

TECHNICAL REPORTS: SERIES 'D'

CONSERVE WATER – SAVE LIFE



भारत सरकार

GOVERNMENT OF INDIA

जल संसाधन मंत्रालय

MINISTRY OF WATER RESOURCES

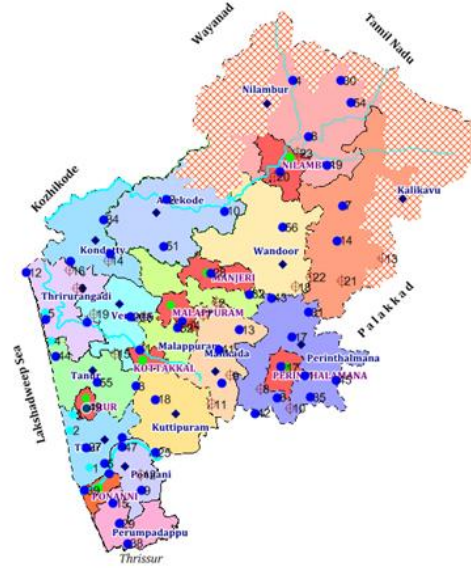
केंद्रीय भूजल बोर्ड

CENTRAL GROUND WATER BOARD

केरल क्षेत्र

KERALA REGION

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GROUND WATER INFORMATION BOOKLET OF MALAPPURAM
DISTRICT, KERALA STATE



तिरुवनंतपुरम

Thiruvananthapuram

December 2013



**GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD**

**GROUND WATER INFORMATION BOOKLET
OF
MALAPPURAM DISTRICT, KERALA**

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**GROUND WATER INFORMATION BOOKLET
OF
MALAPPURAM DISTRICT, KERALA**

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MALAPPURAM DISTRICT AT A GLANCE

Sl.No.	ITEMS	STATISTICS
1.	GENERAL INFORMATION	
	Geographical area (Sq km)	3550
	Administrative Divisions (as in 31-03-2011) Number of Tehsil/Block Number of Panchayats/Villages	6/15 100/150
2.	GEOMORPHOLOGY	
	Major physiographic units	Low land, Midland and Highland
	Major Drainages	Bharathapuzha, Kadalundipuzha and Chaliyarpuzha
3.	LAND USE (Hectares) as in 2009	
	Forest area	103417
	Net area sown	181986
	Area sown more than once	60011
	Cultivable area	4760
	Current Fallow	10609
	Non agricultural Area	41377
4.	MAJOR SOIL TYPES	Laterite Soil, Brown hydromorphic Soil, Coastal and river alluvium and Forest loamy soil
5.	AREA UNDER PRINCIPAL CROPS (Hectares) as in 2009-10	
	Rice	8838
	Fruit crops	26414
	Vegetables	4871
	Pepper	6147
	Cashew nut	4475
	Tapioca	2196
	Coconut	108380
	Arecanut	19994
	Rubber	38136
6.	AREA IRRIGATED BY DIFFERENT SOURCES (Hectares) as in 2009-10	
	Wells (Dug wells & Tube wells / Bore wells)	11966
	Tanks / Ponds	4840
	Canals	3038
	Other Sources	4819
	Net Irrigated area	24663
7.	NUMBER OF GROUNDWATER MONITORING WELLS (as in 31-3-2011)	
	No. of Dug wells	66 (CGWB) + 28 (GWD)
	No. of Piezometers	28 (CGWB) + 30 (GWD)

8	PREDOMINANT GEOLOGICAL FORMATIONS	Recent Alluvium Sub-recent Laterites Semi-consolidated Tertiary Sedimentary Formations Archaean crystalline formations (Charnockite, gneiss, Schists)
9.	HYDROGEOLOGY	
	Major Water bearing formations	Weathered & fractured crystalline formations, Semi consolidated Tertiary formations, Laterites Recent alluvium
	Depth to water level (Pre-monsoon, April 2011)	1.57 to 13.68 mbgl
	Depth to water level (Post-monsoon, Nov. 2011)	0.26 to 12.85 mbgl
	Long term water level trend (2002-2011)	Rise -0.01 to 0.38 Fall - 0.005 to 0.38
10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2011)	
	No. of wells drilled (EW, OW, PZ, SH, Total)	EW -28, PZ – 40,OW – 5 Total - 73
	Depth Range (m)	98 - 300
	Discharge (lps)	0.01 to 15.30
	Transmissivity (m ² /day)	2- 146
11.	GROUND WATER QUALITY	
	Presence of chemical constituents more than permissible limits(e.g. EC, F, As, Fe)	Major chemical constituents within the permissible limits in general. Local patches of high EC.
12	DYNAMIC GROUNDWATER RESOURCES (2009) – in MCM	
	Annual Replenishable Ground Water Resources	484.31
	Net Annual Groundwater Draft	279.51
	Projected demand for Domestic and Industrial Uses up to 2025	243.92
	Stage of Ground Water Development, %	57.71
13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Program organized Date Place No. of Participants	1 December 2003 Malappuram 300
14.	GROUND WATER CONTROL AND REGULATION	
	Number of Over Exploited blocks	Nil
	Number of Critical blocks	Nil
	Number of blocks notified	Nil
15.	MAJOR GROUND WATER PROBLEMS AND ISSUES	
	Localised Salinity Problems	

GROUND WATER INFORMATION BOOKLET OF MALAPPURAM DISTRICT, KERALA STATE

1.0 INTRODUCTION

Malappuram literally means an elevated place on the top of hills. The district has a unique place in the geological history in view of the fact that Laterite, first identified in the area near Angadippuram by Francis Buchanan is the type area of Laterite. The district lies between North latitudes 10° 40' and 11° 32' and East longitude 75 ° 50' and 76 ° 36'. The *Nilgiris* of Tamil Nadu in the east and Lakshadweep Sea in the west provide natural boundaries. In the north it is bounded by Kozhikode and Wayanad districts and in the south by Palakkad and Trichur districts. The district has a geographical area of 3550 sq.km, which is 9.13 % of the total area of the State.

In 2011, Malappuram had population of 4,110,956 of which male and female were 1,961,014 and 2,149,942 respectively. There was an increase of 13.39 percent in the population compared to population as per 2001. The initial provisional data suggest a density of 1,158 in 2011 compared to 1,021 of 2001. Malappuram ranks 3rd in the area and first in the population of the State. Out of the total population 55.81% (2,294,473) is in the rural area and the rest (1,816,483) is in the urban area. Malappuram contributes 12.31% of the total population of the state.

The district is accessible by air, rail and road. The Kozhikode airport is situated near Kondotty in the district. The Kanyakumari-Mangalore-Mumbai broad gauge railway line passes through the western parts of the district. There is another branch rail line to Nilambur from Shornur (Palakkad district). The NH 17 which connects Cochin and Mangalore passes through the western portion of the district.

The Headquarters of the district is at Malappuram. The district has two Revenue Divisions with Headquarters at Perinthalmanna and Tirur. There are 6 taluks namely Ernad (Headquarters at Manjeri), Perinthalmanna, Tirur, Ponnani, Nilambur and Tirurangadi (Headquarters at Parappanangadi), 15 blocks, 100 panchayats and 150 villages. There are 7 Municipalities namely Malappuram, Kottakkal, Ponnani, Perinthalmanna, Tirur, Manjeri and Nilambur.

An index map of the district is given in **Figure 1**.

Drainage

Malappuram district is mainly drained by the *Kadalundi River*, *Chaliyar River* and *Bharathapuzha* (locally known as Ponnani River). Of these rivers, only *Chaliyar* and *Bharathapuzha* are perennial and all others get dried up in summer and hence Malappuram district is highly drought prone. The *Kadalundi River* is formed by the confluence of its two main tributaries viz; the *Olipuzha* and the *Veliyar*. The *Olipuzha* takes its origin from 'the *Cherakkobban Mala*' (1160 m amsl) and the *Veliyar* originates from the forest of the '*Erattakomban Mala*' (1190 m amsl). The *Kadalundi River* is 130 km long with a drainage area of 1274 sq. km. The river joins the Lakshadweep Sea at about 5 km south of the *Chaliyar* river mouth.

The *Chaliyar River*, one of the major rivers of the State, originates from the Iambalari Hills in Nilgiri district of Tamil Nadu (2066 m amsl). The river flows along the northern boundary of Malappuram district through Nilambur, Mambad, Edavanna, Areakode and Feroke. It joins the Lakshadweep Sea near Beypore. The river is 169 km long with a drainage area of 2535 sq. km in Kerala State.

