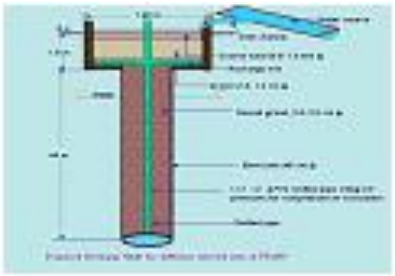
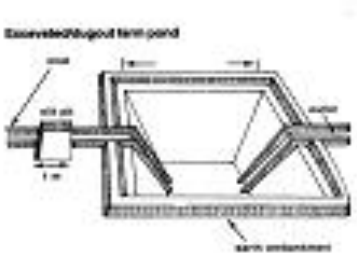
Plan on Artificial Recharge to Groundwater and Water Conservation in Sulur Firka, Sulur Taluk, Coimbatore District, Tamil Nadu






By

Central Ground Water Board
South Eastern Coastal Region
Rajaji Bhawan, Besant Nagar
Chennai

Content

AT GLANCE	
Name of Firka	Sulur
Taluk	Sulur
District	Coimbatore
State	Tamil Nadu
Total area (Sq.Kms)	117.61305
Total Area suitable for recharge	87.03
Co-ordinates: (Latitude. & Longitude)	10°56'45"to 11°04'40" & 77°02'09"to 77°10'33".
Rainfall	569 mm
Monsoon	416 mm
Non- Mon soon	153 mm
Geology	Crystalline and metamorphic gneiss complex of Archaean age
WATER LEVEL	
Pre - Monsoon	2.2 to 18.56 m bgl.
Post - Monsoon	1.4 to 11.20 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	9.93217 MCM
Net ground water available	8.93895 MCM
Ground water draft for irrigation	12.1095 MCM
Groundwater draft for domestic & industrial water supply	1.56292 MCM
Total ground water draft	13.6724 MCM
Stage of ground water development (%)	152.953 %
Uncommitted surface runoff available for the Firka	7.3390 MCM
Total volume of weathered zone	940.9044 MCM
Total volume available for recharge (considering 7 m depth from 3 m bgl	823.27 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft .	 22 11 23
Improving Water Efficiency /saving (Micro irrigation system for 100 ha)	0.7 MCM
Excepted ground water recharge	2.21 MCM
Excepted total ground water recharge/saving	2.91 MCM
Tentative total cost of the project	Rs.7.76 Cr
Expected raise in water level by recharging /saving	1.69 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Sulur Firka, Sulur Taluk, Coimbatore district, Tamil Nadu

1. Introduction

India is the largest user of groundwater in the world. Food grain security of the country is largely dependent on water resources and groundwater resources play major role in irrigation sector. Imprints of Over-Exploitation on groundwater resources are being observed as steep deepening of water levels, drying of shallow groundwater abstraction structures, ingress of salinity in fresh aquifers etc. which signal towards taking necessity of emergent action for artificial recharge and rainwater harvesting by utilizing surplus runoff and maintaining groundwater resources at sustainable stage.

In Tamil Nadu dependency on groundwater has increased many folds during the recent years and the groundwater extraction for irrigation, domestic and industries have resulted in lowering of water levels, long-term water level declining trend and even drying up of wells. In order to regulate the groundwater development, Central Ground Water Board in association with State Ground Water Departments has computed Dynamic Groundwater Resources and categorized blocks as Over Exploited, Critical, Semi Critical and Safe.

Out of 1129 firkas (Assessment Units) in Tamil Nadu the groundwater situation in 374 firkas overexploited, 48 firkas critical, 235 firkas semi-critical, 437 firkas safe and 35 firkas are saline. Various measures such as rainwater harvesting, artificial recharge and water use efficiency are successfully practiced by some NGOs, Central and State Govts., which need replication at larger scale in close coordination with State Govt. agencies and stakeholders so that capacity building of state implementing agencies and awareness of stakeholders towards artificial recharge and rainwater harvesting can be made.

2. Objectives of the scheme

Objectives of the proposed scheme are;

- To upscale recharge activities, supplement additional groundwater resources by harvesting surplus runoff, sustainability of groundwater resources at shallow depths
- Recovery of over-exploited groundwater areas by implementing artificial recharge measures in groundwater stress areas.
- Conservation, development and sustainable management of natural resources including their use.

3. Study area details

3.1 Location

The total area of Sulur firka is 117.61305 sq. km. and lies between North latitudes 10°56’45 “to 11°04’40”and East longitudes 77°02’09”to 77°10’33”. The location map of Sulur firka is given in Figure - 1.

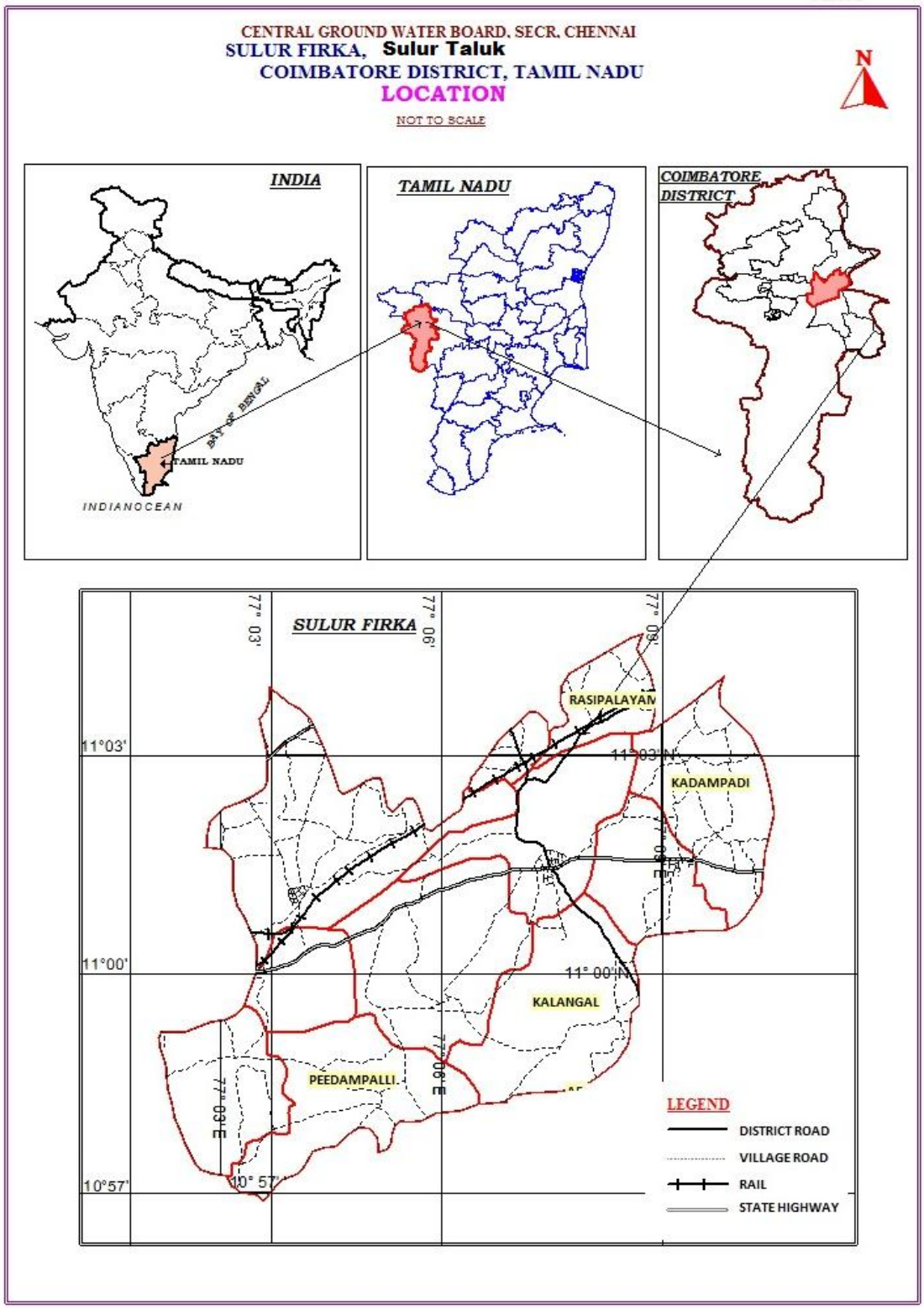


Figure - 1. Location map of Sulur firka

3.2 Geomorphological Set up

Geomorphologically, the area consists of undulating and plain landforms. In plain landforms, weathered moderate and shallow pediments have occupied major part of the firka. These landforms are influencing the ground water recharge. The undulating landforms act as runoff zones. (*Source: IRS, Anna university, Chennai Tamil Nadu). Geomorphological map prepared using IRS- 1D data on 1: 50,000 scale and units are as per NNRMS standard*s. The various geomorphological units with its percentage of coverage area are given in Table - 1 and shown in Figure - 2.

