The Efficiency Of Electrical Resistivity Metho In Site Foundation Problem Where Drilled Bore Hole Information Failed

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Abstract

In the usual geophysical works we need to confirm the validity and accuracy of the information on the presence of geological information and wells(bore holes).In this research note the principle is different above,where geological information failed,despite of their number and high cost,which have drilled 20 wells,but failed to identify th engineering reality.And while the exact geophysical technique executed (the electrical resistivity method) in determining the structural situation and the depth of the water.The reason for this unusual case,because of presence of a large thickness of sediments(recent sediments),which is multi-interbedded sediments of silt,sand,and gravel,and lack of (marked beds) in the drilled depth of the well(20m) to correlate between them to get the precise structural and geological situation.so in this cases, comp-ilation of many investigation methods ,engineering ,drilled borehole,hdr-Ologyand geophysics carried out in Kubasia area to study site area prope-rties.Drilling of 24 boreholes gave misleading geological solution on the Problem because no geological correlation can be done which causesfrom High varieties of rock type(no marked bed) only recent sediments,so in this situation geophysical method be the more suitable in solving problem

Introduction

The study area is situated at the city of (Kubasia) about 80 km from Al-ramdi city within Al-anbar governorate.The study was to determine the precise geologic and structural situation to establish large productive unit.After geological data have been failed in achieving a goal,because presence of recent deposits in the studying area within drilled depth(20) m of the bore holes.So,and in stead of that geophysical method intensively used,and all electrical measurements were done using vertical survey in two direction(circular vertical electrical sounding) in each point.

Aim Of Research

The aim of the research is to conform facts that,in many cases may be the secondary methods be more powerful than bore hole information.

Field Work Procedure

Field procedure conducted by many steps:

-Drilling 24 bore holes(depth 20-40 m),fig.(1).

-Hydrological studies.

-Engineering parameter tests.

-Geophysical survey(schlumberger array).

Geoelectrical work

The aim of the geoelectrical measurements are:-

1-Detemination of subsurface geoelectrical successions

2-Identification of aquifers and water tables

3-Verification of structural pattern

Field measurements

The measurements were carried out using Schlumberger Configuration with electrode separation (AB=500m) inTwo directions parallel to the major strike of the structure (N35W) and perpendicular to it (N55E) on 20 selected Points established on bore holes.(Appendix and table no.10) IBEM Terrameter as instruementWas used in the survey.

Processing and interpretation

The field were interpreted by partial curve matching using Orellano-Mooney two layers master curves. After interpretation of individual sounding points, five Geoelectrical cross-sections were performed in the direction N27W(Appendix no.902), in addition to four other sections in the direction N63E(Appendix no.9.1). CVES interpretation was done for the purpose of determination the lateral inhomogenity of rock units and the fracturing or fissurization inside them,using the graphical elliptical diagrams with the aid of distance

separation (AB⁄ 2=13.4,29.7,63.7,109 and 233meters) From the VES cross-sections ,four geoelectrical horizons Were obtained and correlated with lithology gained from bore holes,

taking in consideration the relation between the apparent resistivities and the depth of the electrical contacts with geological bore holes information.

From the CVES interpretation,the elliptical diagram only four points(bore holes 1,11,12,and 14) were seen to be asymmetrical which may be reflect either shallow inhomogenity of fracturing,fissuring, or cavities within the subsurface horizons(figure No.1 through 4).

Discussion

Depending on interpretation, the area under investigation may be effected by north-south trended discontinuity dividing thte area into two zones,in each zone the following conclusion arised.

Zone No.1	Zone No.2
1-High resistivity value of surface may be Due to occurance of gypsium	-
2-The depth of penetration is nearly 40 m is nearly 15-19 m	The depth of penetration
3-Geoelectrical marks are mainly thick and deep	They relatively thin and shallow
4-Elliptical curves are mainly HK	They are mainly Q-QQ
5-Second electrical horizon is detected	It is missed in many points
6-thick aquifer(may be two aquifer) is detected with high resistivity vales at top andlow at bottom	Thin aquifer is detected with low resistivity values
7-The elliptical diagram of the CVES Are asymmetrical(may be due to either Fracturing,fissuring,cavities)	They are symmetrical

Horizon	Resistivity Range(m)	Thickness Range(m)	Estimated lithology
1	130-6000	-2-4	The cap rock Mantled by Gypsiferous layer
2	10-80	4-18	Chalk 1-5 m. Interbedded With marl& Marly 1m.
3	60-950	7.23	L.st may be aquifer
4	10-54	-	Aquifer

Description to figure(1) through(4)

Ellips No	AB/2 m	MN/2 m	Resistivity	colour
1	13.4	1	Data of points In tables no.2	Brown
2	29.7	5		Black
3	63.7	20		Orange
4	107	20		Green
5	233	20		blue

Geology

The geological section and profiles constructed from the bore holes showed the following:

1-The residual soil of the thickness range(o.1-1.3)mt rich in rock fragments and gypsium of soil matrix.

2-The rock sequence of the Euphrates formation consisted interbeds of lime stone, Marly lime stone and marl.Those beds showed very rapid fail changes in thickness And extension.

Structure

Regionaly the site located on the margin of Abu-Jir deep seated fault.The structural configuration of the local studies site could be summarized as following.

1-The regional dip is almost N55E which amount of less than one degree in the mentioned direction.

2-The geological cross-section showed that the beds have gradient of 1 mt/ 250 mt toward the same above mentioned direction.

3-The structural defects represented by a normal fault most like of mt displacement.

