HYDROGEOLOGICAL REPORT FOR ELAKKURICHI SAND QUARRY

The Applicant requires detailed information on Ground Water Occurrences at Proposed Project Site of Elakkurichi 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 Thiruchirappalli District, Tamil Nadu State – 620 020.
Phone Number	:	+91 98424 62467
State	:	Tamil Nadu.

DETAILS OF THE AREA-

Survey No	:	350 (Part)
Land Classification	:	Government Land **(River poramboke)**
Extent	:	16.00.0Ha
Village	:	Elakkurichi,
Taluk	:	Ariyalur,
District	:	Ariyalur.

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.

3. 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.

BACKGROUND INFORMATION

Geographical Information

Toposheet Number	58-N/01
Latitude between	10°56'34.2967"N to 10°56'42.7622"N
Longitude between	79°09'58.8679"E to 79°10'25.6369"E
WGS datum-1984	

4. GEOMORPHOLOGY

In general, the district has an undulating topography, characterized by low mounds and broad valleys. Hill ranges belonging to Pachaimalai Hills occupy the northwestern part of the district, where the terrain is rugged. The ground elevation ranges from 100 to 1015 m amsl. The region slop is towards east. Denudational, structural and fluvial processes mainly control the geomorphic evolution of the area. Mainly the varying resistance of geological formations to those processes has governed the evolution of various landforms. Various land forms occurring in the area such as structural hills, erosional plains, residual hills rolling uplands and pediments of different facies belonging to the denudational and structural land forms. Fluvial landforms caused by the activity of Cauvery, Marudayar and Vellar river systems, include younger flood plains, older flood plains and buried pediments.

Rainfall

The district receives the rainfall under the influence of both southwest and northeast monsoon. There is a gradual decrease in precipitation from northeast to southwest over the district. The normal rainfall for the period (1901-70) ranges from 843.5 to 1123.3 mm. It is lowest in the Vembavur area and highest in the Jayankondan areas.

Climate

Ariyalur district enjoys a typical semi-arid climate with hot summers and moderately cool winters. The hottest season is from March to May. During the period the maximum temperature often exceeds 40°C. The winter season 4 is spread over two months viz. January and February and the nights are cool and pleasant. The district generally has a high humidity. The district experiences strong winds during the southwest monsoon season. The wind speed during June to August is more than 25 km/hr. Thereafter there is a gradual decrease in speed reaching the lowest value 7.7 km/hr.

5. GEOLOGY OF THE DISTRICT

REGIONAL GEOLOGY OF ARIYALUR DISTRICT-

The Cretaceous Formation of the Ariyalur area (Ariyalur District, Tamil Nadu) is one of the best developed sedimentary sequences in South India. The Cretaceous system of Cauvery Basin consists of shallow marine sequence with a rich faunal succession of Albian Maastrichtian.

The sedimentary rocks of Cretaceous – Palaeocene age are well developed in the Ariyalur area, which consist both clastic and carbonate facies. The diversity of fauna is very large in the vast sedimentary basin that has attracted the attention of geologists not only from India but also from foreign countries. have further divided the Ariyalur Group into four formations mainly based on lithological changes and characteristic faunal content:

i) Sillakudi
ii) Kallankurichi
iii) Ottakoil
iv) Kallamedu Formations.

The exposed area looks like a badland topography with sparse vegetation. Excavation at favorable spots in Kallamedu Formation has yielded a number of well-preserved skeletal parts of Carnosaurs. The lithological association of this formation includes sandstone, siltstone, calcareous sandstone, salty shale and thin band of limestone. The sandstone and siltstone are well exposed in the sections near north of Kallamedu village. Kallamedu Formation is overlain by the Niniyur Formation of Early Paleocene age.

The late Cretaceous sediments are exposed in the western part of the study area and classified into Uttatur, Trichinopoly and Ariyalur formations with a maximum thickness of 900m, 600 m and 1500 m, respectively. The Uttatur formation consists of residual limestone and minor sandstone, with rich faunal assemblages. Conglomerates and quartzites are also found to occur in the Uttatur group of rocks. These rocks are exposed only in Trichirapalli area where they are overlying Gondwana and Dalmiapuram formations. The sub-surface equivalent of the Uttathur formation is devoid of residual elements.