Table - 1. Various geomorphological units with its % of coverage area in Sulur firka

LANDFORMS	% of Area
Pediment (Weathered) Moderate	7.6
Pediment (Weathered) Deep	24.2
Dissected / Undissected	26.3
Pediment-Inselberg Complex	5.9
Pediplain (Weathered) Shallow	36

3.3 Land use and soil

The land use pattern of the Sulur Firka is given in Figure - 3. Predominantly the most of the area is characterised by the wet crop, plantation and dry crop (i.,e agricultural field)and accounts for 50 % of the total area of the firka (Source: IRS, Anna university, Chennai Tamil Nadu). This area is highly suitable for water conservation and recharge. The entire Firkas is occupied by rock outcrops scatter with loamy soil. Map showing the soils of the Sulur Firka is given as Figure – 3A.

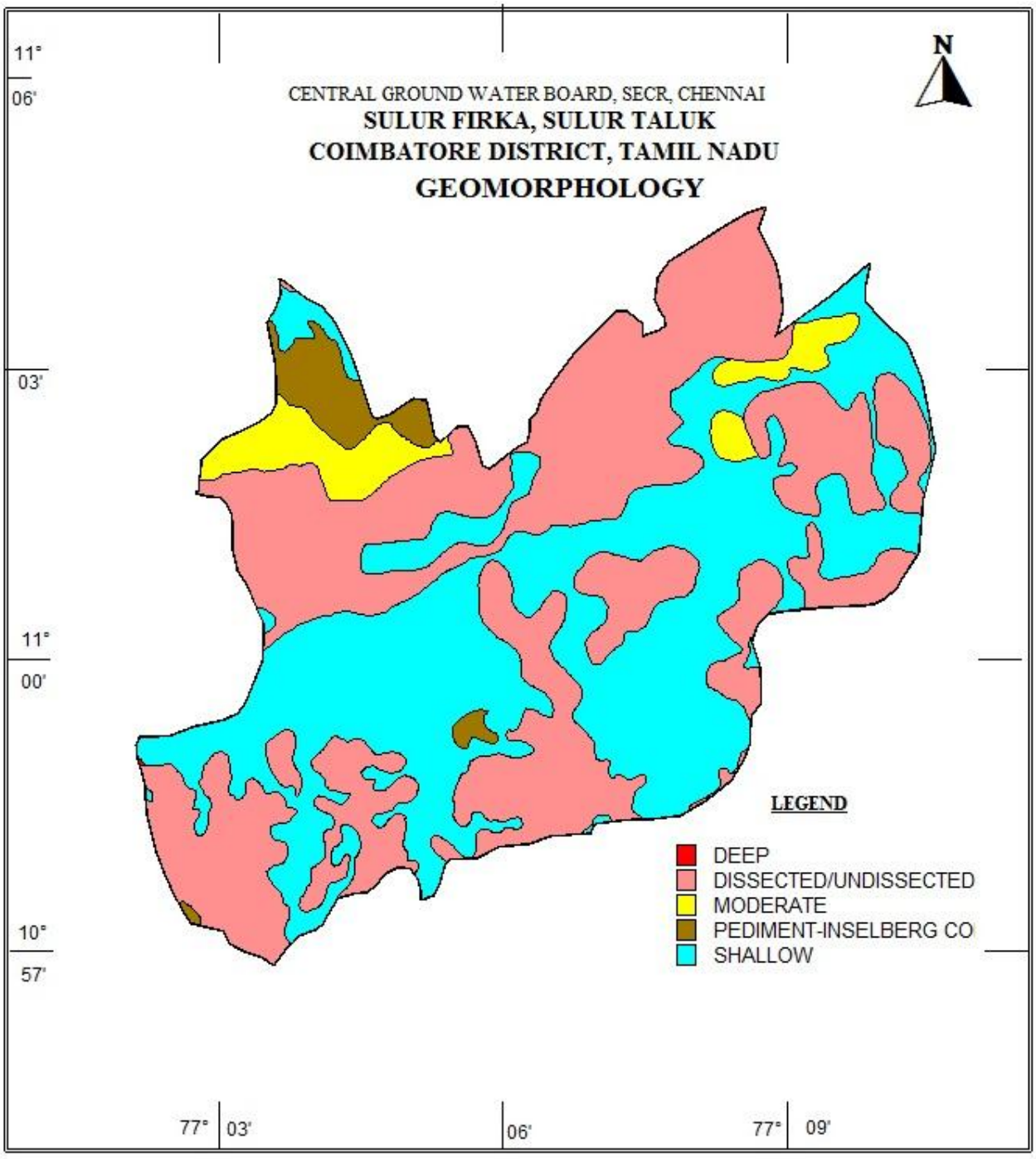


Figure - 2. Geomorphology of Sulur Firka

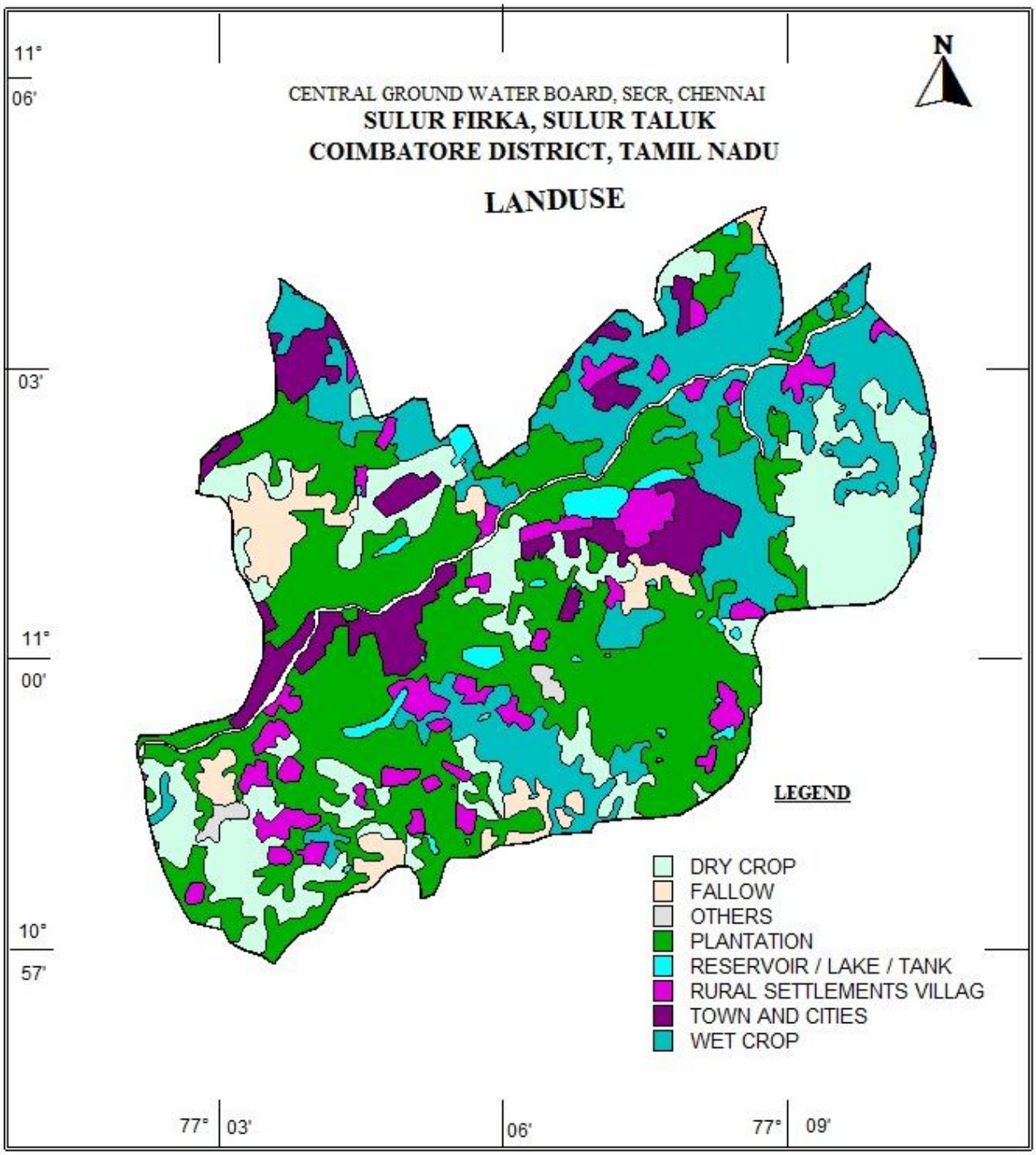


Figure - 3. Land Use Map of Sulur Firka

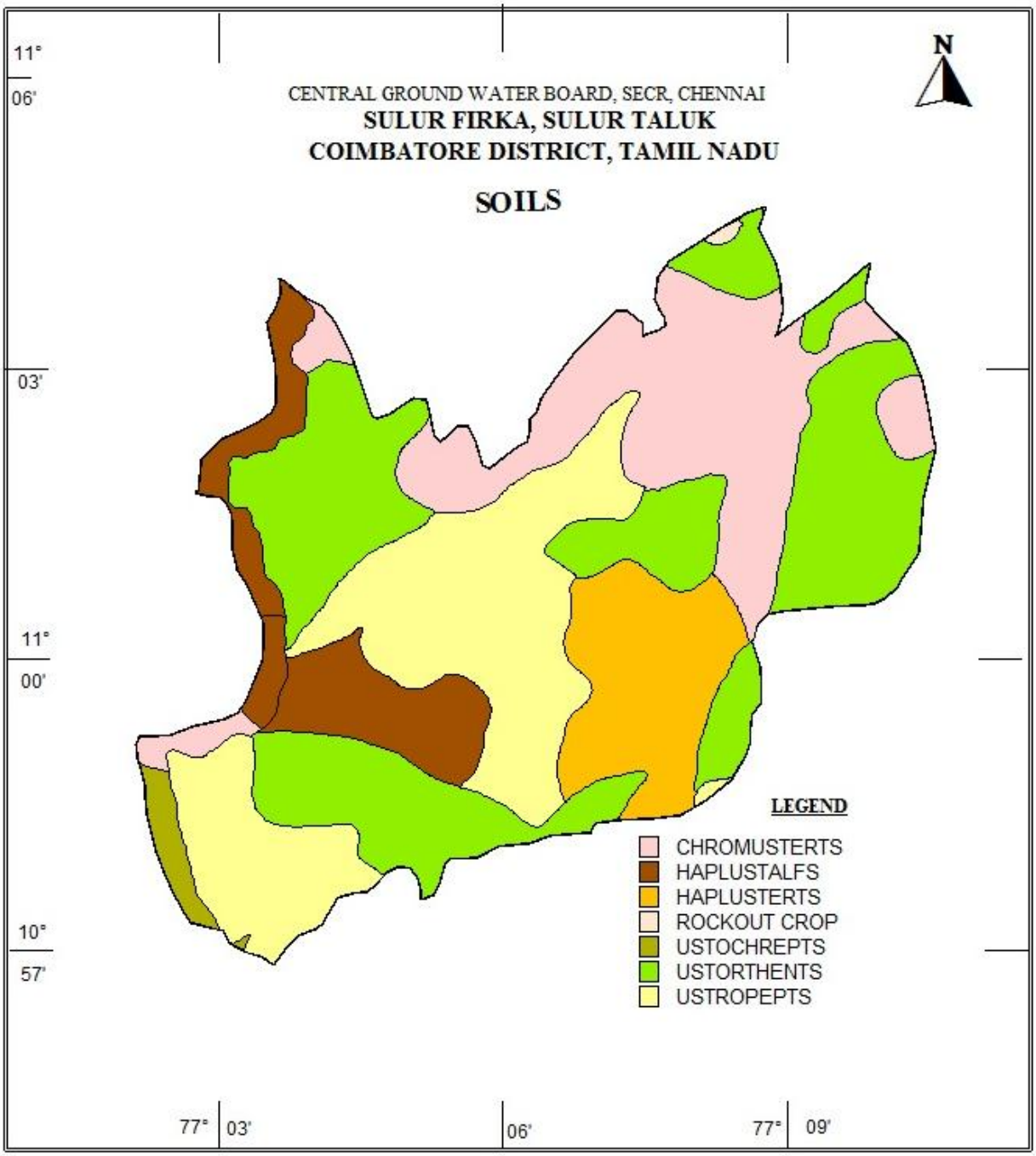


Figure - 3. Land Use Map of Sulur Firka

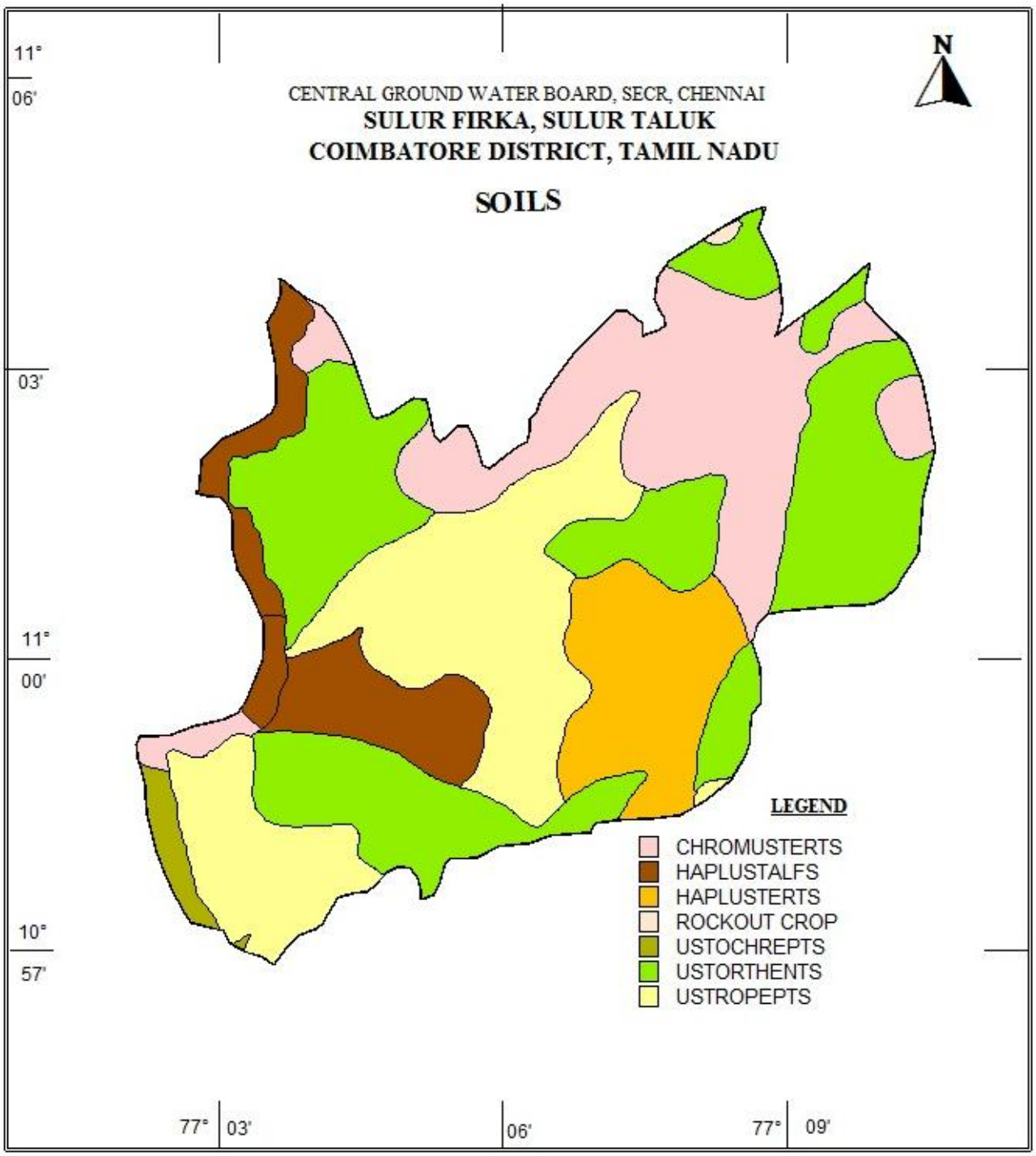


Figure - 3A. Soil Map of Sulur Firka

3.4 Drainage

