HYDROGEOLOGICAL REPORT FOR

C.Arasur Sand Quarry Project for Restoring the Functional Efficiency of the Coleroon River over an Extent of ***10.00.0Ha of Government land in S.F.No. 118/2 (P) of Coleroon River, C.Arasur Village, Kattumannarkovil Taluk, Cuddalore District, Tamil Nadu State.***

HYDROGEOLOGICAL REPORT FOR C. ARASURSAND QUARRY

The Applicant requires detailed information on Ground Water Occurrences at Proposed Project Site of C.Arasur sand quarry. The objective of the present study is to assess the availability of groundwater and comment on aspects of depth to potential aquifers, aquifer availability and type, possible yields and water quality. For this purpose all available hydrogeological information of the areas has been analyzed, and a geophysical survey was done.

1. INTRODUCTION

NAME OF THE APPLICANT WITH ADDRESS-

Name of the applicant	:	**The Executive Engineer.**
Address	:	Water Resources Department Mining and Monitoring Division, Viluppuram District, Tamil Nadu State.
Phone Number	:	9790240626
State	:	Tamilnadu.

DETAILS OF THE AREA-

Survey No	:	118/2 (Part)
Land Classification	:	Government Land **(River poramboke)**
Extent	:	10.00.0Ha
Village	:	C.Arasur,
Taluk	:	Kattumannarkovil,
District	:	Cuddalore

The investigations involved hydrogeological, geophysical field investigations and a detailed study in which the available relevant geological and hydrogeological data were collected, analyzed, collated and evaluated within the context of the Client's requirements. The data sources consulted were mainly:

a) Central Ground Water Board (CGWB) Data
b) State & District Geological and Hydrogeological Reports and Maps.
c) Technical reports of the area by various organizations.

2. SCOPE OF THE WORKS –

The scope of works includes:

- ❖ Site visits to familiarize with the project areas. Identify any issues that might impact the Ground Water Scenario due to proposed mining activities.
- ❖ To obtain, study and synthesize background information including the geology, hydrogeology and existing borehole data, for the purpose of improving the quality of assessment and preparing comprehensive hydrogeological reports,
- ❖ To carry out hydrogeological evaluation and geophysical investigations in the selected sites in order to determine potential for groundwater at project site.
- ❖ To prepare hydrogeological survey reports in conformity with the provisions of the rules and procedure outlined by the Central Ground Water Board (CGWB), by Assessment of water quality and potential infringement of National standards, Assessment of availability of groundwater and Impact of proposed activity on aquifer, water quality and other abstractors.

3. BACKGROUND INFORMATION

Location

The investigated site falls in the Toposheet No: 58-M/11Latitude between11°15'18.1035"Nto11°15'34.7541"Nand Longitude between79°38'45.7852"E to 79°38'53.3996"E on WGS datum-1984.

GEOLOGY

Regional Geology of Cuddalore District-

The general geological formation of the district is simple with metamorphic rocks belonging to the gneiss family. Resting on these are the three great groups of sedimentary rocks belonging to different geological periods and overlaying each other in regular succession from the coast on the east to the hills on the west. The lowest of these groups is the fossil-bearing cretaceous limestone around Pondicherry and Vriddhachalam. Above this comes a younger form the Red hills near Pondicherry and the Mount Capper hills south-west of Cuddalore. Uppermost are the alluvial beds of the deltas of rivers. There is every reason to believe that this order of the strata has existed unaltered through a long geological period; that in fact, since the beginning of the time when the oldest of the sedimentary beds, these of cretaceous age, were deposited.

Cuddalore sandstones and there are a number of flowing wells in this area. Gneiss, trap and sandstone are the main minerals of the district. Gneiss is used for building purposes with excellent results especially in the temples. Its susceptibility to fine carving is exemplified in the chains cut from it which may be seen in the shrine at Srimushnam and the great temple at Chidambaram. Trap is scarcely used for building purposes because of its intractable hardness and inherent moisture absorbing quality. Sandstone is used for building purposes as well as for making mortars, troughs, etc. Besides these minerals, laterite occursover a wide belt of country between Pondicherry and Vriddhachalam (notably on Mount Capper), in the red soil tract around Srimushnam and to the east of Vriddhachalam. It is largely used for building purposes and road making.