The *Bharathapuzha* or the Ponnani River is the second longest river of Kerala, originating from the Anamalai Hills (1964 m amsl) in the Western Ghats. The river below the confluence of *Bharathapuzha* and *Gayathripuzha* is called the Ponnani River. It flows through the districts of Palakkad, Malappuram and Trichur and drains into the Lakshadweep Sea near Ponnani town in Malappuram district.

The drainage pattern of the three rivers in the district is generally dendritic. Tidal effects are experienced in places such as Vallikkunnu and Tirurangadi, which are 6 to 8 km away from the coast. Analysis of the drainage characteristics of the two basins reveals that *Kadalundi* river is a fourth order stream, the *Ponnani* river is fifth order stream and the *Chaliyar* river is a seventh order stream.

Studies carried out by CGWB

Systematic hydrogeological surveys in the district were carried out during 1975 – 76. Detailed water balance studies of *Kadalundi* and *Ponnani* river basins are carried out

during the erstwhile SIDA assisted Coastal Kerala Groundwater Project (1983-88). Subsequent reappraisal hydrogeological surveys were carried out during 1997 – 98 & 2002 – 03. First phase of groundwater exploration in the hard rock as well as in the sedimentary formation of the district were carried out during the SIDA project from 1983 to 1987, in which 3 bore wells in hard rock area and 5 tube wells in sedimentary area were drilled. Subsequently, during 1999-2001(Hydrology Project), 2003-04 and 2007-09, 20 bore wells and 40 piezometers were drilled in hard rock area. by Central Ground Water Board.

2.0 CLIMATE AND RAINFALL

The district has more or less the same climatic conditions prevalent elsewhere in the State viz. dry season from December to February and hot season from March to May, the South-West monsoon from June to September and the North-East monsoon from October to December. The normal rainfall of the district is 2793.3 mm. Out of this, major rainfall contribution is from SW monsoon followed by the NE monsoon. The South West monsoon is usually very heavy and nearly 73.5% of the rainfall is received during this season. NE monsoon contributes nearly 16.4% and March to May summer rain contributes nearly 9.9% and the balance 0.2% is accounted for during January and February months.

The monthly rainfall for the Malappuram district during the period 2001 – 06 is tabulated in **Table 1**.

Table 1: Rainfall in Malappuram District (in mm) (2006 – 2011)

Month	2006	2007	2008	2009	2010	2011
January	0.80	0	0	0	18.40	11.00
February	0	0	21.00	0	0	18.00
March	45.90	0	218.00	49.40	9.30	11.00
April	60.60	100.10	45.70	53.40	74.70	155.00
May	617.50	240.80	59.80	289.40	197.40	56.00
June	644.00	783.20	523.40	586.10	775.80	927.00
July	553.00	1170.20	437.70	972.10	601.50	472.00
August	516.00	533.30	260.20	385.10	236.60	478.00
September	588.00	660.30	345.50	361.40	308.00	403.00
October	371.60	413.30	384.70	156.90	539.60	274.00
November	176.50	48.60	9.00	206.30	332.60	142.00
December	0.70	4.50	5.00	29.70	20.50	7.00
Total	3574.60	3954.30	2301.00	3089.80	3114.40	2954.00

Temperature

The climate is generally hot and humid. March and April months are the hottest and January and February months are the coldest. The maximum temperatures ranges from 28.9 to 36.2°C and the minimum temperatures range from 17.0 to 23.4°C. The temperature starts rising from January and reaches the peak in the month of March and April and then decreases during the monsoon month and again rising from September onwards.

Wind

The wind is predominant from east as well as west during morning and evening hours. The wind speed is more during December to February months. It ranges from 2.9 to 7.2 km per hour.

Humidity

The relative humidity ranges from 84 to 94 % during morning hours. The humidity is more during the peak monsoon months from June to September.

3.0 GEOMORPHOLOGY AND SOIL TYPES

Geomorphologically the district can be divided into three viz. coastal plain (less than 7.5 m amsl) mid land (7.5 – 75 m amsl) and highland (above 75 m amsl). The coastal plains extend as a narrow stretch of land lying along the coast from Kadalundi Nagaram in the north to Ponnani in the south. It becomes very narrow towards north of Tirur and the maximum width is seen along Chauravallam - Tirurangadi area. The area lying between the coastal plain in the west and the high ranges in the east is occupied by midlands. This is the most prominent physiographic unit of the district. This is characterized by flat topped hillock with steep 'U' shaped valleys and ridges. The valley forms potential area for agriculture including paddy, arecanut, vegetable, banana and coconut. The hill tops are generally barren and covered by thick and compact laterite. The eastern parts of the district are characterized by steep hills, gorges and escarpments. The elevation of the hill ranges goes up to 1127 m amsl. Most of the high lands are occupied by forests.

Soils

On the basis of morphological and physico-chemical properties, the Soil Survey Division of Department of Agriculture, Govt. of Kerala has classified the soils of the district into the following types

Soils of the low lands (Alluvial soil)

Those are mainly seen along the coastal plains and valleys. The soils range from exclusively drained to moderately/well drained sand to sandy clay in nature.

Soils of Mid/Up lands (Lateritic soil)

These are mostly lateritic soil, and is seen along the mid land portion of the district. These are deep to very deep, well drained, and gravelly to clayey.

Soils of Central Sahyadri (Hydromorphic soil)

These are deep moderate, well drained and clayey soils with high gravel content. Erosion is moderate to severe. Hard laterites with rock out crops are present.

Soils of eastern part of Malappuram (Forest loamy soil)

These soils are deep or very deep and well drained with loamy to clayey textures and having fairly high gravel content.

4.0 GROUNDWATER SCENARIO

Hydrogeology

Hydrogeologically, the aquifer system in the district can be broadly divided into Crystalline aquifers (fractured basement rock aquifers), Laterite aquifers, Lateralized sedimentary (Tertiary) aquifers and Alluvial aquifers. Crystalline and Laterite aquifers constitute major part (85%) of the district.

Groundwater in crystalline formations

In the crystalline rocks of the area viz. Charnockite, Biotite gneiss and Migmatite, the occurrence and movement of ground water are dominantly controlled by the nature and extent of weathering and the presence of structural features like fractures, joints and shear zones which generally varies from place to place. Ground water occurs in the secondary

intergranular pores and voids, under unconfined conditions in the shallow weathered and fractured rocks and under semi-confined to confined conditions in the deeper fractured zones.

Weathered rock forms potential aquifers and the thickness of weathered rock ranges from 4 to 12 m below ground level. Along valley portions in the area ground water is developed mostly by means of dug wells. The wells piercing the weathered zone vary from 15 to 20 m and ranges in diameter from 2 to 5 m. Their depth varies from 3.5 to 21.2 m bgl. The yields of those wells are of the order of 6 to 12 m³/hrs and the specific yield values ranges from 1-3%. The wells located in the hornblende biotite gneiss vary in depth from 6 to 15 m bgl. The yield of these wells ranges from 4 to 5 m³/hrs. They can sustain pumping for only few hours and recuperation rate is very poor.

Fractured aquifers in the crystalline areas form potential aquifers and ground water occurs under semi-confined to confined conditions. The occurrence and movement of ground water is controlled by the presence of lineaments, fractures and joint pattern. The studies and exploration carried out in the district indicate the intersections of exploratory wells fractures are most potential followed by NE – SW fractures. Ground water is developed by means of bore well. In the case of deep crystalline aquifers the fractures are fairly deep and inter connected.

CGWB has constructed 23 exploratory wells and 40 piezometers in this aquifer system and the salient aspects of the bore wells are given in **Annexure 1a**. The wells tapping deep crystalline aquifers range in depth from 90 to 300 m bgl. The yield of these wells ranges from 0 to 920 lpm. The depth of over burden varies from 3 to 35 m. The water bearing fractured zone were encountered at depth ranges of 20 to 30, 40 to 60, 70 to 80, 90 to 120 and 150 to 160 m bgl. The transmissivity values of the deep fractured confined aquifers ranges from 30-15 m²/day (Charnockites) and 5-50 m²/day (Hornblende biotite gneiss).

Groundwater in Laterites

This is the most widely distributed aquifer system in the district and occupies the midland region. The laterite constitutes the potential aquifer because of the porous and highly permeable nature. Ground water occurs under water table conditions. Due to this porosity, the stored water escapes as sub-surface run-off from the elevated hills and slopes once the

rain recedes. The laterite is derived from both the Tertiary formation and also from the crystallines. The laterite mainly occupy the hill top areas as laterite capping. Also occupy in low land areas where thickness is very meager.

