	SALINE
34	T.U.MANGAI	1,918.58	342.00	52.70	394.70	21	SAFE
35	THERIRUVELI	1,286.87	61.80	35.94	97.74	8	SAFE
36	THIRUPULLANI	-	-	-	-	--	SALINE
37	THIRUVADANI	2,141.07	24.00	52.89	76.89	4	SAFE
38	THONDI	-	-	-	-	--	SALINE
TOTAL		51,962.52	5,931.04	1,403.53	7,334.57	14	

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 Ramanathapuram 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 Kazhuvveli 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) Statute/Law/Policy/Regulations if any:

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) Suggestions for improvement of groundwater governance.

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) Institutions governing/managing/monitoring the resources and Institutional structure, gaps if any :

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) Areas of people/private participation if any:

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 11 blocks in Ramanathapuram District, 11 blocks are categorized as Semi Critical and 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 Ramanathapuram District, totally 38 Firkas, 38 Firkas are categorized as Safe blocks and Saline.

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 Ramanathapuram 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. In 2011 assessment, out of 38 Firkas, the total percentage of over exploited and critical Firkas is Nil but, In 2013 assessment, out of 38 Firkas, it has been come down marginally to Nil in the Ramanathapuram District.

- Existing state of groundwater resources as compared to previous assessment (2013 Vs 2011 assessment).

Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2013, Out of 38 Firkas in the District, 1 Firkas are categorized as “Semi Critical Firkas”, 37 Firkas are categorized as “Safe Firkas” and “Saline”.

Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2011, Out of 38 Firkas in the District, 29 Firkas are categorized as “Safe Firkas”,9 Firkas are categorized as “Saline”.

When compared to last assessment as on March 2011, the “Semi Critical Firkas” increased marginally from Nil to 1 Firkas, the “Safe Firkas” decreased from 29 to 28 firkas and the “Saline Firkas” maintains same as 9 Firkas. The alteration of Firkas are due to the construction of Artificial Recharge structures such as Check Dams, Recharge Wells, Recharge shafts, percolation ponds; etc was constructed in the “Over Exploited Firkas” by various departments.

S.No	Categorisation	No of Firkas	
		2011	2013
1	Over Exploited	Nil	Nil
2	Critical	Nil	Nil
3	Semi Critical	Nil	1
4	Safe	29	28
5	Saline	9	9
TOTAL		38	38

(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.