The Trichinopoly formation, unconformably overlying the Uttatur formation, comprises conglomerate, pebbly sandstone as well as gritty calcareous sandstone with bands of clay stone, gypseous clay stone, sandy limestone, shelly limestone and clayey limestone with abundant fauna. They are exposed in Ariyalur, Vridhachalam and Pondicherry areas. The rocks are mainly greenish grey, friable clayey sandstone, fossiliferous argillaceous limestone and sandstone. The lower part of Ariyalur formation is highly fossiliferous while the upper is largely unfossiliferous.

I) Evolution of Cauvery Basin

The Cretaceous–Paleogene sections of Cauvery Basin are closely related to the Rifting and drifting phases of peninsular India. The basement is characterized by structural highs and lows, these being evidenced by strong tectonic activity affecting the basin since its inception. Two major tectonic and sedimentary phases are deciphered. The first is taphrogenic rifting and associated block movements along the dominant NE-SW trend during Late Jurassic, resulting in morphotectonic humps and deep slopes. The second phase signifies coastal progradational/deltaic sedimentation through a series of marine transgression and regression in response to the oscillatory tectonic movements. During Paleocene, the basin continued to tilt towards east and depocentres consequently shifted.

Cauvery Basin comprises of depressions separated from one another by Subsurface ridges; these structural elements extend into the offshore area. The structural elements from north-south are, (1) Ariyalur Pondicherry depression, (2) Kumbakonam – Madnam - Shiyali ridge (3) Tanjore Tranquibar – Nagapattinam depression (4) Pattukottai – Mannargudi ridge (5) Ramnad – Palk Bay depression (6) Mandapam–Delft ridge. The first marine transgression occurred during the close of Late Jurassic. The marine environments of sedimentation continued till Cretaceous although a series of minor transgressions and regressions. A major regression occurred during the close of Cretaceous. The basin underwent an easterly tilt and the depocenters shifted due east prior to marine transgression during the beginning of Paleogene.

The evolution of Cauvery Basin is largely controlled by dominant trends in the Precambrian crystalline basement as is evident from the similarity between the alignment of the basinal structural elements and the major trends in the adjoining peninsular shield. The

NE-SW Eastern Ghats trends are by far the most dominant and taphrogenic movements long these basement trends resulted in a series of elongated depressions that were separated from one another by intra-depression ridges.

II) Lithostratigraphic Classification

Blanford (1862) has classified the Cretaceous sediments of Cauvery Basin into: Uttatur plant beds, Uttatur and Trichinopoly Groups. Classified the Cretaceous sections into four stages: Uttatur (Cenomanian to Uppermost Albian), Trichinopoly (Mid-Cenomanian to MidTuronian), Ariyalur (Maastrichtian to Mid- Cenomanian) and Niniyur (Danian to Maastrichtian). Ramanathan (1968) has divided the Upper Jurassic to Cretaceous sections of Cauvery Basin into three formations: Upper Gondwana (Bathonian to Neocomian), Uttatur (Barremian to Albian) a Trichinopoly (Turonian to Upper Cenomanian). Two groups for the Cretaceous sections: Ariyalur for Maastrichtian age and Uttatur for the rest part of the Cretaceous age. Three groups for Cretaceous of Cauvery Basin: Uttatur, Trichinopoly and Ariyalur. Complied the outcrop and subcrop sediments are proposed the sediments classification.

Geological Age	Formation with Geological period	Lithology
Recent and Quaternary		Alluvium, Kankar, Laterite, etc
Palaeocene	-Unconformity- Niniyur (Danian)	Variegated clays with nodular lime stones and marls with occasional boulders of flint and chest.
Cretaceous	-Unconformity- Ariyalur (Maastrichtian) Upper Lower	White friable sandstone with purple clays, etc Clayey sandstones, loose conglomerates and yellowish fossiliferous limestone, marls and hard limestones.
	-Unconformity- Trichinopoly (Turonian to Sanonian) Upper	Calcareous gritty sandstone, shell limestones and conglomeratic sandstones.