Archaean

The Archaean rocks are exposed in the north-western and western part of the area or more precisely a hence passing roughly west of Virdhachalam and Ulundurpettai. The basement rocks (i.e. Archaean) constitute granitoid gneisses with pegmatite and dolerite intrusive in Neyveli Basin. The Archaean rocks form the basement in the area over which the later sediments were deposited. Outcrops of granitoid gneisses (i.e. Archaean) can be seen around Mangalam and Ulundurpettai. The coarse granite gneisses chiefly consist of quartz, feldspar, biotite and hornblende Pegmatite and quartz veins intruding the granitoid gneisses. The pegmatite predominantly consists of quartz and feldspar. The dolerites are the youngest intrusive rocks in the area. They cut across the geinesses in NNE-SSW or NE-SW direction between Mangalam and Ulundurpettai.

Cretaceous

Ariyalur Group

In the western of the area, marine fossiliferous limestone, calcareous sandstones and marlstones succeed the Archaean crystalline basement rocks. They were deposited in shallow marine environment and have been classified as Ariyalur group of rocks. The rocks of Ariyalur group are exposed in a narrow NE-SW trending formation.

Tertiary

The Tertiary geology is represented by the sediments of Mio-Pliocene periods. No basement rocks have been encountered even in the few deep bore holes drilled by the Neyveli Lignite Corporation. But sediments probably representing Cretaceous period such as siliceous limestone, calcareous sandstone, black silts and clay with thin bands of lignite have been encountered in the bore hole recently drilled by Neyveli Lignite Corporation.

These Cretaceous formations are overlain by the yellowish white to dirty white sandstone, grey siltstone, and pebbly gravelly coarse grained sandstones with minor clays which form the Mio-Pliocene Cuddalore sediments. They are prominently seen as raised mounds around Pudur Sedapallayam, Samatikuppam areas in the northwestern part and these are only the continuation of large Tiruvendipuram sandstone plateau occurring south of GadilamRiver. Pebbly, gravelly, ferri-crete, concretionary soils with reddish brown sands (Lateritised, weathered gully eroded outcrops) occur as veneer over the sandstone. This lateritic cover of sandstone slowly disappears towards east as they are covered by thick alluvium and dunal sands. But the slopes of the sandstone plateau have thin soil cover and form a gently sloping pediplain in the areas of Kothandaramapuram, Palliodai, Puvanikuppam and Kullanchavadi.

Neyveli Formation

The Neyveli Formation represents the lower most tertiary group of rocks. They are essentially argillaceous and occur as a narrow belt overlying the Ariyalur group. It also occurs as inliers and outliers surrounded by Cuddalore Formation and Ariyalur Formation respectively. The Neyveli Formation is composed of silty claystones; black clays /shells, argillaceous sandstones, calcareous sandstones, fossiliferous limestones, algal limestones, etc. The algal limestones and argillaceous sandstones of the Neyveli Formation can be correlated to that of the Niniyur Formation of Ariyular area. It is occurring around Gopurapuram village near Vridhachalam and is assigned to Paleocene to Oligocene in age.

Cuddalore Formation

The Cuddalore sandstones occur intermittently along the eastern coast of south India and represent the upper most Tertiary Formation. The rocks of this Formation consist of argillaceous sandstone, pebble-bearing sandstones, mottled sandstone, ferruginous sandstone, grits and clay beds and lignite seams. The presence of the pebble and cobbles, mottled appearance, general impoverishment in micas and absence of garnet grains help to distinguish them from the older group of rocks. The sandstones of the Cuddalore Formation are whitish, pinkish or mottled in colour and are chiefly argillaceous. The sandstone generally consists of rounded pebbles (pebbles and fragments) of quartz. The Cuddalore sandstones were altered and covered by either Laterite capping or by thick alluvium of Gadilam and Ponnaiyar rivers in the north and in the south by Vellar and Manimutha rivers.