The entire Firka area is within the Bhavani river Basin. A number of small streams originate from the hills located in the Sulur firka are seasonal floods inundate lower parts of the basins. Basin sub soil water is used to irrigate the lands. Tanks and surface water bodies are spread over the entire firka. The drainage pattern is the dendritic and sub- dendritic. The drainage map of Sulur firka is given in Figure - 4.

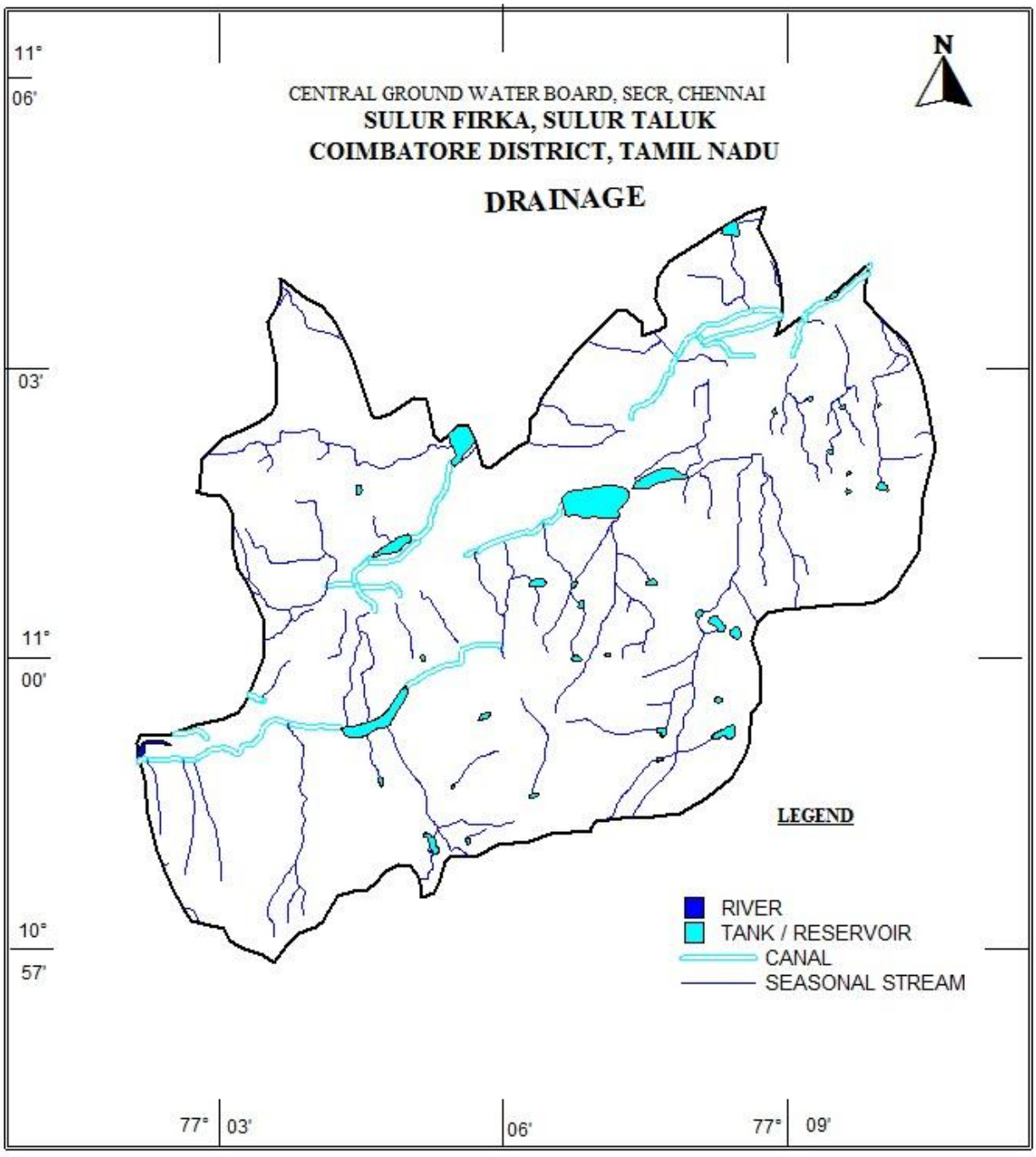


Figure - 4. Drainage Map of Sulur Firka

3.5 Rainfall

Sulur area falls under tropical climate with temperature in the summer months of March to May. The average temperature varies from 26 to 41° C. The humidity is also high in the order of 80%. The wind speed is high during the months of July and August. The wind speed ranges from 7.4 to 12.6 km/hr, which increases from 100 to 120 km/hr during cyclone period. Sulur Firkas receives rainfall from southwest monsoon (June – September), northeast monsoon (October – December) and non-monsoon periods (January – May). The area receives the major rainfall from northeast monsoon. Rainfall is generally heavy during low-pressure depressions and cyclones during the northeast monsoon period. The normal annual rainfall is 569 mm.

Taluk	Name of Firkas	Area in sq.km	Monsoon rainfall (Jun to Dec) In m	Non monsoon rainfall (Jan – May) In m	Total Rainfall In m
Sulur	Sulur	117.61305	0.416	0.153	0.569

3.6 Hydrogeology

The entire firka is underlain by the Archaean crystalline and metamorphic gneiss complex consisting Honrblede –Biotite gneiss and granite. Ground water is occurring in pheratic conditions in weathered and fractured gneiss rock formation. The weathering is erratic and the depth of abstraction structures is controlled by the intensity of weathering and fracturing.Large diameter dug well is more common ground water abstraction structures in the area. The diameter of the dug well is in the range of 5 to 10 m and depth of dug wells range from 15 to 40 m bgl. The dug wells yield up to 1 lps in summer months and few wells remains dry. The yield is adequate for irrigation for one or two crops in monsoon period.

The hydrogeological map of Sulur firka is given in Figure - 5. Decadal mean water level ofpre-monsoon and post monsoon are given in Figure - 6 a & b respectively. The decadal maps reveal that, mean water level during pre-monsoon in majority area is < 6 m bgl likewise during post monsoon majority part is under < 5m ground level.

