CHAPTER 4.1.9 GROUND WATER RESOURCES

ARIYALUR DISTRICT

INDEX

GROUND WATER REPORT OF ARIYALUR 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

Ariyalur district located in the Central eastern part of Tamil Nadu lies between North Latitudes 10º52'30"-11º25'20"and East Longitudes 78º57'00"-79º31'00". Ariyalur district with Headquarter at Ariyalur consists of two Revenue Divisions of Ariyalur and Udayarpalayam three Taluks of Ariyalur, Sendurai and Udayarpalayam.The district is further divided into six development blocks viz., Andimadam, Ariyalur, Jayankondan, Sendurai, T.Palur and Thirumanur for administrative reasons. The district comprises 15 Firkas with 201 Village Panchayats, two town Panchayats and two municipalities. It is an inland district without coast line.

Ariyalur District is totally bifurcated into 15 Firkas.

1. HYDROGEOLOGY

(i) Major Geological formations:

Ariyalur District is underlain by crystalline metamorphic complex in the western parts of district and sedimentary tract in eastern side. An area of 4551 Sq.km is covered by crystalline rocks (63%)and 2671 Sq.km is covered by sediments(37%). The general geological sequence of formation is given below:

Quaternary - Laterites, Sands and Clays

Tertiary - Sandstone, Gravels and Clays

Cretaceous - Limestone, Calcareous Sandstone and Clay

unconformity.

Archaean - Charnockites, Gneisses, Granites, Dolerites and Pegmatite

- The major part of the area is covered by metamorphic crystalline rocks of charnockite, granitic gneiss of Archaean age intruded by dolerite dykes and pegmatite veins. These rocks are highly metamorphosed and have been subjected to very severe folding, crushing and faulting.
- Ground Water occurs under the phreatic condition and wherever there are deep seated fractures, it occurs under semi-confined to confined conditions.
- Occurrence of Ground Water in hard rock depends upon the intensity and depth of weathering, fractures and fissures present in the rocks.
- Granites and gneisses yield moderately compared to the yield in Charnockites.
- Depth of well in hard rock generally ranges between 8 and 15m below ground level.
- Generally yield in open wells ranges from 30 to 250m^3/day and in bore well between 260 and 430 m^3/day.The weathered thickness varies from 2.5 m to 42m in general there are 3 to 5 fracture zones within 100 m and 1 to 4 fracture zones between 100 and 200 m.

The **Cretaceous formation** is represented by Arenaceous Lime stone, Calcareous sand - stone and marl.

The **Tertiary formation** is argillaceous comprising of Silty clay stones, argillaceous Lime stone.

The **Quaternary deposits** represented by the river deposits of Ponnaiyar and Varahanadhi spread over as patches in Ariyalur District. The alluvium consists of unconsolidated sands, gravelly sands, clays and clayey sands. The thickness of the sands ranges between 15 and 25 m in the alluvial formation which also form potential aquifers. In some areas, sand stone of tertiary formation are the potential groundwater reservoirs.

(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 Ariyalur 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. A brief description of occurrence of groundwater in each formation is furnished below.

Alluvial Formations

In the river alluvium groundwater occurs under water table condition. The maximum thickness is 37 m and the average thickness of the aquifer is approximately 12 m. These formations are porous and permeable which have good water bearing zones.

Tertiary Cuddalore sandstone

Tertiary formations are represented by Cuddalore Sandstone and characterised as fluvial to brakish marine deposits. Predominantly this formation is divided into Lower and Upper Cuddalore formations. In the Upper Cuddalore formations the groundwater occurs in semi confined conditions, whereas in the Lower Cuddalore the groundwater occurs in confined condition with good groundwater potential.

Cretaceous Formations

Groundwater occurring in the lens shape in the sandy clay lenses and fine sand is underlain by white and black clay beds which constitute phreatic aquifer depth which

ranges 10m to 15m below ground level. Phreatic aquifer in Limestone is potential due to the presence of Oolitic Limestone.

Hard Rock Formations

Groundwater occurs under water table conditions but the intensity of weathering, joint, fracture and its development is much less in other type of rocks when compared to gneissic formation. The groundwater potential is low, when compared with the gneissic formations.