Quaternary Formation

The quaternary formation is comprises sediments of fluvial, fluvio-marine and marine regime. The sediments includes fine to coarse-grained sands, silts, clays, laterites and lateritic gravels. The fluvial sediments are confined in the flood plains of the Ponniyar, Gadilam, Manimuktha Vellar and Kollidam rivers which consist of mostly of sands and sandy or clay loams. The laterites were generally ferruginous, yellowish dark brown, metallic luster, hard and with fairly extensive occurrence in the area are underlined by Cuddalore sandstones.

Geomorphology

The entire district can be broadly divided into following 3 zones.

Western pediplains of entire area is covered by Mangalur and Nallur blocks. This area is occupied by denudational landforms like shallow buried pediment, deep buried pediment and pediments.

Central part of the district is characterized by sedimentary high grounds, elevation >80 m of Cuddalore sandstone of Tertiary age. This zone occupies part of Virudhachalam, Kammapuram, Kurinjipadi, Cuddalore and Kattumannarkoil taluks.

Rest of the area in the district is covered by eastern coastal plain, which predominantly occupied by the flood plain of fluvial origin formed under the influence of Penniyar, Vellar and Coleroon river systems.

Marine sedimentary plain is noted all along the eastern coastal region. In between the marine sedimentary plain and fluvial flood plains, fluvial marine deposits are noted, which consists of sand dunes and back swamp areas.

Drainage

The district is drained by Gadilam and Pennaiyar rivers in the north, Vellar andcoleroon in the south. All these rivers are ephemeral and carry floods during monsoon. They generally flow from west towards east and the pattern is mainly sub parallel. The eastern coastal part near Porto-Novo is characterized by lagoons and back waters.

Ponniyar is one of the major seasonal river drains the northern part of the district, which originates from the Nandi hills of Karnataka state. Thurinjalar and Musukundah rivers are the tributaries, which join the Ponnaiyar river, Malattar river is the distributory of the Ponnaiyar river.

Vellar, is the other major seasonal river, which drains the major portion in the southern part of the district. Manimuktha, Gomukhi and Mayura are the major tributaries which join the Vellar river.

Rainfall and Climate

The district has a hot tropical climate. The summer season, which is very oppressive,is from March to May. The southwest monsoon, which follows, lasts till September. October to December constitutes northeast monsoon season. January to February is the comparatively cooler period. The annual rainfall for the period is (1901-2000) ranges from 1050 – 1400 mm.

The normal annual rainfall over the district varies from about 1050 mm to about 1400 mm. It is the minimum around Vriddhachalam (1051.3 mm). It gradually increases and reaches a maximum around Chidambaram (1402.6 mm) and Portonovo (1347.1). The contributions of individual seasons are as follows: NE-57%, SW-31%, Summer- 7% and winter 5%.

4. GEOPHYSICAL INVESTIGATION METHODS

A variety of methods are available to assist in the assessment of geological sub-surface conditions. The main emphasis of the fieldwork undertaken was to determine the thickness and composition of the sub-surface formations and to identify water-bearing zones.This information was principally obtained in the field using, and vertical electrical soundings (VES). The VES probes the resistivity layering below the site of measurement. This method is described below.

Resistivity Method

Vertical electrical soundings (VES) were carried out to probe the condition of the sub-surface and to confirm the existence of deep groundwater. The VES investigates the resistivity layering below the site of measurement.

Basic Principles

The electrical properties of rocks in the upper part of the earth's crust are dependent upon the lithology, porosity, and the degree of pore space saturation and the salinity of the pore water. Saturated rocks have lower resistivity than unsaturated and dry rocks. The higher the porosity of the saturated rock, or the higher the salinity of the saturating fluids, the lower is the resistivity. The presence of clays and conductive minerals also reduces the resistivity of the rock.