6. 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,

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

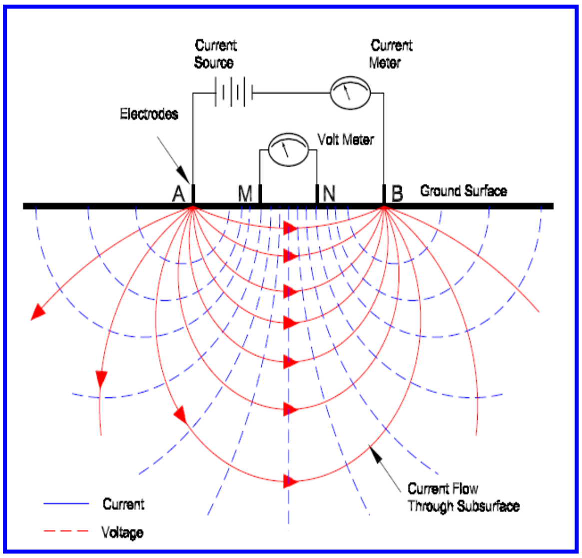
Where dV is the potential difference across the resistor and I is the electric current through the resistor. The specific resistivity may be determined by:

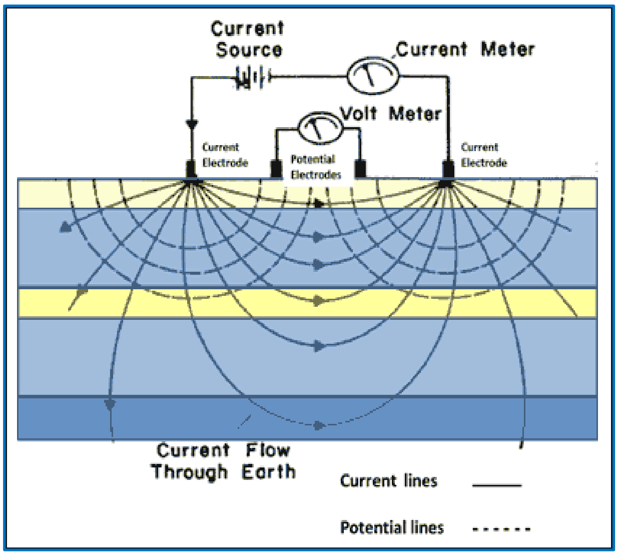
$$Rs = (A/L) * (dV/I) \text{ (in Ohm m)}$$

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.