The thickness of laterite overlying charnockites varies from 1 to 3 m and from 15 to 20 m in hornblende gneiss. Dug wells are the main water abstraction structures in the aquifer and the depth of these wells range from less than 5.0 m to 15 m bgl. Majority of well tapping laterites dry up during summer months. The bottom part the wells are mainly of lithomargic clay and becomes low yielding during peak summer periods. Subsequent rains contribute little to the aquifer system and escapes as rejected recharge. However in the lower attitudes especially in valley portions the water table is shallow and appreciable thickness of saturated zone is available for ground water development. Yield ranges from 8 to 10 m³ per hour and the specific yield values ranges from 2-5%.

Groundwater in Lateralized Sedimentary Formations

The lateralized Vaikom formation (sandstone and clay) with thickness varying from 23 m to 59 m forms one of the major aquifer occurring along the coastal tract of the district spatially sandwiched between the coastal sandy plain and the laterites basement rock aquifers. The depth to basement at Vettom is 71 m below ground level. They comprise of gravel, coarse sand, clay. They are found below the alluvial formation and the absence of Warkali bed is noteworthy. The thickness of the granular zones tapped in the tube wells constructed in this aquifer ranges between 5 m and 35 m with discharge in the range of .316 to 22.86 lps .These aquifer are extensively tapped for domestic requirements through shallow tube wells or deep dug wells and yet is less explored scientifically. The piezometric surface in respect of Vaikom aquifer is ranged between 1.53 and 2.74 m below ground level. However the ground water quality was not suitable for domestic purpose .The EC varied from 2000 to 4950 Ms/ cm except at Parappanangadi where it was 80 ms/cm with a discharge of 3.34 lps. Laterite of 6 m thickness was found at Pariyapuram area at depth of 18 to 25 m. CGWB has constructed 5 exploratory wells in this aquifer and the salient features of the tube wells are given in **Annexure 1b**.

Groundwater in Alluvial Formations

This is the most potential aquifer in the district. The coastal alluvium is essentially composed of sand, silt and clay. The ground water occurs under water table conditions. Large number of dug wells and filter point wells tap this aquifer to meet the domestic and agricultural needs. The coastal alluvium can sustain medium to heavy duty pumping. Filter point wells are feasible along the coast wherever the saturated sand thickness exceeds 5 m. Such potential areas are seen around Ponnani, Chamravattom, Mangalam, B.P Angadi, Tirur, Tanur, Parappanagadi and Kadalundi. Riverine alluvium of considerable thickness is seen in and around Thirunavaya, Kuttipuram area along the northern side of Bharatapuzha (Ponnani) river. Open dug wells and shallow tube wells are feasible in the stretch.

Valley fill materials (colluviums) are seen along almost all major and minor valleys. The formations form potential aquifers wherever the sandy portion is more. The specific yield values of these aquifers ranges from 10-20%. Dug wells tapping this aquifer often meet entire needs of minor irrigation schemes. The alluvial deposits are tapped by dug wells. Shallow dug wells piercing alluvium over laying the lateritic horizon vary in depth from 15 to 20 m bgl. The water level ranges from 1.6 to 13.3 m bgl.

Water levels and their Long term behaviour

The Central Ground Water Board is having 94 Ground Water Monitoring Wells (GWMW) in Malappuram district consisting of 66 dug wells and 28 piezometers. The dug wells are established in the laterite aquifers (Phreatic aquifers) and piezometers are established in the fractured basement rock aquifers (Confined/semiconfined). These stations are monitored for ground water level and quality. The analysis data indicate that the depth to water level in the wells tapping weathered crystalline rock aquifers ranges from 6.46 to 8.79 m bgl during pre-monsoon and from 4.21 to 5.88 m during Post-monsoon. The depth to water level in the wells tapping laterites ranges from 2.08 to 12.47 m bgl during pre-monsoon and from 1.75 to 10.32 m bgl during post monsoon. The water level ranges from 3.4 to 8.85 m bgl during the pre-monsoon and from 1.4 to 5.36 m bgl during post monsoon in alluvial aquifers. Depth to water level in the lateralized sedimentary aquifers varies from 10.46 to 21. 22 mbgl during

the premonsoon and from 7.0 to 10.11m bgl during the post monsoon. Depth to water level maps during premonsoon and postmonsoon are shown in **Figures 2 & 3** respectively. .

Long Term Water Level Trend

Long term trend of pre-monsoon and post-monsoon water level, between 1981 and 2010 is analyzed. The water level Hydrograph depicting pre-monsoon trend and post monsoon trend for select monitoring stations having continuous data for a considerable period have been selected for the analyzes. The results of the analysis shows that data from 85% of the hydrograph network stations in Malappuram show either rising trend or no trend both in the pre monsoon and post monsoon phase. The maximum premonsoon rise (0.70m/year) is shown in the data recorded at Thiruvalli station in Wandur block where as in the post monsoon phase the maximum rise is shown by the Cheruvannur station in Kuttippuram block. The annual trend indicates that 95% of the network stations show either rising trend or no trend.

Ground water Resources

Assessment of dynamic ground water resources of the district as in March 2009, computed block-wise as per the norms of Ground Water Estimation Committee (GEC) 1997 indicate net annual ground water availability of 484.31 MCM. The gross ground water draft for all uses is of the order of 279.51 MCM. The net availability of ground water for future irrigation is of the order of 158.72 MCM. The stage of ground water development for the district as a whole is about 58%, ranging from 35% in Nilambur block to 92% in Tirurangadi block. Salient details of the computation of ground water resources in the district are shown in **Table 2**.

Table 2: Salient Details of Assessment of Dynamic Ground Water Resources of Malappuram District as in 2009

Sl. No.	Assessment Unit/ Block	Total Annual Ground Water Recharge	Provision for Natural Discharges during non monsoon season	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for All uses	Net Ground Water Availability for future irrigation development	Stage of Ground Water Development (%)
1	Areacode	5334.07	533.41	4800.67	2365.38	2013.96	49.27
2	Kondotty	3055.32	305.53	2749.79	1992.19	426.28	72.45
3	Kuttippuram	2722.56	272.26	2450.30	1676.65	521.60	68.43
4	Malappuram	3644.29	364.43	3279.86	1901.65	1029.08	57.98
5	Mankada	4036.03	403.60	3632.42	2305.77	980.41	63.48
6	Nilamboor	7441.40	744.14	6697.26	2327.12	3932.04	34.75
7	Perinthalmanna	4845.22	484.52	4360.69	1876.04	2157.15	43.02
8	Perumpadappu	2194.00	109.70	2084.30	1278.64	629.15	61.35
9	Ponnani	2576.09	257.61	2318.49	1436.21	606.95	61.95
10	Tanur	3694.67	184.73	3509.94	2533.92	550.63	72.19
11	Tirur	3976.45	198.82	3777.63	2418.07	986.69	64.01
12	Tirurangadi	2259.63	112.98	2146.65	1968.27	0.00	91.69
13	Vengara	2801.00	280.10	2520.90	1801.82	389.77	71.48
14	Wandoor	4557.97	455.80	4102.17	2069.40	1648.51	50.45
	TOTAL (ha.m)	53138.69	4707.63	48431.05	27951.12	15872.22	57.71
	TOTAL (MCM)	531.39	47.08	484.31	279.51	158.72	57.71

Based on the stage of ground water development and the long term trend of water levels, 3 blocks namely Kondotty, Tirurangadi and Vengara have been categorized as ‘Semi-Critical’ and the remaining blocks are categorized as ‘Safe’(**Figure 5**).

Groundwater quality

The chemical quality of the ground water in the district is generally good. The shallow groundwater from the alluvial formation has higher total dissolved solids and major ion constituents than that of other formations. This is due to the proximity of the pond water channels and tidal influence in the area occupied by coastal alluvium. In the coastal alluvium the electrical conductivity ranges from 1360 – 2130 $\mu\text{S}/\text{cm}$ at 25^o C. In the other

areas the EC is within permissible limit. Since the district is devoid of any major industries the ground water pollution due to industrial pollution is not a major issue of concern. The chemical analysis data of samples collected from exploratory bore wells and piezometers are given in **Annexures 2a** and **2b** respectively. The range of chemical constituents of groundwater in the shallow phreatic aquifers of the district are summarized in **Table 3**.

Table 3: Range of chemical parameters in shallow wells

Sl.No	Properties/ constituents	Maximum permissible limit as per ISI (1983)	Range (NH stations) April -2009
1	pH	6.5 - 9.2	7.1-9.5
2	Electrical conductivity(in $\mu\text{S}/\text{cm}$ at 25°C)	-	50-974
3	Total hardness as CaCO_3 ppm	600	8-160
4	Ca "	200	2.4-32
5	Mg "	100	1-19
6	Na "		0.3-73
7	K "		0.3 – 2.5
8	CO_3 "		0-2.4
9	HCO_3 "		7 - 154
10	SO_4 "	400	0.8-.245
11	Cl "	1000	5-124
12	NO_3 "	45	0.5-54
13	F "	1.5	0-0.4

5.0 GROUNDWATER MANAGEMENT STRATEGY

Malappuram district is the most populous district in the State with highest decadal population growth rate. With the ever increasing population, to meet the demand of water for various purposes, there is a growing stress on the ground water resources. Management of ground water is becoming a deep concern for the scientists, planners and administrators alike. Sustainable management of available ground water resources has thus become vital for the prevention of over exploitation and contamination of groundwater.