The resistivity of earth materials can be studied by measuring the electrical potential distribution produced at the earth's surface by an electric current that is passed through the earth. Current is moved through the subsurface from one current electrode to the other and the potential difference is recorded as the current passes. From this information, resistivity values of various layers are acquired and layer thickness can be identified.

The apparent resistivity values determined are plotted as a log function versus the log of the spacing between the electrodes. These plotted curves identify thickness of layers. If there are multiple layers (more than 2), the acquired data is compared to a master curve to determine layer thickness.

This method is least influenced by lateral in-homogeneities and capable of providing higher depth of investigation.

The resistance R of a certain material is directly proportional to its length L and cross-sectional area A, expressed as:

$$R = Rs * L/A \text{ (in Ohm)}$$

Where Rs is known as the specific resistivity (characteristic of the material and independent of its shape or size)

With Ohm's Law,

$$R = dV/I \text{ (Ohm)}$$

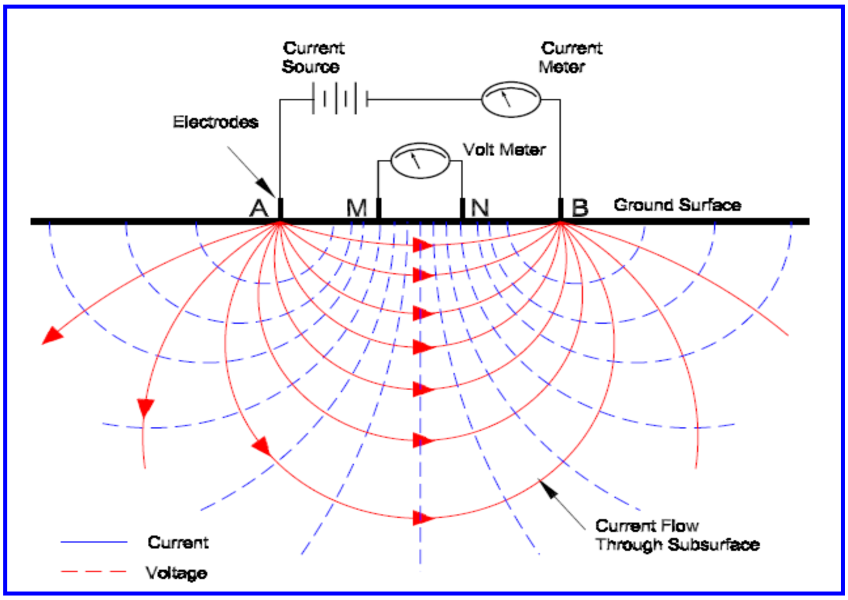
Where dV is the potential difference across the resistor and I is the electric current through the resistor. The specific resistivity may be determined by:

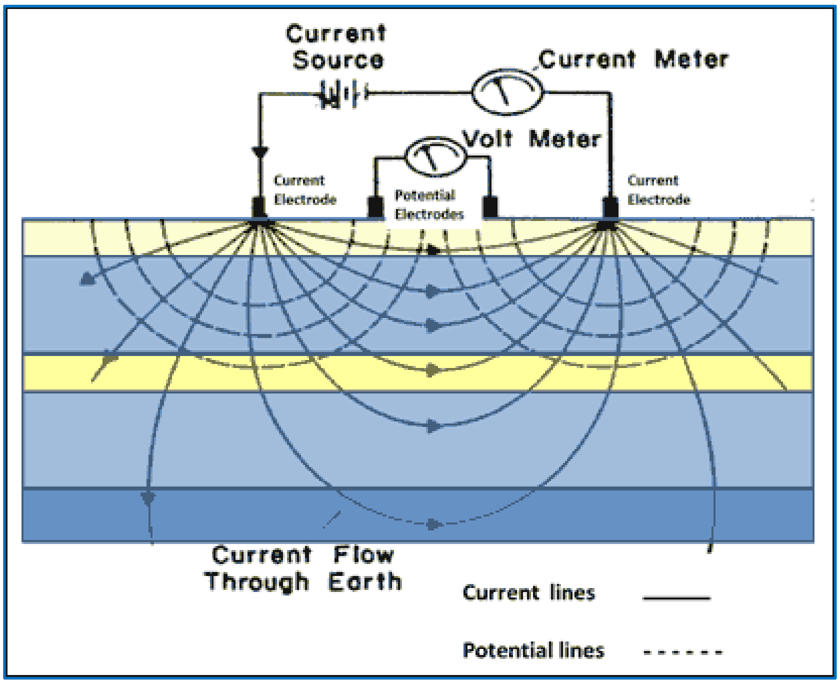
$$Rs = (A/L) * (dV/I) \text{ (in Ohm m)}$$