- **Granitic Gneiss**

Groundwater occurs under water table conditions in weathered, jointed and fractural formations. The pore space developed in the weathered mantle acts as shallow granular aquifers and forms the potential water bearing and yielding zones water table is shallow in canal and tank irrigation regions and it is somewhat deeper in other regions.

- **Charnockite**

Groundwater occurs under water table conditions but the intensity of weathering, joint, fracture and its development is much less when compared to gneissic formations. The groundwater potential is low, when compared with the gneissic formations.

Aquifer Parameters

The thickness of aquifer in this district is highly erratic and varies between 15 m to 40 m below ground level. The inter granular Porosity is essentially dependent on the intensity and degree of weathering and fracture development in the bed rock. As discussed earlier deep weathering has developed in Gneissic formations and moderate weathering in charnockite formations. The range of aquifer parameters in hard rock and sedimentary formations are give below:

Table - 11 Range of aquifer parameters

Name	Sp. Capacity (lpm/d)	Specific Yield (%)	T (m^2/d)	K (m/day)	Yield of wells (lps)
Alluvium	2.08	7.2	98	19.7	2.5
Tertiary	78-173	1.4-3.5	46-134	16-33	2-3.3
Cretaceous	33-782	0.3-2.56	33-782	10-66	1.1-3.5
Crystalline	27-224	0.8-2.5	16-60	5-20	1-2

(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 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 Ariyalur District, 85 observation wells and 12 piezometers,totally 97 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 Ariyalur 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 Ariyalur District. The analysis reveals that the water level has gone down in the north, west and central parts of the Ariyalur 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 Ariyalur District.

(iii) Existing network of Monitoring wells:

In Ariyalur District, the existing network of monitoring wells is 97 wells, 85 wells are observation wells and 12 wells are piezometers. These wells are observed for every month water level.

Ariyalur District: Observation Wells - Location and Co-ordinates

Well No	District	Tahsil / Taluk	Block / Mandal	Village	Latitude	Longitude
43026A	ariyalur	Udayarpalayam	Jayamkondam	Kuruvalapperkovil	11°12'18"	79°26'54"
43027	ariyalur	Udayarpalayam	Jayamkondam	Jayamkonda Cholapuram	11°12'45"	79°21'30"