Though the district is endowed with an average annual rainfall about 3000mm spread over both the southwest and northeast monsoons, the ground water availability during the peak requirement period (Dec – May) has been found to be meager for domestic and agricultural purposes. This is mainly on account of the large dependence on ground water

in rural areas and the resultant high well density, where the spacing between pumping wells often less than 50 m. Further, as the major part of the district is underlain by crystalline rocks with very thin unconsolidated phreatic aquifer with steep hydraulic gradient from east to west, the ground water runoff from the phreatic aquifer is appreciable on account of the unique geomorphic and hydrogeological set up of the area . Hence ground water management to ensure equity, efficiency and sustainability should focus on suitable water harvesting and artificial recharge techniques. A strong ground water legislation with strict regulation and control with mandatory registration of all new pumping ground water extraction structures with the State Ground Water Authority would aid in proper governance and ensure sustainability of this precious resource.

There is no major urban water supply scheme in the district. Major schemes are mostly river based. However, majority of rural water supply schemes depend on ground water. The status of drinking water supply schemes in the district is summarised in **Table 4**. About 32% of the schemes depend on open wells and 36 % of the schemes are bore well based. About 2 % of the schemes are a combination of open and bore wells. Springs constitute for 1.5 % of schemes. Only 21 % of the schemes depend on groundwater as their source.

The following areas have been suggested for further development of deeper fractured aquifers in the hard crystalline basement rock.

- (1) The Karipuzha and Chaliyar lineaments are potential zones for the development of deeper aquifers in Chaliyar basin.
- (2) The Olipuzha – Kadalundi lineament (ENE – WSW) is a potential area for the development of deeper aquifers in Kadalundi basin.
- (3) Minor lineaments trending E – W, WNW – ESE (Kottakkal, Kulattur) are also potential in Kadalundi basin
- (4) The EW and NNW - SSE trending minor lineaments are good for ground water development potential in Ponnani basin
- (5) The NW – SE trending major lineament is not always promising due to the local filling of the aquifer with clay.

- (6) The intersection points of the major NW – SE lineaments with minor fractures are having very good groundwater potential.
- (7) The approximate casing depth will normally vary from 5 to 25 m. No formation instability during drilling operation is expected in the district.

Table 4: Status of Drinking water Supply in Malappuram District

Sl.No	Block	Public Wells		Public Tanks		Hand Pumps		Others		Total		Public Taps	
		W	NW	W	NW	W	NW	W	NW	W	NW	W	NW
1	Perumpadappa	94	13	2	1	237	6	0	0	333	20	429	14
2	Areacode	171	40	33	3	36	12	6	0	246	55	497	39
3	Kondotty	159	14	18	2	50	3	8	0	235	19	368	0
4	Kuttipuram	66	11	9	8	88	5	45	0	208	24	219	18
5	Malappuram	136	24	17	4	42	7	0	0	195	35	513	0
6	Mankada	125	34	31	0	123	17	5	0	284	51	775	130
7	Nilambur	277	13	20	1	18	14	2	4	317	32	342	135
8	Perintalmanna	132	2	31	0	81	1	0	0	244	3	227	0
9	Ponnani	114	35	0	0	48	0	0	0	162	35	582	149
10	Tanur	85	11	25	4	52	9	0	0	162	24	372	44
11	Tirur	86	5	10	2	19	19	0	0	115	26	362	154
12	Tirurangadi	140	10	3	0	44	0	2	0	189	10	620	60
13	Vengada	242	0	5	0	110	0	0	0	357	0	124	0
14	Wandoor	188	12	93	2	55	15	0	0	336	29	504	85
	Total	2015	224	297	27	1003	108	68	4	3383	363	5933	828

Water Conservation and Artificial Recharge

So far no large scale artificial recharge schemes have been implemented in the district so as to augment the natural recharge to the aquifer system. Overall the district offers tremendous scope for artificial recharge due to the highly porous and deep lateritic profile, especially at places where the ground water is deep. Since the district is characterized by the presence of table topped mountain and ridges covered by lateritized beds, construction of artificial recharge by tapping surface run off is a feasible proposition. Abandoned lateritic quarry pits can be used as percolation tanks for this purpose. The proposed Artificial Recharge structures in Malappuram district are shown in **Figure 6**. Details of AR/RWH structures constructed in the district by State Ground Water Department are furnished in **Table 5**.

Table 5: AR/RWH Structures Constructed by SGWD in Malappuram District

Year	Type of structure	Location
2010	Check Dam	Chennaythodu in Thiruvalli Grama Panchayat
		Parappoduthodu-Kapradu in Tirurangadi Pt.
		Karakkunnu in Trikkalanguodu Grama Panchayat
2009	NIL	
2008	Ferro cement tank & over flow recharge to Open well	GLP School, Cherukulam, Thrikkalanguode Pt.
		GHS School, Karakkunnu, Thrikkalanguode Pt.
2007	Recharge to Open well	1) AMLPS, Chemmala, Pulamanthole Pt.
		2) Govt.H.S.S., Vettathur
		3) GHS School, Pattikkad
		4) Aided Mappila DS, Tirurkad
2006	Recharge to Open well	1) St.Joseph English medium school, Puthanangadi
		2) AUP School, Pulamanthole
		2) Thirumandamkunnu Devaswam Board building, Angadippuram
	Recharge to Bore well	4) AUP School, Chemmala
	Recharge to Open well	5) GHS Pulamanthole
		6) Aided PTM HS School, Thazhekodde
		7) Govt.UP School, Panangangara
		8) ALP School, Paloor

6.0 GROUNDWATER RELATED ISSUES AND PROBLEMS

In general the district is devoid of any serious ground water related issues in terms of quantity and quality. However, the dug well in the lateritic aquifer goes dry immediately after the monsoon season causing drinking water shortage to rural population.

7.0 AWARENESS AND TRAINING ACTIVITY

Mass awareness programme and Water Management Training Programme

CGWB has conducted a mass awareness programme on conservation and protection of groundwater resources at Malappuram on December 2003. The programme got wide publicity and was attended by about 300 participants.

8.0 AREA NOTIFIED BY CGWA/ SGWA

No blocks in the district has been notified by CGWA / SGWA.

9.0 RECOMMENDATIONS

- There are no major irrigation projects in the district. An area of 24663 ha is being irrigated using minor and lift irrigation schemes. Ground water irrigation is still in the infant stage in the district and is confined to cash and garden crops. The government should introduce more beneficial schemes to promote ground water irrigation in the district
- The deep fractures in the crystalline basement offers huge prospects for further ground water development. The following areas have been identified for the development of the above said resource.
 - Karimpuzha and Chaliyar lineaments in the Chaliyar basin
 - Olipuzha – Kadalundi lineaments (ENE – WSW) in Kadalundi basin
 - Minor lineaments trending E- W, WNW- ESE (Kottakkal – Kulathur) in Kadalundi basin.
 - E-W and NNW – SSE trending minor lineaments in Ponnani basin.
 - Intersection points of major NW – SE lineaments with minor fracture/joints have very good ground water development potentials.
- Abandoned laterite quarries can be developed as percolation tank for recharging laterite/hard rock aquifer by tapping surface run off/rainfall.
- Check dams are recommended for the recharge of the vast alluvial track in Bharathapuzha basin.
- The intersection of Palakkizhi lineament with Olipuzha lineament (at Kizhuttur, about 3 km south of Melattur) is a potential area for development of deeper aquifer.
- There are about 26 springs reported in the district. They emerge along the contact between laterite and crystalline along topographic lower valleys. The yield of the spring ranges from 1 to 500 lpm. These springs can be developed for planned rural water supply schemes.
- Some of the promising potential valleys where groundwater can be developed by means of open wells are :
 - Valley between Kolathur - Karuvambalam - Pookkatteri (58 B/1 - I B)
 - Ramapuram Valley - (58 B/1, 1B)
 - Palpatta Valley (EW), (58 B/5 - 2 C)

- Valley running from Ponmala to Chappanangadi, (58 A/3,3A)
- Puttur - Irringalur valley - 58 A/3, 3 A)
- Vadakkangara Valley, (58 A/3, 3C)
- Valley running (WNW - ESE) between Karipur (south of Kondotty) and Kunnamangalam on the Kondotty - Kuriyad road (49 M)
- The (E-W) valley between Kodavayur, Olakkara and Paravallur on the Vallikunnu - Karipore road side (49 M/15, 3 C)
- Valley (WNW - ESE) running between Munniyur - Tirurangadi (49 M/15, 3 B)
- Valley (NW - SE/N-S) running between Ponmundam and Perumanna - (49 N, 1 C)

Dug well with diameters of 2.0 - 3.5 m is recommended in the area. The well should be deep enough to tap the entire thickness of weathered rock, the thickness of which may range from 6 - 13 m below ground level along the valley portion.