The present water level in the firka is in the range of 1.4 to 11.2 m bgl.(May 2016)

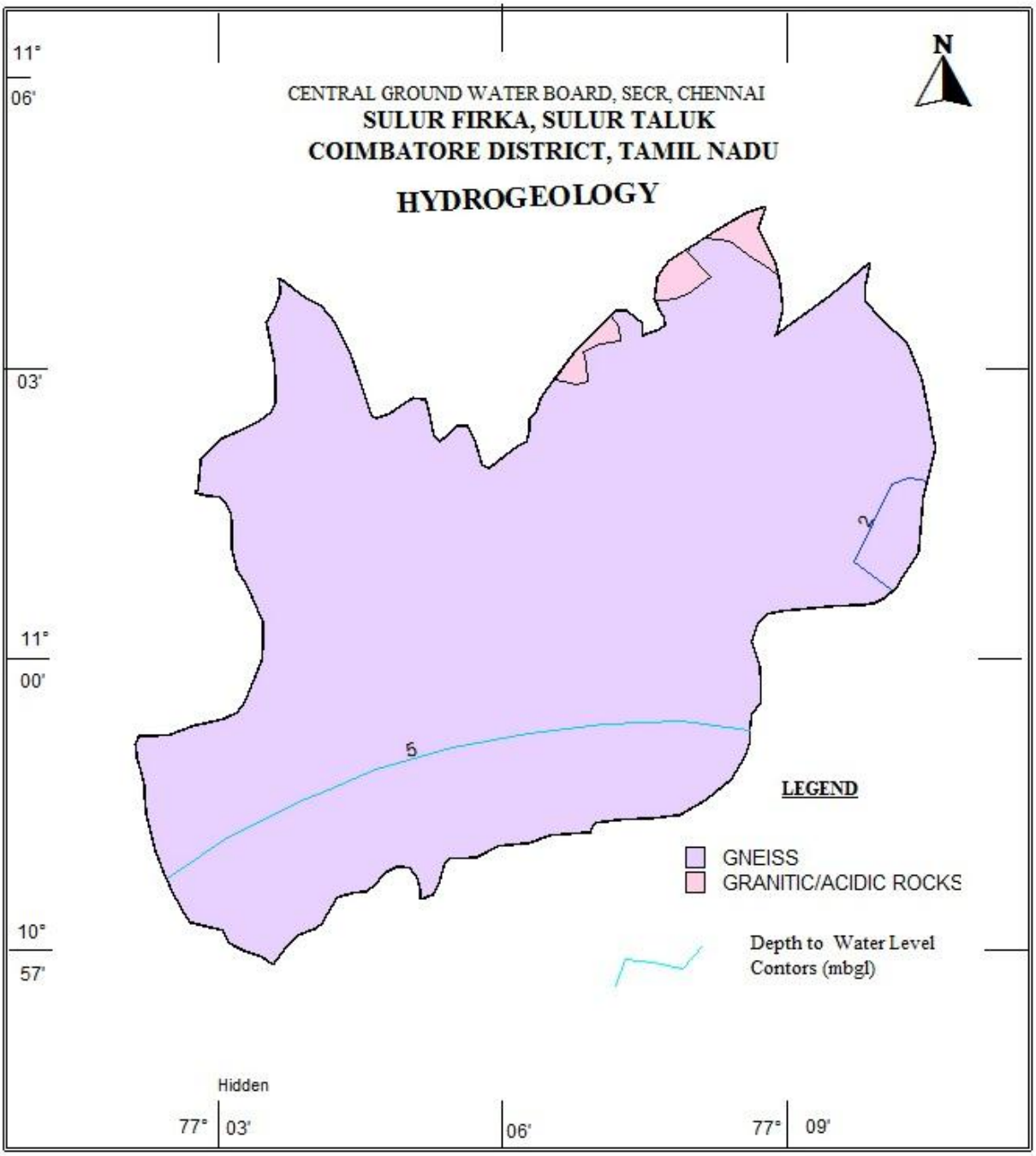


Figure – 5. Hydrogeological Map of Sulur Firka

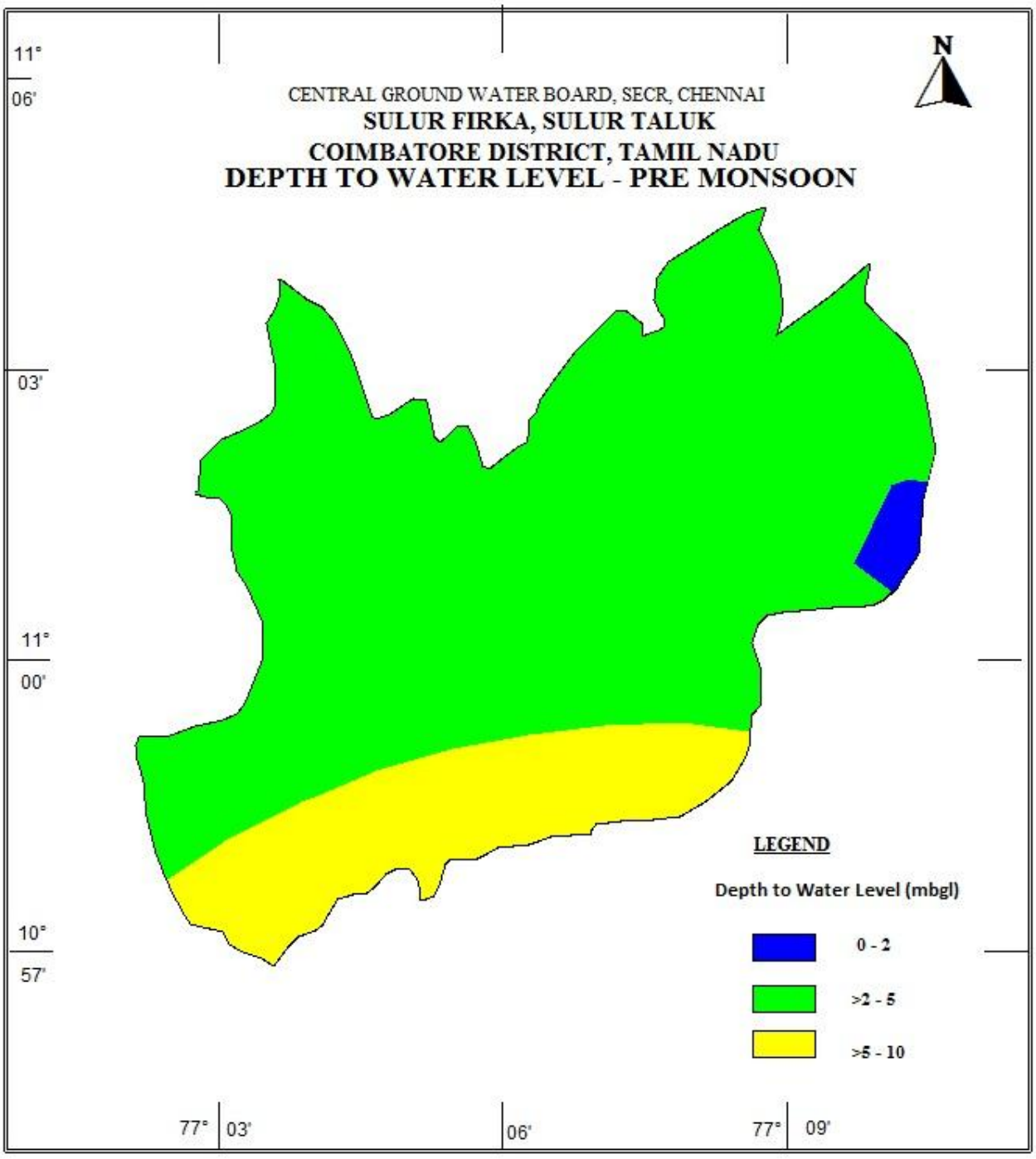


Figure - 6a. Pre -monsoon water level in Sulur firka (Decadal mean)