43028	ariyalur	Udayarpalayam	Jayamkondam	Udaiyarpalayam	11°11'15"	79°18'00"
43028A	ariyalur	Udayarpalayam	Jayamkondam	Udaiyarpalayam	11°11'15"	79°18'00"
43029	ariyalur	Udayarpalayam	T.pazhur	T.pazhur (u)	11°05'35"	79°22'35"
43029 A	ariyalur	Udayarpalayam	T.pazhur	T. Pazhur	11°05'45"	79°22'30"
43029A	ariyalur	Udayarpalayam	T.pazhur	T. Pazhur	11°05'45"	79°22'30"
43030 A	ariyalur	Udayarpalayam	T.pazhur	Kodali	11°08'50"	79°25'43"
43030A	ariyalur	Udayarpalayam	T.pazhur	Kodali	11°08'50"	79°25'43"
73011A	ariyalur	Senthurai	Senthurai	Aathanakurichi	11°20'45"	79°14'45"
73012	ariyalur	Udayarpalayam	Andimadam	Agaram	11°21'15"	79°19'45"
73013	ariyalur	Udayarpalayam	Andimadam	Varadharajanpettai	11°20'45"	79°25'15"
73020	ariyalur	Senthurai	Senthurai	Senthurai	11°15'05"	79°10'45"
73021	Ariyalur	Sendurai	Sendurai	Ponparappi	11°16'15"	79°14'30"
73022	ariyalur	Udayarpalayam	Andimadam	Devanur	11°15'45"	79°19'15"
73023	ariyalur	Udayarpalayam	Andimadam	Kallattur	11°15'30"	79°22'30"
73024	ariyalur	Udayarpalayam	Jayamkondam	Pappakudi	11°15'45"	79°30'15"
73033	ariyalur	Ariyalur	Ariyalur	Kadugur	11°10'00"	79°09'00"
73034	ariyalur	Ariyalur	Ariyalur	Kumbiliyam	11°11'15"	79°14'30"
73035	ariyalur	Udayarpalayam	Jayamkondam	Udayarpalayam	11°10'30"	79°19'00"
73035 A	ariyalur	Udayarpalayam	Jayamkondam	Udayarpalayam	11°10'30"	79°19'00"
73035A	ariyalur	Udayarpalayam	Jayamkondam	Udayarpalayam	11°10'30"	79°19'00"
73036	ariyalur	Udayarpalayam	Jayamkondam	Ullkottai	11°10'30"	79°25'30"
73036A	Ariyalur	Udaiyarpalayam	T.palur	Kokkaranai	11°10'30"	79°25'30"
73046A	ariyalur	Ariyalur	Ariyalur	Varanavashi	11°05'30"	79°04'00"
73047	ariyalur	Ariyalur	Ariyalur	Puduppalayam	11°05'15"	79°08'45"
73048	ariyalur	Udayarpalayam	Jayamkondam	Ulliyakkudi	11°04'45"	79°13'45"
73049 A	ariyalur	Udayarpalayam	T.pazhur	Erugaiyur	11°04'45"	79°20'30"
73049A	ariyalur	Udayarpalayam	T.pazhur	Erugaiyur	11°04'45"	79°20'30"
73050	ariyalur	Udayarpalayam	T.pazhur	Thenkatchiperumalnatham	11°05'30"	79°24'45"
73050A	ariyalur	Udayar palayam	T.palur	Edanganni	11°05'30"	79°24'45"
73065	Ariyalur	Ariyalur	Thirumanur	Sathamangalam	11°00'15"	79°04'00"
73066	ariyalur	Ariyalur	Thirumanoor	Chinnapattakadu	11°00'00"	79°09'30"
73066A	ariyalur	Ariyalur	Thirumanur	Kovilur	11°00'00"	79°09'30"
73067	ariyalur	Udayarpalayam	T.pazhur	Kadampoor	11°00'30"	79°14'30"
73081	Ariyalur	Udaiyarpalayam	Andimadam	Annimangalam	10°55'30"	79°04'00"