Management of any system should balance the demand and supply in a sustainable manner. The stress on groundwater system is reflected in steep decline of water levels and sharp deterioration of quality of water. A scientific development and management of groundwater is the need of the time to avert any future crisis. The National Water Policy and the State Water Policy lay down directives and principles for assessment, development and management of water resources in the country which can be taken as guidelines for evolving ground water management.

Figure 2: Pre monsoon Decadal Average water levels (April 2002-11)

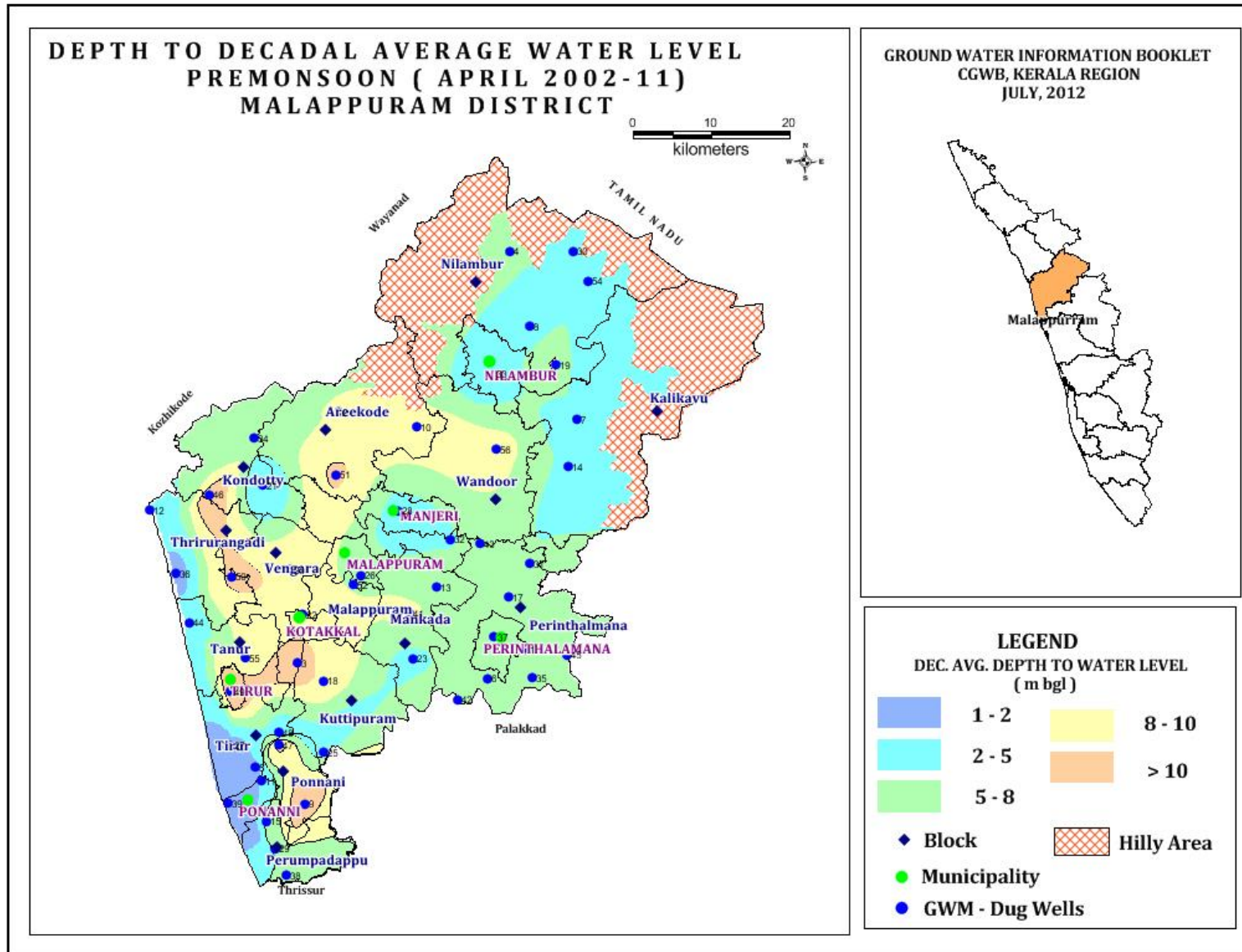


Figure 3: Post monsoon Decadal Average water levels (November 2002-11)