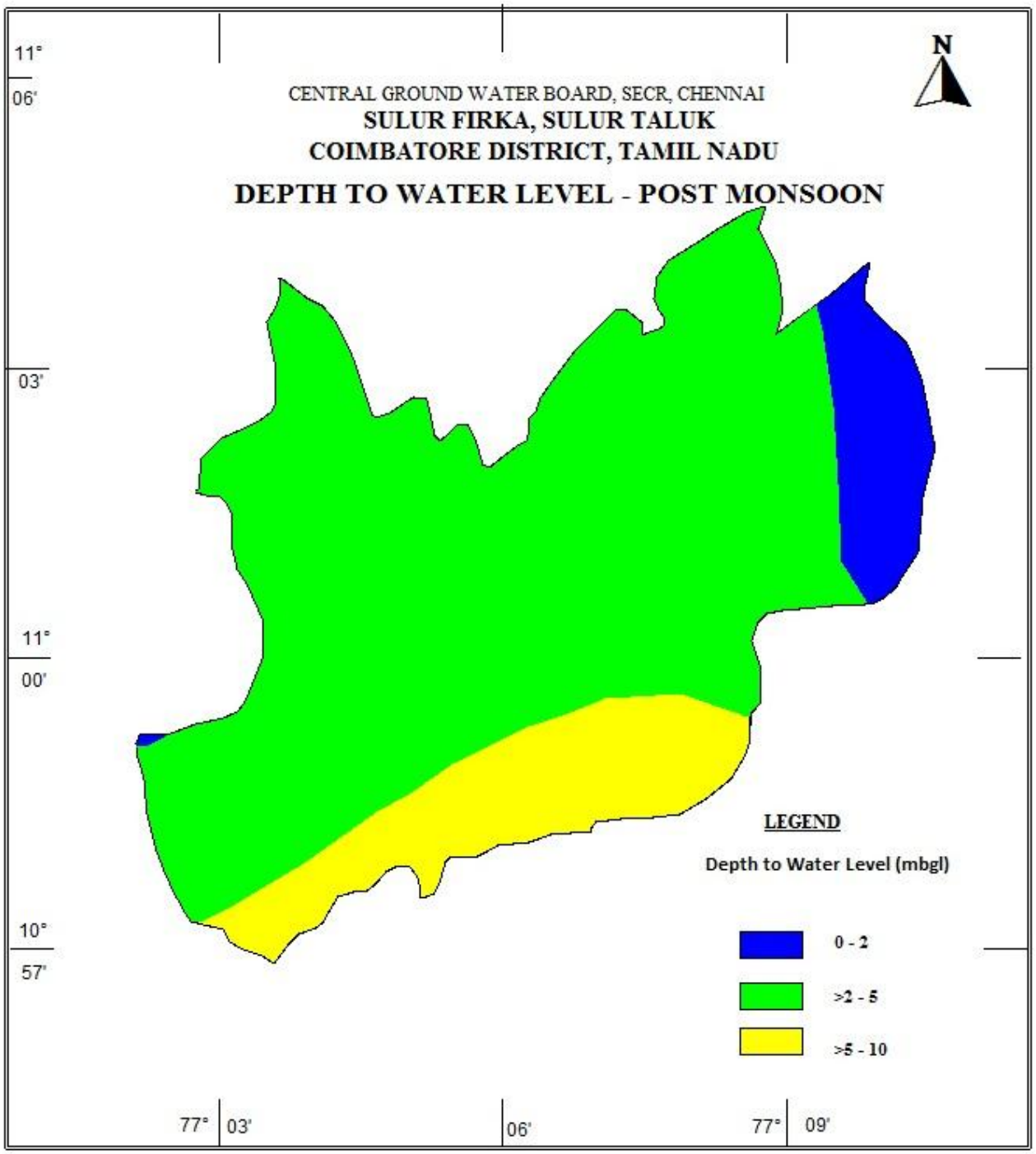


Figure - 6 b. Post-monsoon water level in Sulur firka (Decadal mean)

3.7 Dynamic Groundwater Resources

The ground water resources have been computed jointly by Central Ground Water Board and State Ground Water Resources Data Centre (PWD, WRO, Govt. of Tamil Nadu) as on 31st March 2011. The computation has been done using GEC1997 methodology. The salient features of the computations are furnished in table 2.

Table 2. Dynamic Ground water resources estimation of Sulur firka

GW WORTHY AREA	REPLENISH ABLE GROUND WATER RESOURCES	NET GROUND WATER AVAILABLE	GROUND WATER DRAFT FOR IRRIGATION	GROUNDWATER DRAFT FOR DOMESTIC & INDUSTRIAL WATER SUPPLY	TOTAL GROUND WATER DRAFT	STAGE OF GROUND WATER DEVELOPMENT (%)	CATEGORY
(Sq. Km.)	(In MCM)					%	
117.61305	9.93217	8.93895	12.1095	1.56292	13.6724	152.953	Over Exploited

4. Spatial Data Integration

The potential area for groundwater recharge is highly influenced by Geology, Geomorphology, Land use /land cover, Drainage, Surface Water Body, Weathered Thickness and first fractured Depth in the area. In order to ascertain the suitable area for groundwater recharge in firka, spatial data integration of have been attempted using index overlay model in GIS environ. In this model, above seven layers have been integrated by assigning weightage for the theme having scale of 1-100 and sub-classes of the theme between 1 to 10 scales. The resultant map has been reclassified into four classes (High-low integrated values) indicating the suitable area for artificial recharge and given in Figure - 7 and described below.

Zone	% of Area Coverage	Significance*
Very high	0.5	Suitable for all major recharge structures like Percolation pond and nalla bund, check dam etc.,
High	8.7	Suitable for all major recharge structures like nalla bund , check dam etc.,
Moderate	64.8	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	26	Hilly/Forest /Catchment area

*However, the field verification is required to confirm above potential area for groundwater recharge.

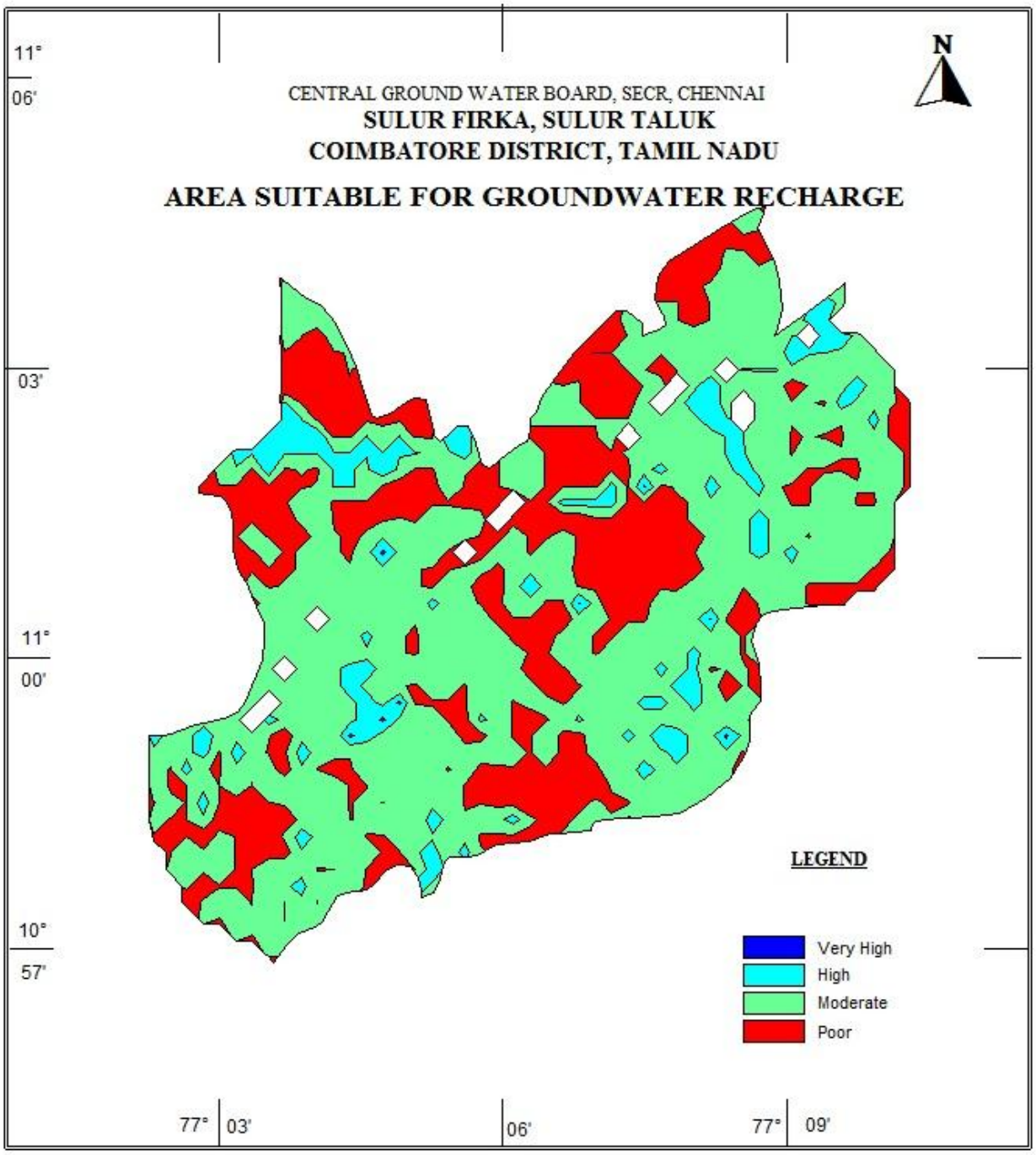


Figure - 7 Showing the recharge worthy area Sulur firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Sulur Firkas is with high stage of groundwater development i.e, 152.953 % and with sufficient amount of uncommitted surface runoff/flow of 7.3390 MCM.
- The total weathered zone available beneath the ground in the firka is 940.9044 MCM. Out of these total volume available for recharge considering 7 m depth from 3 m) is 823.27 MCM.