Vertical Electrical Sounding (VES)

When carrying out a resistivity sounding, current is led into the ground by means of two electrodes. With two other electrodes, situated near the center of the array, the potential field generated by the current is measured. From the observations of the current strength and the potential difference, and taking into account the electrode separations, the ground resistivity can be determined. During a resistivity sounding, the separation between the electrodes is step-wise increased (known as a Schlumberger Array), thus causing the flow of current to penetrate greater depths. When plotting the observed resistivity values against depth on double logarithmic paper, a resistivity graph is formed, which depicts the variation of resistivity with depth. This graph can be interpreted with the aid of a computer, and the actual resistivity layering of the subsoil is obtained. The depths and resistivity values provide the hydro geologist with information on the geological layering and thus the occurrence of groundwater.

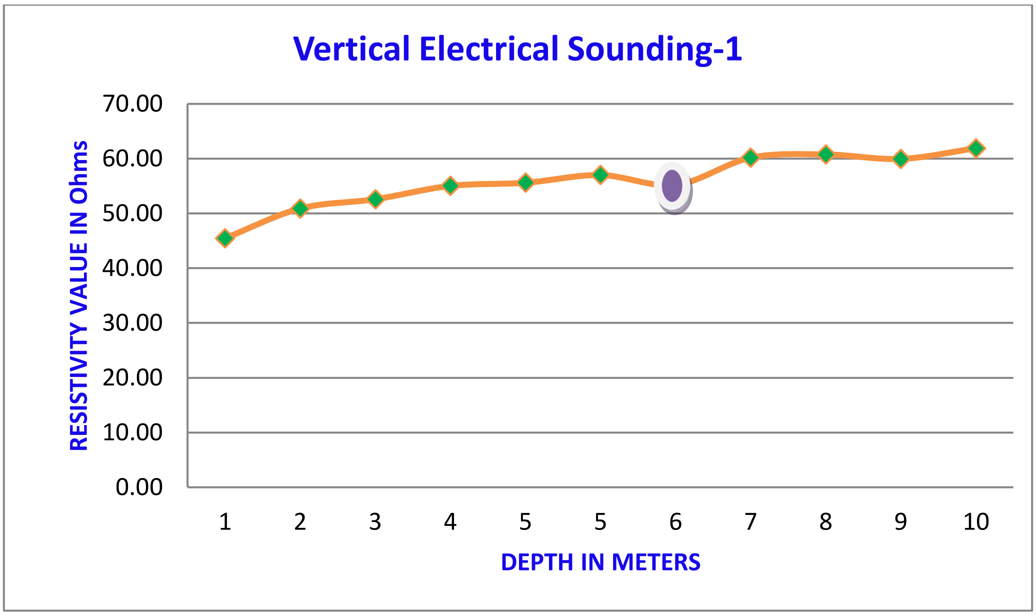
Vertical Electrical Sounding Methods





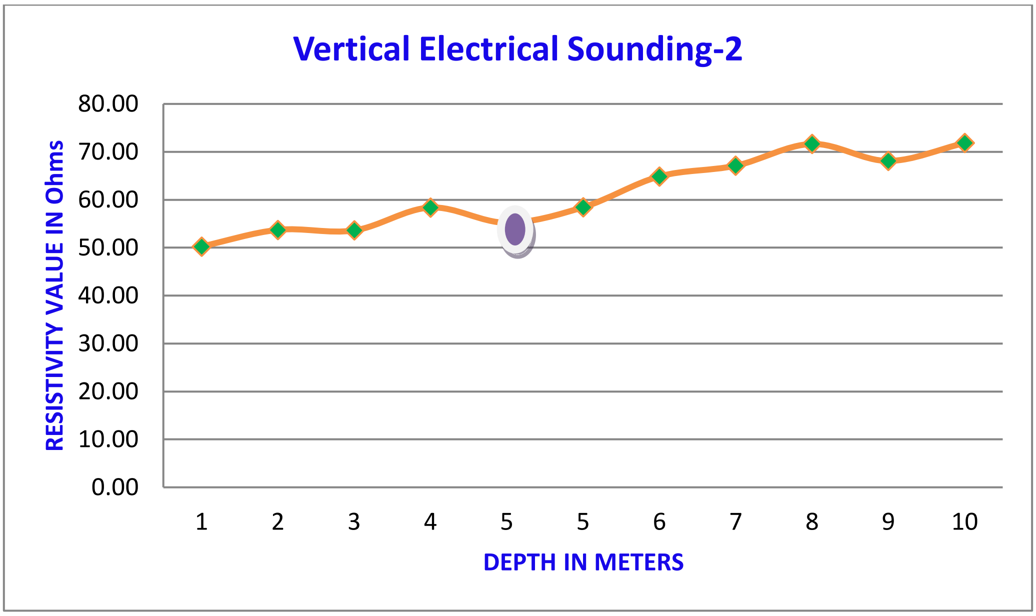
Vertical Electrical Sounding data's with Graphs

Vertical Electrical Sounding -1					
GPS Coordinates - 11°15'30.13"N 79°38'40.05"E					
S.NO	AB/2 (m)	MN/2(m)	Geometric Factor (K)	Resistance (R) Ohm	Apparent Resistivity Rho Ohm-meter
1	1	0.5	2.4	19.3	45.5
2	2	0.5	11.8	4.32	50.9
3	3	0.5	27.5	1.913	52.6
4	4	0.5	49.5	1.112	55.0
5	5	1	77.8	0.715	55.6
6	5	1	37.7	1.512	57.0
7	6	1	55.0	1.004	55.2
8	7	1	75.4	0.798	60.2
9	8	1	99.0	0.614	60.8
10	9	1	125.7	0.4771	60.0