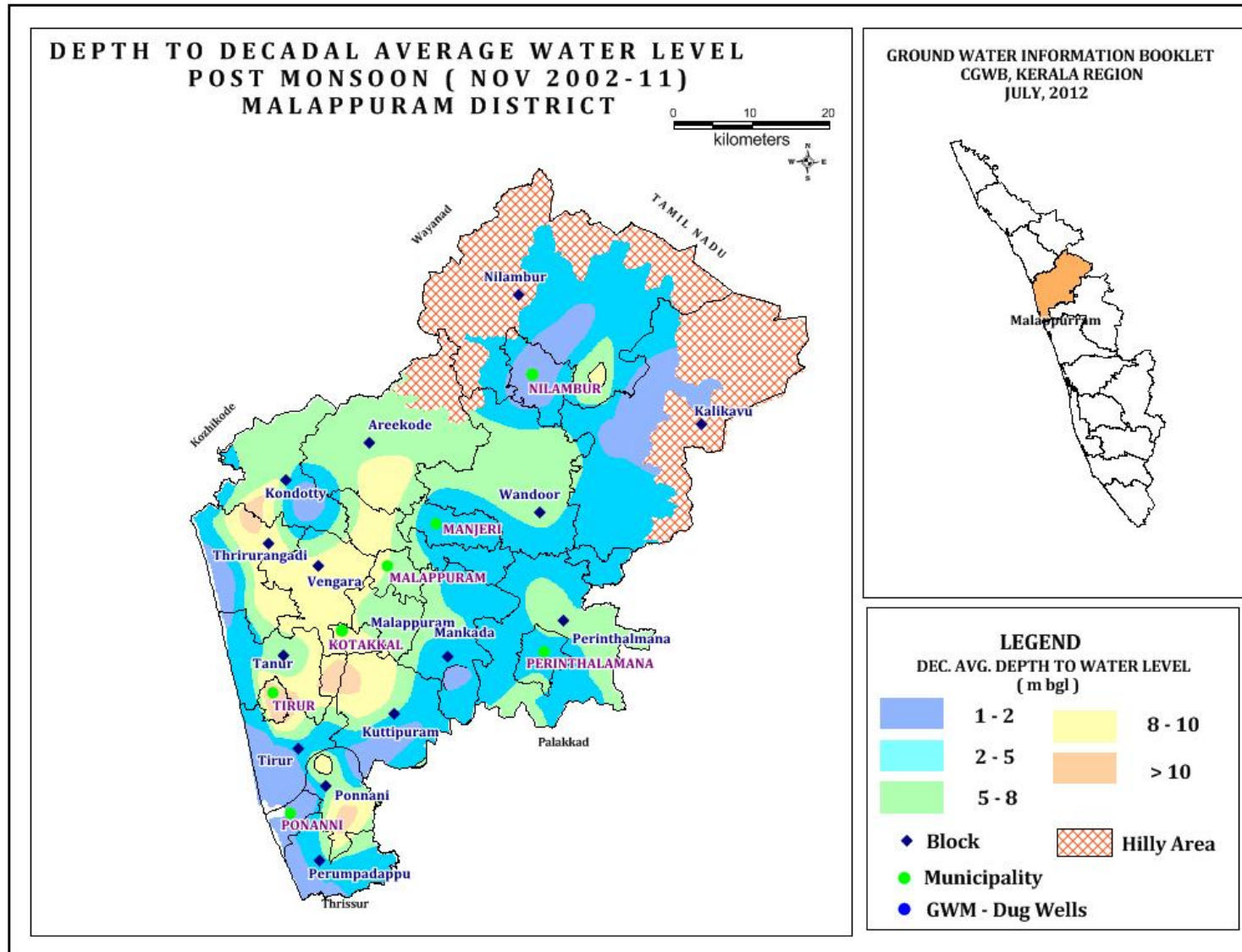


Figure 4: Hydrogeology of Malappuram District, Kerala State

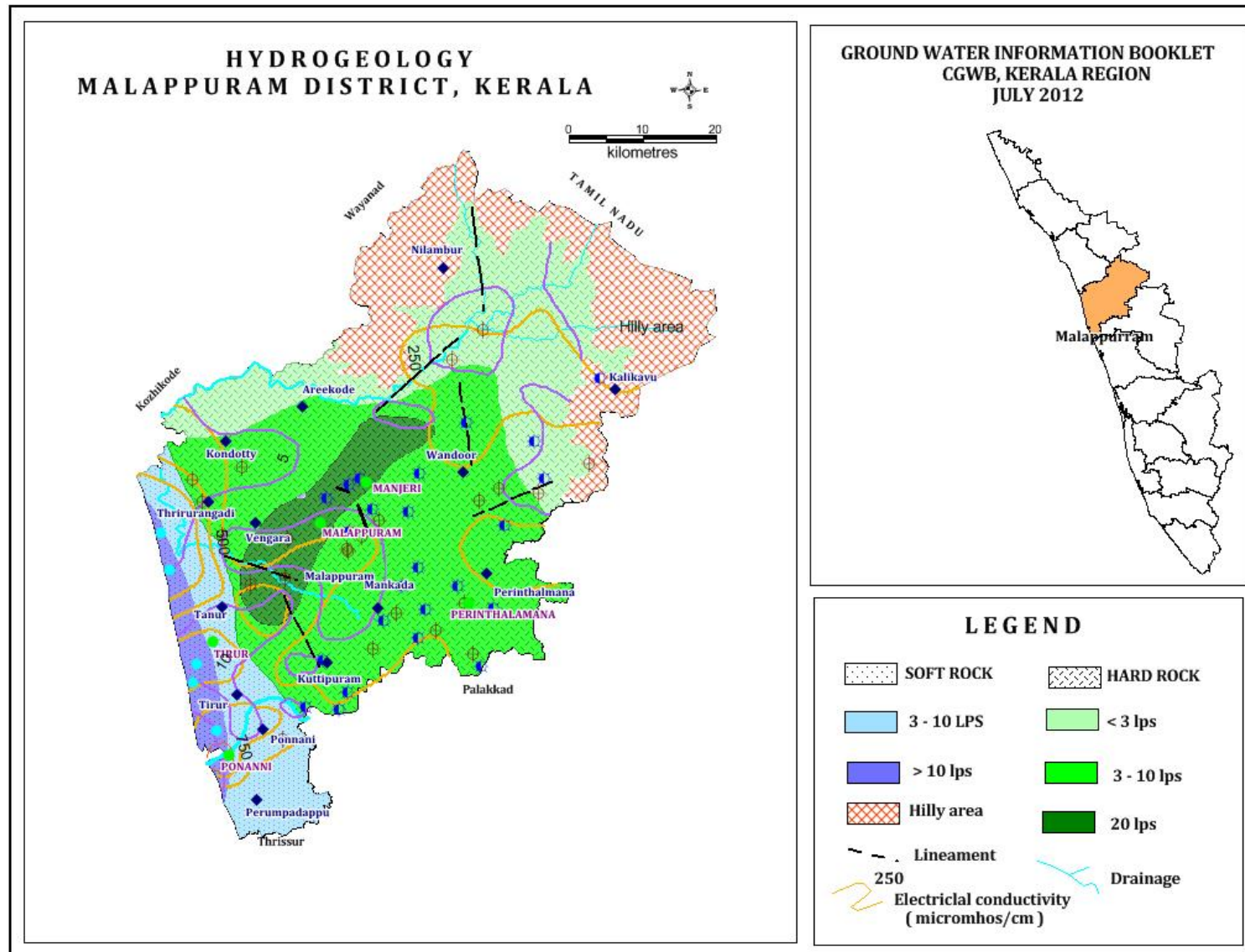


Figure 5: Categorization of Blocks in Malappuram District (2009)

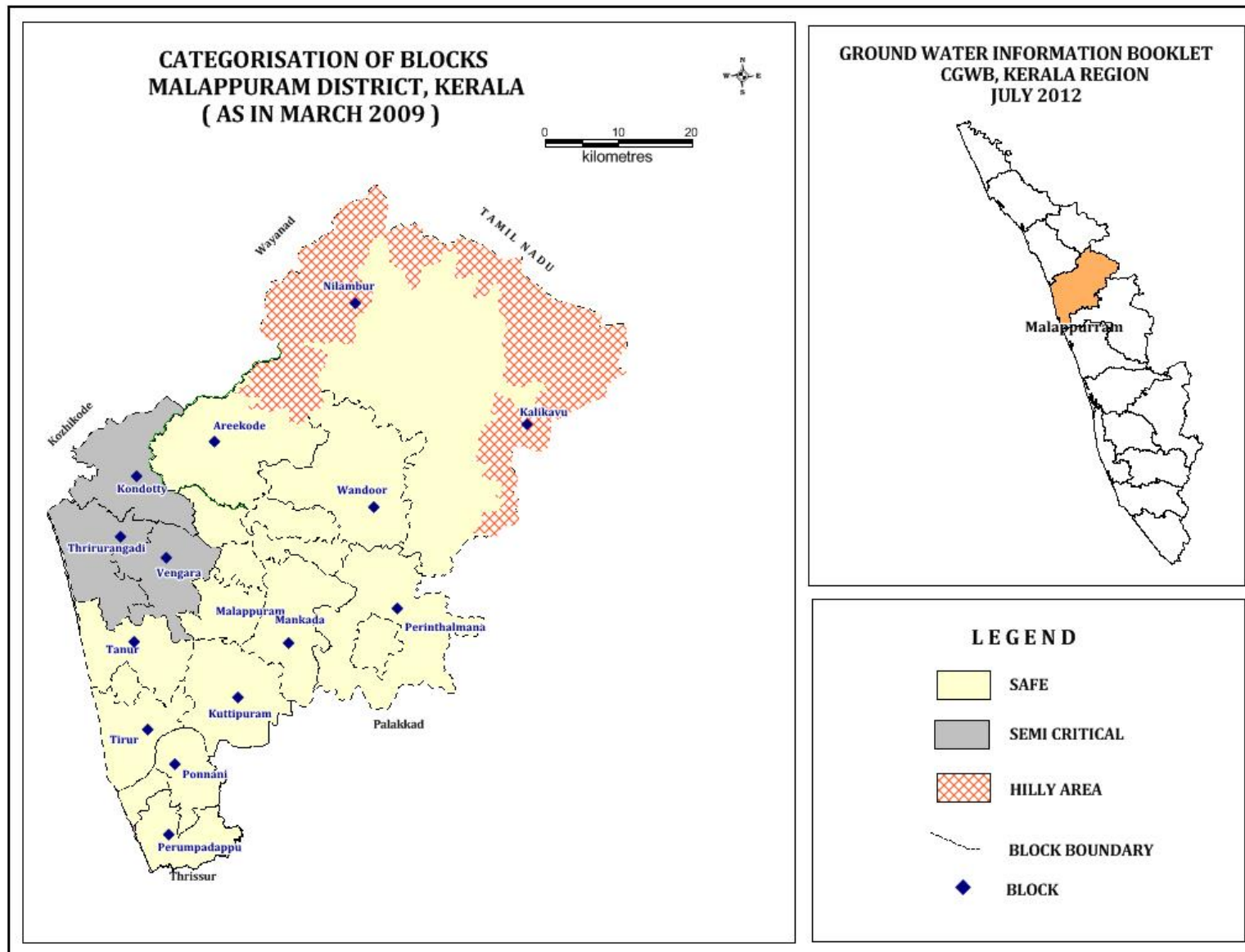
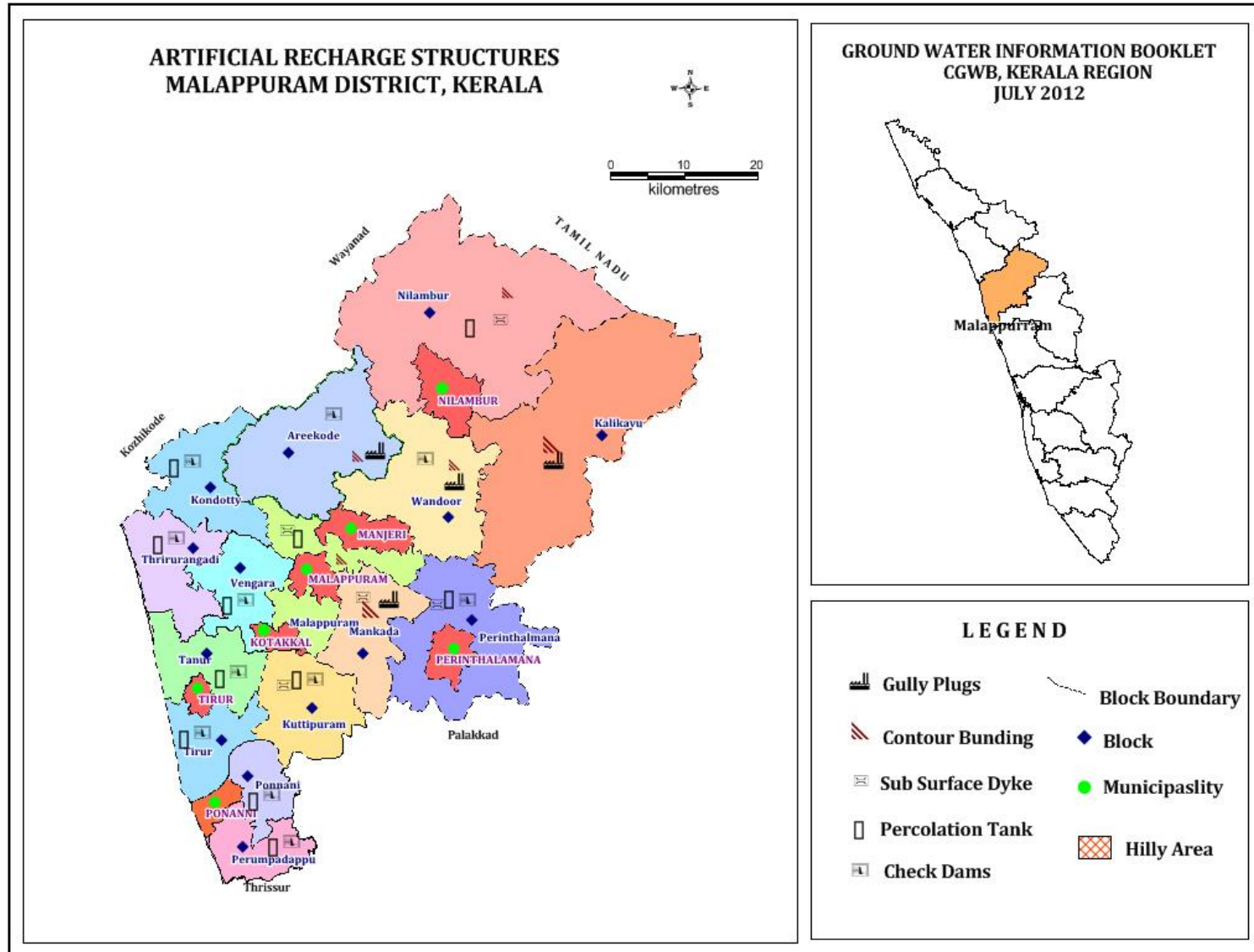