- ❖ The Sulur Firka consists of surface water bodies /lakes (cover almost 10 % of the total area of the firka) which are well connected by the drainage. Revival and Recharge of these ponds will enhance the sustainability of the ground water abstraction structures.
- ❖ However, most of the ground water developments for agricultural purposes are met through dug-cum bore well and bore wells only. Hence, there is sufficient scope of recharge.
- ❖ Model generated in the Sulur areas reveals that more than 80 % of areas are suitable for recharge.
- ❖ In Sulur firka more than 50 % area is characterised by the agricultural activities, there is sufficient scope for the water conservation measures for enhance the crop production and better ground water development.

5.2 Availability of surplus surface water for artificial recharge or conservation

The uncommitted surface flow for Sulur Firka is estimated as per the norms followed by State Ground & Surface Water Resources data centre, PWD, Taramani, Chennai (Aug 2015). The available of surplus surface water for Sulur Firka is 7.34 MCM.

5.3 Proposed interventions including tentative location of artificial recharge /conservation measures

On basis of above description the following three type of approach have been made to propose artificial recharge or conservation structures.

a. Artificial recharge
b. Water conservation measure /Water Efficiency

5.3.1 Artificial recharge

The details of artificial recharge structure proposed along with justification are given below.

5.3.1.1 Check dam/Nala bund

Sulur firka area is covered by the seasonal nallahs /drains which carry heavy discharge during monsoon period this is debauched into the water bodies within a short duration. It is proposed that such seasonal nala rivers will be identified and the rain water will be harnessed through construction of series of check dams, nala bund and gabion structures so as to harness this water thereby increasing the resident period of the water in these channels and to increase the soil moisture content. As per the integrated model prediction around 30 % of the firkas areas are suitable for these structures. It is proposed to construct 22 Check dam and 11 Nala bunds. The tentative location of these 33 ARs are given below and shown in **Plate - 1.** The size and location of these structures are tentative and details field survey is essential to ascertain the exact size and location.

Tentative locations of proposed 22 Check dams in Sulur firka

S. No.	Latitude	Longitude	Type of ARS
1	11.0361	77.0588	Check Dam
2	11.0375	77.0684	Check Dam
3	11.0050	77.0800	Check Dam
4	11.0616	77.1424	Check Dam
5	11.0536	77.1288	Check Dam
6	11.0179	77.1509	Check Dam
7	11.9966	77.1330	Check Dam
8	11.0148	77.1404	Check Dam
9	11.0330	77.1452	Check Dam
10	11.0413	77.1363	Check Dam
11	11.0470	77.1608	Check Dam
12	11.0410	77.1653	Check Dam
13	11.0330	77.1345	Check Dam
14	11.0395	77.1119	Check Dam
15	11.0146	77.1013	Check Dam
16	11.0031	77.1247	Check Dam
17	11.0177	77.0699	Check Dam
18	11.0084	77.0604	Check Dam
19	11.9612	77.0641	Check Dam
20	11.9691	77.0641	Check Dam
21	11.9847	77.0646	Check Dam
22	11.9725	77.0876	Check dam

Tentative locations of proposed 11 Nalla bund in Sulur firka

S. No.	Latitude (DD)	Longitude (DD)	Type of ARS
1	11.0410	77.1525	Nala Bund
2	11.0216	77.1456	Nala Bund
3	11.0093	77.0876	Nala Bund
4	11.0068	77.0724	Nala Bund
5	11.0055	77.0623	Nala Bund
6	11.0190	77.1078	Nala Bund
7	11.0080	77.0816	Nala Bund
8	11.0158	77.0957	Nala Bund
9	10.9755	77.0474	Nala Bund
10	10.9811	77.0441	Nala Bund
11	10.9643	77.0396	Nala Bund

5.3.1.3. Revival, repair of water bodies

The existing ponds and tanks in loose their storage capacity as well as the natural ground water recharge through these water bodies has also become negligible due to siltation and encroachment by farmers for agriculture purposes. There are several such villages where ponds/ tanks are in dilapidated condition. These existing village tanks which are normally silted and damaged can be modified to serve as recharge structure in case these are suitably located to serve as percolation tanks. Through de-silting, coupled with providing proper waste weir, the village tanks can be converted into recharge structure. Several such tanks are available in the area which can be modified for enhancing ground water recharge. Studies, however, are needed to ascertain whether the village tanks are suitably located to serve as recharge structures. The locations of about 23 existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate - 1. The above 23 tanks/ponds could be taken up for the renovation with recharge shaft.

Tentative location of proposed de-siltation of pond/tanks with recharge shaft in Sulur firka

Sl. No.	Latitude	Longitude	Structure	Action
1	11.0188	77.0790	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
2	10.9894	77.0964	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
3	11.0002	77.1128	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
4	11.0065	77.1371	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
5	11.0044	77.1411	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
6	11.0296	77.1666	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
7	11.0293	77.0747	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
8	11.0130	77.1063	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
9	10.9997	77.0864	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
10	11.0008	77.1179	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
11	11.0286	77.1606	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
12	11.0424	77.1472	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
13	11.0449	77.1535	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
14	11.0096	77.1143	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
15	10.9868	77.1388	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
16	10.9899	77.0790	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
17	10.9670	77.0878	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
18	10.9873	77.1278	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
19	10.9878	77.0787	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
20	10.9023	77.1273	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
21	10.9524	77.0941	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
22	10.9641	77.0724	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT
23	10.9792	77.0911	TANK / RESERVOIR	DESILTING AND RECHARGE SHAFT

5.3.2 Water conservation measure

5.3.2.1 Farm Pond

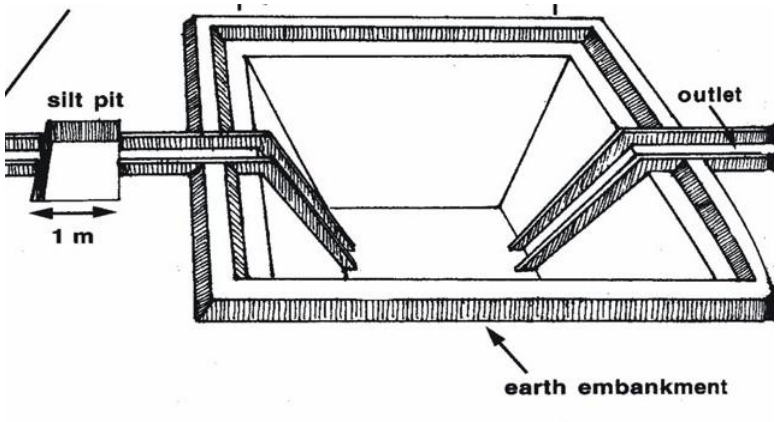
A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to

discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available, the type of soil, the farmer's water requirements, the cost of excavation, and the possible uses of the excavated earth. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods.

Advantages of Farm Ponds

- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees, thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.
- They supplies water for domestic purposes and livestock
- They promote fish rearing.
- They recharge the ground water.
- They improve drainage.
- The excavated earth has a very high value and can be used to enrich soil in the fields, levelling land, and constructing farm roads

As per the Land use classification of the firka, majority of the area is covered by the agricultural field. Hence it is proposed to construct 100 farm ponds as per the specification of AED, Govt. of Tamil Nadu (30 x 30 x 1.5 m).