11	10	1	155.5	0.398	61.9



Above the vertical electrical sounding graphs purple color is fracture zone

Vertical Electrical Sounding -2					
GPS Coordinates - 11°15'23.21"N 79°38'39.58"E					
S.NO	AB/2 (m)	MN/2(m)	Geometric Factor (K)	Resistance (R) Ohm	Apparent Resistivity Rho Ohm-meter
1	1	0.5	2.4	21.33	50.3
2	2	0.5	11.8	4.56	53.7
3	3	0.5	27.5	1.95	53.6
4	4	0.5	49.5	1.18	58.4
5	5	1	77.8	0.71	55.2
6	5	1	37.7	1.55	58.4
7	6	1	55.0	1.18	64.9
8	7	1	75.4	0.89	67.1
9	8	1	99.0	0.724	71.6
10	9	1	125.7	0.542	68.1
11	10	1	155.5	0.462	71.8



Above the vertical electrical sounding graphs purple color is fracture zone

5. Conclusion –

The study area exhibits slightly undulated topography, having gentle slope towards North side. The altitude of the area between 4.86m to 8.17m above from MSL. The sand is derived by erosion of weathered rocks and Mineral particles and transported by the river water and deposited on the floor of the river in the interface.

The proposed depth of quarrying operation is 2m (avg) above bed level only, hence the ground water will not be affected in any manner due to the quarrying operation during the entire life period.

Based on the available information and the geophysical investigations it is concluded that the proposed project area is considered tohave medium groundwater potential. Productive aquifers are expected at depth of 7m to 8m where minor fractures are observed and shallow aquifers are expected above 4m-5m BGL.The ultimate pit limit as per the approved mining plan depth is 2m above bed level only BGL which will have no impact on the Ground Water.

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