Figure 6: Artificial Recharge Structures proposed in Malappuram District



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Annexure 1a: Details of exploratory wells constructed by CGWB (Hard Rocks)

Sl. No	Location	Block/Panchayath	Depth drilled (mbgl)	Lithology	Thickness of overburden	Depth ranges of Water yielding zones	SWL (mbgl)	water yield (lpm)	EC in $\mu\text{S/cm}$	Cl ⁻ ppm
1	Kottakkal	Kottakkal Municipality	229.01	Charnockite gneiss	13.72	23-40, 54-61, 103-111, 114-119	1.97	920.00	890	18
2	Vallikkappatta	Malappuram/ Koottilangadi	300.81	Charnockite gneiss	7	Nil	4.53	nil	60	11
3	Koyappa Olakara	Vengara/ A. R. Nagar	300.81	Charnockite gneiss	14.95	Nil	7.3	Negligible	210	17
4	Malappuram-I M.S.P Camp	Malappuram Municipality	200	Charnockite	11.6	29.0-32.0	13.35	19.20	296	7.1
5	Urakom	Malappuram/ Urakam	200	Charnockite	17.4	59.0-62.0	47.45	240.00	370	8.5
6	Malappuram-II M.S.P staff quarters	Malappuram Municipality	200	Charnockite	16.2	59.0-62.0	16.6	60.00	197	8.5
7	Padinjattumuri	Mankada/ Koottilangadi	102	Charnockite gneiss	15	32.0-44.0	10.8	840.00	217	5.7
8	Chirattamala	Mankada/ Pulamanthol	200	Charnockite	15.5	46.0-49.0	28	360.00	265	2.8
9	Paloorkotta	Mankada/ Puzhakkattery	200	Charnockite	16	47.5-49.5	38.75	30.00	247	4.3
10	Thevarparambu	Perinthalmanna/ Elamkulam	200	Charnockite	3.7	108.0-111.0	17.12	60.00	459	9.9
11	Vengad	Mankada/ Moorkkanad	172	Charnockite gneiss	7.3	66.0-68.0 72.0-74.0 90.0-93.0	16.31	720.00	267	7.1
12	Edappal	Ponnani/ Edappal	200	Charnockite	10	123.0-126.0	9.73	240.00	764	64
13	Thavanur	Ponnani/ Thavanur	200	Charnockite	7.3	29.0-35.0		dry		
14	Karippur	Kondotty/ Pallikkal	200	Charnockite	18.5	54.0-72.0 154.0-157.0	23.8	30.00	272	9.9

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15	Klari	Thanur/ Perummanna Klari	200	Charnockite	13.1	16.0-26.0, 43.0-56.0, 78.0-85.0, 98.0-109.0	14.9	90.00	270	4.3
16	Thenhippalam	Thirurangadi/ Thenhippalam	111.5	Charnockite gneiss	14.4	48.0-55.0, 86.0-110.0	30.74	600.00	314	14
17	Perinthalmanna	Perinthalmanna Municipality	200	Charnockite gneiss	13.4	75.0-78.0, 96.0-99.0, 120.0-124.0		Nil		
18	Kolapparambu	Wandur/ Pandikkad	200	Hornblende Biotite Gneiss	22	48.0-51.0	11.8	30.00	175	4.3
19	Kolappuram	Vengara/ A. R. nagar	187.3	Charnockite gneiss	23	35.0-40.0, 156.0-165.0	14.4	150.00	175	4.3
20	Nilambur	Nilambur Municipality	200	Hornblende Biotite Gneiss	33.85	44.0-49.0	15.36	60.00	98	7.1
21	Thuvur	Wandur/ Thuvur	200	Hornblende Biotite Gneiss	7.3	Nil		nil		
22	Punnakkad	Wandur/ Karuvarakundu	162.9	Hornblende Biotite Gneiss	7.4	47.0-50.0, 69.0-73.0, 115.0-120	6.11	300.00	371	5.7
23	Valluvassery	Nilambur/ Chungathara	89.7	Hornblende Biotite Gneiss	24.6	29.0-35.0, 72.0-78.0	17.38	420.00	384	5.7

Annexure 1b: Details of Piezometers constructed by CGWB (Hard Rocks)									
Sl. No	Location	Block/Panchayath	Depth drilled (mbgl)	Lithology	Thickness of overburden	Depth ranges of Water yielding zones	Discharge (lpm)	EC in $\mu\text{S/cm}$	Cl (ppm)
1	Kolathur	Mankada/ Moorkanad	101	Charnockite /hornblende biotite gneiss	6.6	37-49, 67-68	420.00	455	0.26
2	Puppallam	Mankada/ Valumbram	101	Charnockite	6.6	67-68	Negligible	338	7.1
3	Thozhavannur	Kuttippuram/ Kattiparuthi	101	Charnockite	7.4	32-33	30.00	403	21
4	Kizhakkumppuram	Perinthalmanna/ Melattur	116.4	Charnockite	6.6	61-62	Negligible	443	8.5
5	Kalikkavu	Nuilambur/ Kalikkavu	100	hornblende biotite gneiss	15.2	20-22 42-43	120 60	258	9.9
6	Wandur	Wandur/ Wandur	101	Granitic gneiss	21.5	70-71	Negligible		
7	Pandalur	Malappuram/ Pandallur	101	Granitic gneiss	10.6	NIL	nil		
8	Munduparamba	Malappuram Municipality	100	Granitic gneiss	16.5	NIL	nil		
9	Karuvarakundu	Wandur/ karuvarakundu	101	Hornblend biotite gneiss	30.1	53-54	Negligible	321	4.3
10	Puthanangadi	Mankada/ Andagipuram	101	Charnockite	8.6	13-14 56-58	120.00	344	13
11	Mankada	Mankada/ Mankada	101	Charnockite	12.9	47-50	Negligible	109	11
12	Klarimoochikkal	Thanur/ Perumanna	101	Charnockite	12.8	56-58	15.00	547	7.1
13	Pangh	Mankada/ Ponmala	80	Charnockite	6.5	57-58	600.00	330	7.1
14	Nediyirippu	Kondotty/ Nediyirippu	101	Charnockite	12.4	NIL		218	7.1
15	Cherukulam	Wandur/ Thrikkalangode	101	Charnockite	17.5	25-26 , 66-67	15.00	219	5.7