73081A	Ariyalur	Ariyalur	Thirumanur	Keelaesanai	10°55'30"	79°04'00"
73180	Ariyalur	Udaiyarpalaya m	Jayankondam	Oolaiyur	11°24'00"	79°19'00"
73181	ariyalur	Udayarpalayam	Andimadam	Azagapuram	11°22'30"	79°20'15"
73181A	ariyalur	Udayar palayam	Andimadam	Keelaesanai	11°23'30"	79°21'45"
73182 A	ariyalur	Udayarpalayam	Andimadam	Chiluvaicheri	11°23'30"	79°21'45"
73182A	ariyalur	Udayarpalayam	Andimadam	Chiluvaicheri	11°23'30"	79°21'45"
73182B	ariyalur	Udayar palayam	Andimadam	Andimadam	11°23'30"	79°21'45"
73183	ariyalur	Udayarpalayam	Andimadam	Andimadam	11°20'45"	79°22'15"
73184	ariyalur	Udayarpalayam	Andimadam	Varadharajan Pettai	11°21'15"	79°25'00"
73185	ariyalur	Udayarpalayam	Andimadam	Khuvathur	11°17'45"	79°22'30"
73186	ariyalur	Udayarpalayam	Andimadam	Khuvathur	11°17'15"	79°20'00"
73187	ariyalur	Udayarpalayam	Andimadam	Kallathur	11°15'00"	79°22'30"
73188	ariyalur	Udayarpalayam	Jayamkondam	Eravankudi	11°17'15"	79°25'45"
73189 A	ariyalur	Udayarpalayam	Andimadam	Thirukzapur	11°18'00"	79°24'30"
73189A	ariyalur	Udayarpalayam	Andimadam	Thirukzapur	11°18'00"	79°24'30"
73190	ariyalur	Udayarpalayam	T.pazhur	Uthayanatham	11°09'00"	79°24'30"
73191	ariyalur	Udayarpalayam	T.pazhur	Anaikudam	11°09'30"	79°22'30"
73192	ariyalur	Udayarpalayam	T.pazhur	Kodangudi	11°07'15"	79°22'30"
73193	ariyalur	Udayarpalayam	T.pazhur	Nayaganaiprial	11°07'30"	79°20'30"
73194	ariyalur	Udayarpalayam	Jayamkondam	Vanathirayanpattinam	11°08'45"	79°19'30"
73195	ariyalur	Udayarpalayam	Jayamkondam	Thathanoor	11°08'15"	79°16'00"
73196	ariyalur	Udayarpalayam	Jayamkondam	Sooriyamanal	11°12'15"	79°20'30"
73197	ariyalur	Udayarpalayam	Jayamkondam	Periyavalayam	11°11'00"	79°22'00"
73198	ariyalur	Udayarpalayam	Jayamkondam	Angarayanallur	11°10'15"	79°21'30"
73199	ariyalur	Udayarpalayam	Jayamkondam	Periyavalayam	11°11'30"	79°23'30"
73200	ariyalur	Udayarpalayam	Andimadam	Ilaiyur	11°13'30"	79°18'45"
73201	ariyalur	Udayarpalayam	Andimadam	Nagakkuli	11°13'45"	79°16'45"
73202	ariyalur	Udayarpalayam	Jayamkondam	Pirancheri	11°13'00"	79°23'15"
73203	ariyalur	Udayarpalayam	Jayamkondam	Kuruvalapperkovil	11°12'30"	79°26'15"
73204	ariyalur	Udayarpalayam	Jayamkondam	Thaluthalaimedu	11°11'00"	79°27'45"
73204A	ariyalur	Udayar palayam	Udayar palayam	Vanathirayamkuppam	11°11'00"	79°27'45"
73205	ariyalur	Udayarpalayam	Jayamkondam	Muthuservamadam	11°12'30"	79°28'00"
73206	ariyalur	Udayarpalayam	Jayamkondam	Ilaiyaperumalnallur	11°14'15"	79°27'00"
73207	ariyalur	Udayarpalayam	Jayamkondam	Minsurutti	11°14'00"	79°28'30"
73208	ariyalur	Udayarpalayam	Jayamkondam	Chokkalingapuram	11°15'05"	79°28'30"
73209	ariyalur	Udayarpalayam	Jayamkondam	Vankudi	11°16'45"	79°28'00"
73210	ariyalur	Udayarpalayam	Jayamkondam	Pappakudi	11°16'30"	79°30'00"
73210A	ariyalur	Udayar palayam	Jayamkondam	Padainilai	11°16'30"	79°30'00"
73211	ariyalur	Udayarpalayam	Jayamkondam	Pappakudi	11°18'45"	79°30'00"
73211A	Ariyalur	Udaiyarpalaya	T.palur	Pappangudi	11°18'45"	79°30'00"