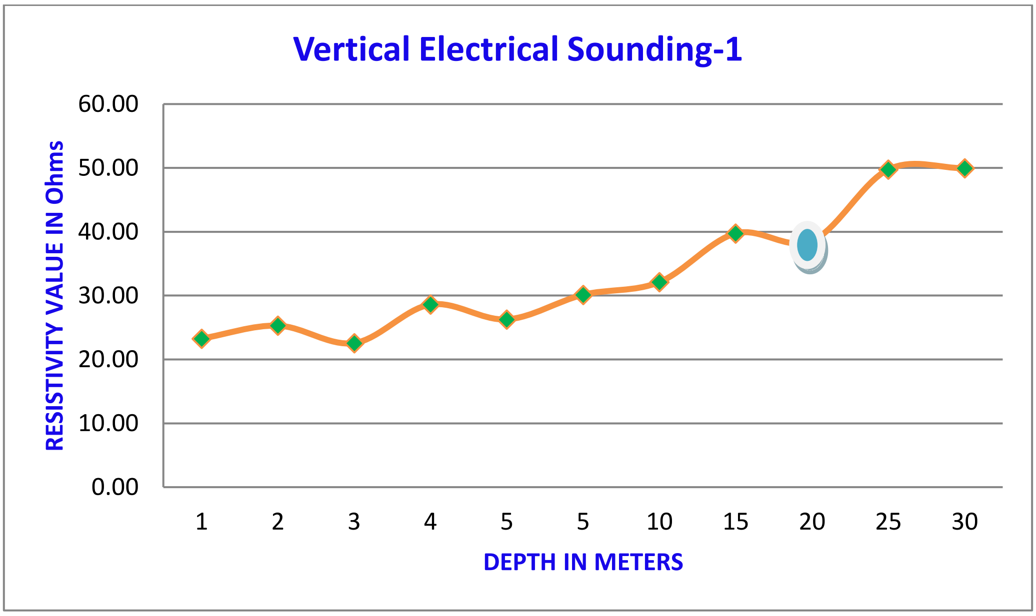
Vertical Electrical Sounding Methods





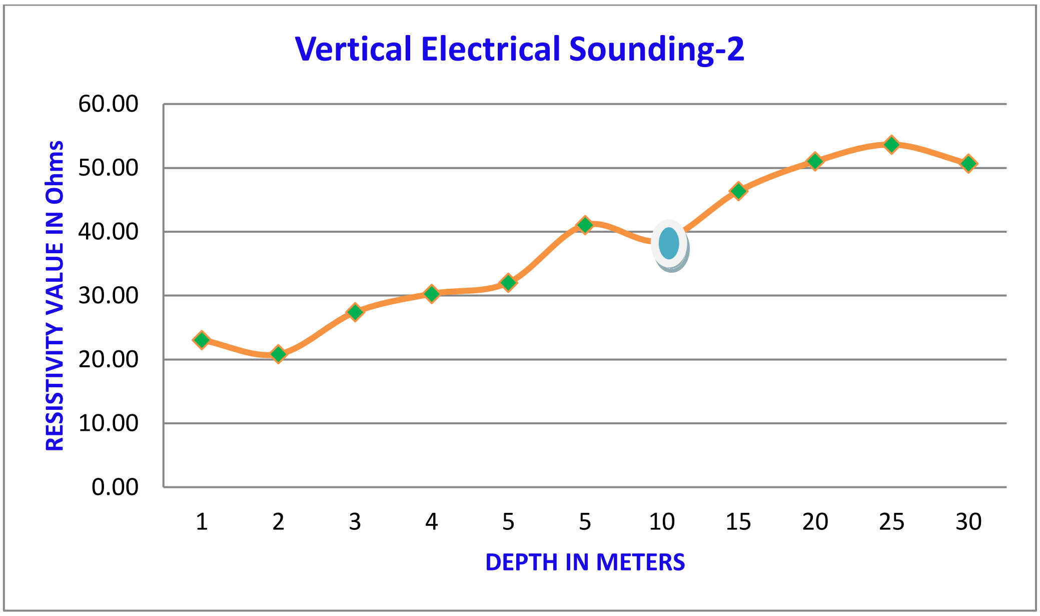
Vertical Electrical Sounding data with Graphs

Vertical Electrical Sounding -1					
GPS Coordinates - 10°56'47.01"N 79°09'59.95"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	9.876	23.3
2	2	0.5	11.8	2.147	25.3
3	3	0.5	27.5	0.821	22.6
4	4	0.5	49.5	0.578	28.6
5	5	0.5	77.8	0.338	26.3
6	5	2	16.5	1.827	30.1
7	10	2	75.4	0.426	32.1
8	15	2	173.6	0.229	39.7
9	20	2	311.0	0.124	38.6
10	25	2	487.7	0.102	49.7
11	30	2	703.7	0.071	50.0



Above the vertical electrical sounding graphs blue color is fracture zone

Vertical Electrical Sounding -2					
GPS Coordinates - 10°56'44.76"N 79°10'13.34"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	9.789	23.1
2	2	0.5	11.8	1.768	20.8
3	3	0.5	27.5	0.997	27.4
4	4	0.5	49.5	0.612	30.3
5	5	0.5	77.8	0.412	32.0
6	5	2	16.5	2.489	41.1
7	10	2	75.4	0.512	38.6
8	15	2	173.6	0.267	46.3
9	20	2	311.0	0.164	51.0
10	25	2	487.7	0.11	53.7
11	30	2	703.7	0.072	50.7



Above the vertical electrical sounding graphs blue color is fracture zone

7. Conclusion –

The lease applied area exhibits flat topography, having gentle slope towards Eastern side. The altitude of the area varies from 30.47m to 32.66m above from MSL and the River bed level is 30.857m on the upstream side and 30.377m on the downstream side 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 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 to have medium groundwater potential. Productive aquifers are expected at depth of 19m to 20m where minor fractures are observed and shallow aquifers are expected above 12m-14m BGL. The ultimate pit limit as per the approved mining plan depth is 2m only BGL which will have no impact on the Ground Water.

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