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16	Karuvambram	Manjeri Municipality	113	Charnockite	18	73-74	Negligible		
17	Narukara	Manjeri Municipality	98	Charnockite	27	NIL	15.00	114	4.3
18	Anakkayam	Malappuram/ Anakkayam	116	Charnockite	6	64-65	nil		
19	Pookkottur	Malappuram/ Pookkottur	101	Charnockite	13.2	17-17.5	negligible		
20	Mankeri	Kuttippuram/ Irimbiliyam	100	Charnockite gneiss	11.9	19-20 31-32 41-42 47-48	1260.00	79	5.7
21	Amminikkad	Perintahmanna / Thazhekkode	100	Charnockite gneiss	5.4	29-30 40-41 55-56	6.00	154	trace
22	Muthukurussi	Perinthalmanna/ Elamkulam	100	Hornblende Biotite Gneiss	15.9	20-21 31	30- 30.00	350	8.5
23	Chemmalassery	Mankada/ Pulamanthol	100	Charnockite gneiss	7.5	24-25 54	53- 6.00	531	13
24	Pananganagara	Mankada/ Puzhakkatteri	100	Charnockite gneiss	7.8	29-30 55-56 65-66 71-72	240.00	400	7.1
25	Kurtippuram	Kuttippuram/ Kuttippuram	92	Hornblende Biotite Gneiss	15.95	18-19 26-27 55-56	1200.00	159	8.5

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Annexure 1c Details of Tube Wells drilled (Sedimentary Rocks)

Sl.No.	Location, Coordinates & Toposheet No.	RL	Depth drilled	Depth constructed	Aquifer zones tapped						Depth to basement	Remarks
		m amsl	(m bgl)	(m bgl)	Recent	Laterite	Warkalai	Quilon	Vaikom	Alleppey	(m bgl)	
1	Purathoor 10°49'00" 75°55'40" 49 N/13	1.73	67.06	41.04	18.2				47.24		65.63	EC=4950 Cl=1716 SWL=1.53 m bgl
2	Vettom 10°52'30" 75°53'50" 49 N/13	NA	73.25	57	12	0	0	0	59	0	71	
3	Pariyapuram, 10°53'55" 75°54'10" 49 N/13	4.47	64.32	Nil	18.29	6.09			30.48		54.86	E.log EC>3800 below 15 m bgl
4	Thanur 11°00'50" 75°52'05" 49 M/16	NA	65.75	32	NA	NA	NA	NA	NA	NA	NA	
5	Parappanangadi 11°03'30" 75°51'30" 48 M/16	NA	46	44	14.75	7	0	0	23	0	44.75	

Annexure 2a: Hydrochemical data of water samples collected from Exploratory wells of CGWB in Malappuram district

Sl. No	LOCATION	Source	Date of sampling	pH	EC in $\mu\text{s}/\text{cm}$ at 25°C	TH as CaCO_3	Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3
1	Kottakkal	EW	12.04.03	7.8	570	250	60	24	16	2.9	0	166	45	72	0.4	0.2
2	Urakom	EW	24.06.03	7.98	370	154	33	18	12	3.1	0	149	57	8.5	0.3	0.8
3	Urakom	OW	29.07.03	7.77	384	152	24	22	12	3.1	0	139	58	5.7	0.3	1.2
4	MSP Camp, Malappuram	EW	05.06.03	8.05	296	112	19	16	9.2	3.2	0	139	16	7.1	0.5	1
5	Padinjattumuri	EW	12.08.03	7.6	217	86	14	13	6.7	2.4	0	120	3.7	5.7	0	0.6
6	Thevarapambu	EW	30.08.03	7.76	459	194	47	18	11	2.8	0	264	21	9.9	0.4	0.2
7	MSP Staff Quarters	EW	05.08.03	7.76	197	66	14	7.8	9.2	3.8	0	93	9.4	8.5	0.1	2
8	Tenhipalam	EW	06.12.03	7.16	314	126	28	14	11	3.5	0	163	14	5.7	0.4	0.2
9	Klari	EW	29.12.03	7.82	270	100	22	11	9.8	3.3	0	102	45	4.3	0.3	1.6
10	Karippur	EW	19.12.03	7.96	272	102	19	13	13	3.7	0	146	11	9.9	0.2	0.2
11	Chirattamala	EW	15.09.03	8.46	265	116	25	13	8.1	2.1	7.2	124	21	2.8	0.2	0.03
12	Chirattamala	OW	20.09.03	8	712	200	46	21	71	4.1	0	110	258	14	0.5	0.4
13	Paloorkotta	EW	30.09.03	8.48	247	106	18	15	8	4.1	7.2	124	17	4.3	0.4	1.6
14	Vengad	EW	17.10.03	8.16	267	112	20	15	10	4.2	0	149	9.6	7.1	0.4	0.4
15	Vengad	OW	08.11.03	8.55	326	146	28	18	11	4.8	14	159	16	7.1	0.3	0.2
16	Edappal	EW	20.11.03	8.32	764	345	62	46	27	3.1	6	140	197	64	0.6	0.1
17	Kollaparambu	EW	31.01.04	7.66	175	60	13	6.8	9.7	3.6	0	93	7	4.3	0.6	0.8
18	Karuvarakundu	EW	19.03.04	7.74	371	132	33	12	18	8.2	0	227	0	5.7	0.2	0.3
19	Nilambur	EW	03.03.04	7.06	98	26	5.6	2.9	7.5	2.6	0	41	1.9	7.1	0.1	2.6
20	Kollapuram	EW	12.02.04	7.77	163	52	9.6	6.8	7.6	3.7	0	78	2.2	8.5	0.3	1
21	Valluvacherry	EW	11.04.04	7.92	384	158	48	9.2	16	4.2	0	229	5.9	5.7	0.4	0.1

Annexure 2b: Hydrochemical data of water sample collected from the piezometers in Malappuram district

Sl.No	Location	pH	EC in	TH as	Ca	Mg	Na	K	CO ₃	HCO ₃	SO ₄	Cl	F	NO ₃
			us/cm at	CaCO ₃										
			25 ^o C	-----in mg/-----										
1	Mankeri	7.88	79	22	5.6	2	4.8	1.2	0	32	2	5.7	0	2
2	Amnikkad	8.32	154	58	14	5.4	6.2	5.3	7.2	54	1.5	traces	0.04	12
3	Mathukurissy	8.67	350	162	38	17	9.4	7.1	36	116	18	8.5	0.56	2.6
4	Chammalassery	8.27	531	255	60	26	13	9.8	0	262	72	13	0.54	0.6
5	Panangangara	8.56	400	210	38	28	9.7	3	36	201	7	7.1	0.17	0.5
6	Kuttipuram	8.29	159	55	12	6.1	10	3.6	0	79	4	8.5	0.4	3
7	Narukara	8.24	114	34	8	3.4	8.2	2.7	0	61	4	4.3	0.32	0
8	Cherukulam	8.34	219	82	20	7.8	12	3.9	3.6	129	3	5.7	0.36	0
9	Klarimoochikkal	7.89	547	225	54	22	24	2.8	0	226	150	7.1	0.47	1.5
10	Poopalam	8.48	328	130	18	21	14	11	24	177	5.5	7.1	0.22	1.5
11	Puthenangadi	8.45	344	160	42	13	9.4	2	24	104	56	13	0.35	0.4
12	Kolathur	8.52	455	205	42	24	14	2.4	24	146	113	7.1	0.38	0.26
13	Thozhuvannur	8.57	403	190	38	23	11	2.4	30	165	8.5	21	0.38	1
14	Kizhakkumpuram	8.32	443	165	40	16	19	18	24	207	29	8.5	0.68	0.74
15	Karuvarakund	8.33	321	90	22	8.5	24	7.4	24	159	0	4.3	0.22	0.09
16	Kalikavu	7.08	258	90	30	3.6	9	3.9	0	63	68	9.9	0	11
17	Pangh(GHSS)	8.58	330	155	28	21	8.4	2.7	24	128	45	7.1	0.34	0.98
18	Neeliyirippu	8.91	218	85	16	11	7.6	2.5	24	85	2.5	7.1	0.38	0.33
19	Klarimoochikkal	7.52	109	40	10	3.6	5.5	0.4	0	24	4.5	11	0.08	0.45