		m				
73312	ariyalur	Veppanthattai	Veppanthattai	Mangalamedu	11°20'55"	78°57'02"
MMWS ARY 1	Ariyalur	Ariyalur	Ariyalur	Ariyalur	11°08'33"	79°04'44"
MMWS ARY 2	Ariyalur	Ariyalur	Ariyalur	Kattupringam	11°06'55"	79°08'44"
MMWS ARY 3	Ariyalur	Jayankondam	Jayamkondam	Ampapur	11°03'10"	79°13'25"
MMWS ARY 4	Ariyalur	Ariyalur	Thirumanur	Sullangudi	11°03'10"	79°14'44"
MMWS ARY 5	Ariyalur	Ariyalur	Ariyalur	Ayan Athur	11°10'22"	79°10'55"
MMWS ARY 6	Ariyalur	Ariyalur	Ariyalur	Kelapalur	11°02'44"	79°04'12"
NO.16	Ariyalur	Jayankondam	Jayankondam	Athanagurichi	11°08'16"	79°04'33"
NO.2	Ariyalur	Ariyalur	Ariyalur	Dalmia Cements	11°10'51"	79°06'02"
NO.M1	Ariyalur	Jayankondam	Senduriai	Alathiyur	11°08'16"	79°04'33"

Ariyalur District- Piezometers - Location and Co-ordinates

Well no	District	Tashil/Taluk	Block/Mandal	Village	Latitude	Longitude
13009 D	Ariyalur	Ariyalur		Kattuppirangiyam	11.116667	79.147222
13010 D	Ariyalur	Udaiyarpalayam		Ambappur	11.043056	79.225000
13011 D	Ariyalur	Udaiyarpalayam	Ariyalur	Marudur	11.261111	79.275000
13012 D	Ariyalur	Udaiyarpalayam		Jayamkondam	11.208333	79.370833
13013 D	Ariyalur	Udaiyarpalayam		Andimadam	11.338889	79.395833
13014 D	Ariyalur	Ariyalur		Sullangudi	10.955556	79.144444
13015 D	Ariyalur	Udaiyarpalayam		T.pazhur	11.094444	79.372222
13016 D	Ariyalur	Ariyalur		Edaiyathankudi	11.055556	79.155556
13017 D	Ariyalur	Ariyalur		Rayampuram	11.216111	79.158889
13018 D	Ariyalur	Ariyalur		Elandakoodam	10.927778	79.030556
13019 D	Ariyalur	Udaiyarpalayam		Kattakoram South	11.195556	79.483333
13020 D	Ariyalur	Udaiyarpalayam		Eravankudi	11.288889	79.427778

(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 Ariyalur 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

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

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)

ARIYALUR 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	ARIYALUR	35,251.72	13,264.47	2,269.52	15,534.00	44	Nil

Firka Wise Summary

(in ha.m)

ARIYALUR 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	2	3	4	5	6	7	8
1	ANDIMADAM	2,770.10	873.40	168.42	1,041.82	38	SAFE
2	ARIYALUR	2,877.84	1,125.57	451.46	1,577.03	55	SAFE
3	ELAKURICHI	3,199.64	1,204.80	55.24	1,260.04	39	SAFE

4	JAYANKONDAM	1,876.58	553.60	96.17	649.77	35	SAFE
5	KEELAPALUR	3,321.98	1,607.20	82.81	1,690.01	51	SAFE
6	KUNDAVELI	1,809.17	647.70	78.28	725.98	40	SAFE
7	KUVAGAM	2,234.26	949.40	91.27	1,040.67	47	SAFE
ARIYALUR 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	MATHUR	2,308.23	1,145.20	103.79	1,248.99	54	SAFE
9	NAGAMANGALAM	2,160.35	549.00	65.44	614.44	28	SAFE
10	PONPARAPPI	1,184.32	436.00	55.89	491.89	42	SAFE
11	SENDURAI	1,337.01	861.40	245.40	1,106.80	83	SEMI CRITICAL
12	SUTHAMALLI	2,312.66	1,577.40	83.67	1,661.07	72	SEMI CRITICAL
13	T. PALUR	3,281.69	461.70	343.08	804.78	25	SAFE
14	THRUMANUR	2,684.29	728.10	292.35	1,020.45	38	SAFE
15	UDAYARPALAYAM	1,893.60	544.00	56.25	600.25	32	SAFE
TOTAL		**35,251.72**	**13,264.47**	**2,269.52**	**15,534.00**	**44**	

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 Ariyalur 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) 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 6 blocks in Ariyalur District, Nil blocks are categorized as Over Exploited and Critical blocks and remaining 6 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 Ariyalur District, totally 15 Firkas, 1 Firkas are categorized as Over Exploited and Critical blocks and remaining 14 Firkas are categorized as Semi Critical and Safe blocks.

  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 6.666%, in the Ariyalur 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 15 Firkas, the total percentage of over exploited and critical Firkas is 6.666%, but, In 2013 assessment, out of 15 Firkas, it has been come down marginally to Nil, in the Ariyalur 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 15 Firkas in the District, 2 Firkas are categorized as “Semi Critical Firkas”, 13 Firkas are categorized as “Safe Firkas”.

Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2011, Out of 15 Firkas in the District, 1 Firkas are categorized as “Over Exploited Firkas”, 1 Firkas are categorized as “Semi Critical Firkas”, 13 Firkas are categorized as “Safe Firkas”.

When compared to last assessment as on March 2011, the “Over Exploited Firkas” comes down from 1 to Nil Firkas, the “Critical Firkas” remains Nil firkas, the “Semi Critical Firkas” increased marginally from 1 to 2 Firkas, the “Safe Firkas” maintains the same as 13 Firkas and the “Saline Firkas” remains Nil 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	1	Nil
2	Critical	Nil	Nil
3	Semi Critical	1	2
4	Safe	13	13
5	Saline	Nil	Nil
TOTAL		15	15

(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.