5.3.2.2. Micro Irrigation System (Sprinkler/ drip/ HDPE pipes)

Micro irrigation is defined as the frequent application of small quantities of water directly above and below the soil surface; usually as discrete drops, continuous drops or tiny streams through emitters placed along a water delivery line

In flood/furrow irrigation method more than 50% of applied water is wasted through seepage to deeper level, localized inundation causes loss through evaporation and it leaches out the nutrients from the plant. While through drip & sprinkler irrigation wastage of irrigational water could be minimized. The studies on different crops, has revealed that irrigation water is saved drastically. The conveyance losses (mainly seepage & evaporation) can be saved up to 25 to 40% through utilization of HDPE pipes. Initially the scheme is proposed to be implemented in worst affected areas showing deepest water levels and significant declining trends. It is proposed to take up micro irrigation system in 100 ha. The cost estimation for this component has been taken from SOR of Agricultural Engineering Department (AED), Govt. of Tamil Nadu.

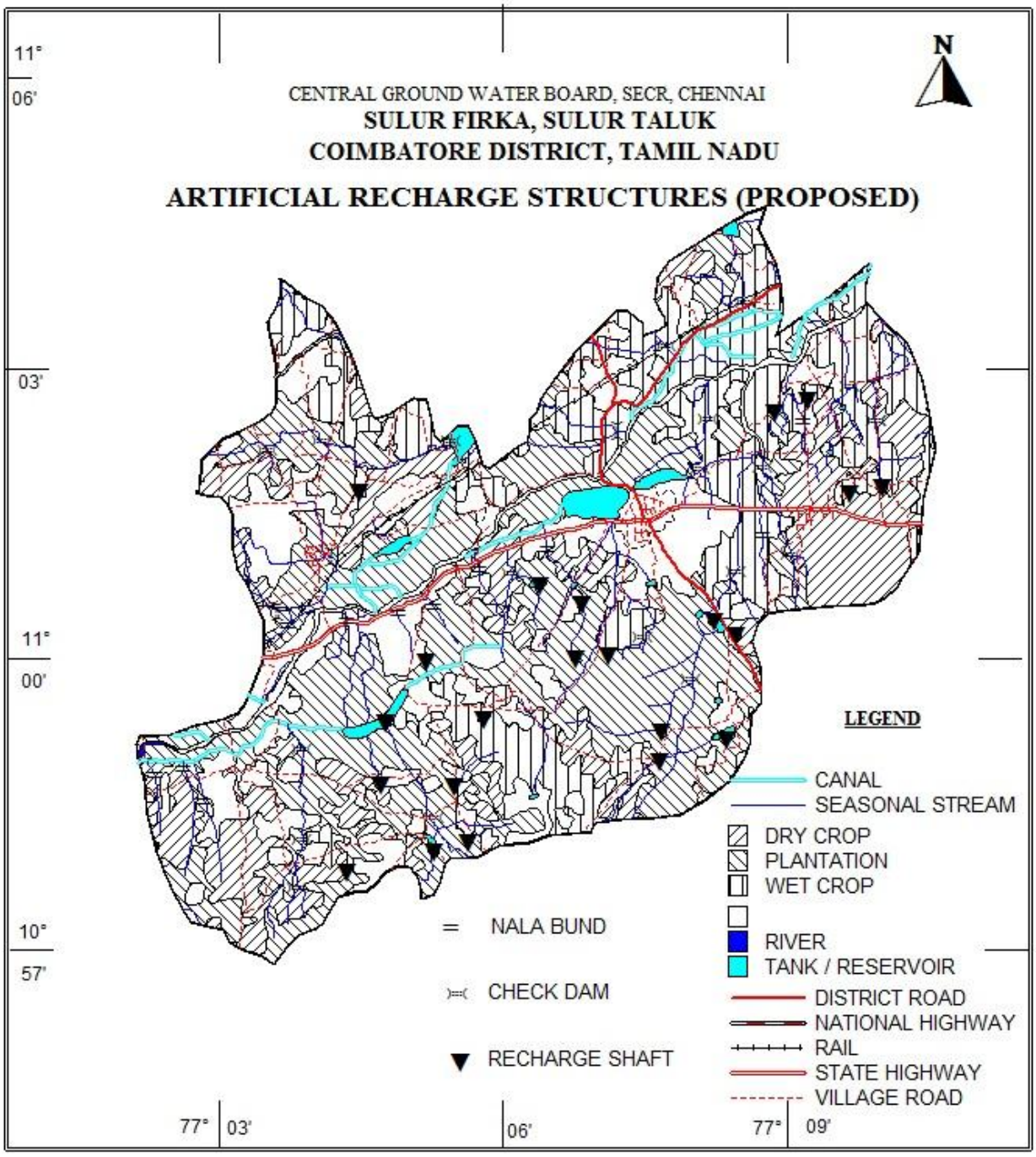


Plate - 1. Location map showing the proposed AR Structures in Sulur firka

6. Tentative Cost Estimation

A tentative number of feasible structures, its cost and expected annual ground water recharge /water saving is given in the table 7. The unit rates are as followed by the PWD, Govt. of Tamil Nadu (Sources: Schedule of rates, Govt. of Tamil Nadu 2015).

Table 7. Showing the Cost Estimation of proposed Artificial Recharge Structures

Feasible Artificial Recharge & Water Conservation structures/ activities	Tentative Design	quantity (in nos. or area in sq. m)	Total volume (cu. m)	Tentative unit cost (in Rs. lakh)	Total tentative cost (in Rs. lakh)	Expected Annual GW recharge /saving (cu. m)
Recharge Structures/ Activities						
Masonry Check dams (5 Fillings)	Crest- 10 -15 m; Height- 1 to 1.5 m	22	374000	9	198	299200
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	11	33000	2.0	22	26400
Revival, repair of water bodies (3 fillings)	(~100mx100mx2.5m)	23	1725000	12.0	276	1380000
Recharge shaft (within pond /tank)	Recharge shaft of 1.5 m dia. with 2 m depth with filter media in lower 1 m Bore dia 10" Casing 6" Depth 30 m	23		2	46	
Water Conservation Activities						
Farm Pond (in ha) (5 filling)	(30 m x 30m x 1.5 m)	100 unit	600000	1	100	510000
Sprinkler/ drip/ HDPE pipes	For 1 ha with 5 m interval HDPE pipe	100 ha	1000000	0.6 /ha	60	700000
				Sub total	**702**	**2915600**
Impact assessment and O & M						
Piezometers Up to 50 m bgl – 6 nos. @ 0.6 lakh					**3.6**	
Total cost of the project					**705.6**	
O & M - 5 % of total cost of the scheme					**35.28**	
Impact assessment -5 % of total cost of the scheme					**35.28**	
				TOTAL	**776.16**	

Note:

- The type, number and cost of structure may vary according to site, after the ground truth verification
- CD, PC – the storage of Check dams and percolation ponds is also proposed for irrigating the surrounding areas for enhancing the ground water recharge as well as effective utilisation of the artificial recharge structures.

7. Implementation modalities

The implementation of the scheme will be done by the line department of the state selected by the respective State authority. Further, it is to add that more than 50 % MGNREGA works related to water conservation/sustainable management, accordingly a convergence guideline has been made between National Rural Employment Guarantee Act (NREGA) (Ministry of Rural Development) & Programmes of Water Resources (MoWR , RD & GR). The Coimbatore district is one among the list of districts identified for Convergence between NREGS and schemes of MoWR. The details of permissible works under convergence are envisaged in the Joint Convergence Guideline.

a.) Time schedule

Steps	1st Quarter	2th Quarter	3rd Quarter	4th Quarter	5th Quarter	6th Quarter	7th Quarter	8th Quarter
❖ Identification of line department /implementing agency and preparation of DPR								
❖ Approval of scheme and release of sanction of funds								
❖ Implementation of ARS								

b.) Operation and maintenance

In all projects Impact assessment has to be carried out to ensure that projects is economically viable, socially equitable and environmentally sustainable by inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse. Accordingly it is proposed to have impact assessment at the rate of 5 % of the total cost of the project for 5 years from the completion of artificial recharge structures.

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