The this fault is indicated on left side of site,move precisely between the broe hole 23,24,13.

4-Iso-depth map of the marker white recrystallized lime stone indicateding that this bed is uniform consisted in the area,but showed small undulation especially a long the bore holes 7,8,9&10.This finding in a very detail with respect to the presented available drilling data for conformation of such phenomena further investigation is needed.

Hydro-geology

1- Two water bearing layers(aquifers)are marked in the area,the first is within the Euphrates formation at approximatetly depth 14-20 mt from the surface.The second aquifer located at depth below 30 mt.Within the Anah formation.The two aquifers are separated by marl impervious beds of Ibrahim formation.The marl acting as aquiclude bed.

2-The constructed contour map of the ground water level is coincided with the regional water direction of the area i.e.from northwest toward the southeast.But the site showed different local ground water direction particularly at left and upper left side of the site.These differences are probably attributed to some type of structural and stratigraphic defects.

3-Preliminarly in situ permeability tests by pouring method indicated that the aeration zone to depth interval o.1mt.has low permeability and 6-12mt of very high permeabil- ity .That is coincide with behavior of the interval depth of the white recrystallized lime stne.

4-Water chemistry analysis showed total soluble salt beween approximately 2000-3000mg/liter with neutral ph value.

5-The quality of water is chloride-sulphate-sodium type.The sodium absortion ratio is small with respect to the water salinitly,it is very high to be used for irrigation accord- ing to agrarian standards,but it could be used for agricultural purposes provided very well drainage system is made.

Engineering Geology

Rock engineering properties

1-The geotechnical logs of the bore holes showed variation in both mass and intact properties where reflected by lithological constituents and the facial change.

2-The porosity,density and seismic logs are good models of great help for any further geophysical resistivity,gravity,and seismic studies should they be needed for extra detail work.

3-The geotechnical logs of physo-mechnical properties gives the basic designing para meters for civil engineering works.

4-The combination of feild logging of cores and their laboratory strength testing gave the allowable rock bearing capacity indicated as(stra comprehensive strength) given in the logs.On such accountment,two relatively high bearing capacity beds of interest to foundation engineering are marked in the geotechnical sections.The first one is just below the soil mantle.This bed is not consistent in thickness and extention at the studies site.Nevertheless it could be estimated at the spots of the drilled bore holes further shallow drilling of (3-4mt)depth between the existing one can be of vale to generate 150 thickness map of this bed.The second bed which is the white recrystallized lime stone whish is characterized by general consistency and sand thickness(3-7mt).It is expected that this Fig.No.2show the 1so-depth a.b.s.of this bed. Bed is characterized by very nature as indicated in the lithological description and due to drilling water circulation lose at level,coincided with the bed interval depth.

5-The recrystallized hard lime stone Anah formation in the key bore hole No.12 showed shear fractures which in turn indicated shearing effects most probably due to faulting in the area or nearby.

6-Sudden dropping of the drill pipe or remarkable increase of penetration speed were observed during the drilling of the following bore holes at the corresponding depth interval depth and as follow:

N0.Bore hole	Depth interval(mt)
1	11.1-11.7 sudden penetration
2	15.5-16.5 sudden drop
3	4-4.5 sudden drop
4	11.8-12.1 sudden drop
5	16.o-16.5 speed penetration
15	15.5 16.5 speed penetration
17	10.5-10.55 sudden drop

The sudden dropping of the drilling could only be interpreted due to subsurface cavernity,while drilling speed changes may be due to lithological changes.nevertheless some cavities could be expected as well.

7-The bore holesNo.12&1 showed probable connected cavities as indicated by the continuous air below out of the two bore holes mouths.

8-Rock water saturation:

The floor behavious and and floor strength under load are important factor in the control of future surface building.Additional weakening of foundation strata is often brought about by water added during rock saturation from water bearing of the country rock or from surface water infilteration downward.

For that the litho-engineering units were treated for water saturation effects for both densities and intact strength to find out the possible limiting values on the dry and Saturated condition.Althougth the final result showed not much differsnces,but it is suggested here to design the foundation on saturated basis.

9-Water content reflects the state of water Saturation susceptibility and in situ state of wetness.Also has an effect on the blastibility expansion factor,and the angle of repose for the excavated material in the site if this action is taken.

10-The determination of dynamic passion ratio and modulus of elasticity could be used for dynamic evaluation of the site if heavy vibratory machineries are used in the plant.

Soil engineering properties

The preliminary soil physical tests may indicate the following aspects.The top soil is of residual type,mainly well graded gravely,silty sand(sm group on u.s.c.)classification basis.The soil is characterized by high sulphate content which give an cidic envir-oment.

1-All the samples have plastic index below 15% that mean the soil may consolidated below the foundation within within a relatively short time.

2-The relatively high proportion of SIH could have bad effect on the shallow foundation since such material is very sensitive to change in water content.

3-The silt content is almost always more than that of clay.This lead to low cohesion value.

4-The organic content is less than o.5%.This is within the tolerable limit and unlikely to effect the setting of the content.

Conclusion

1-The cross-section gave four geological horizons.These were correlated with lithology from the bore holes.They have probable thickness interval as 3-4mt,4-18mt,7-23mt,and more than 23mt.

2-The graphical/elliptical diagram produced by the(CEVES)interpretation for the bore holes No 1,11,12,&14,indicated asymmetrical relationship which mean that there is shallow inhomogenity due to either fracturation or cavities.

3-There was high variety of porosity for zone No.1 to zone No.2 as example,BH.13 is 7.16 and BH.17 is 42.7.

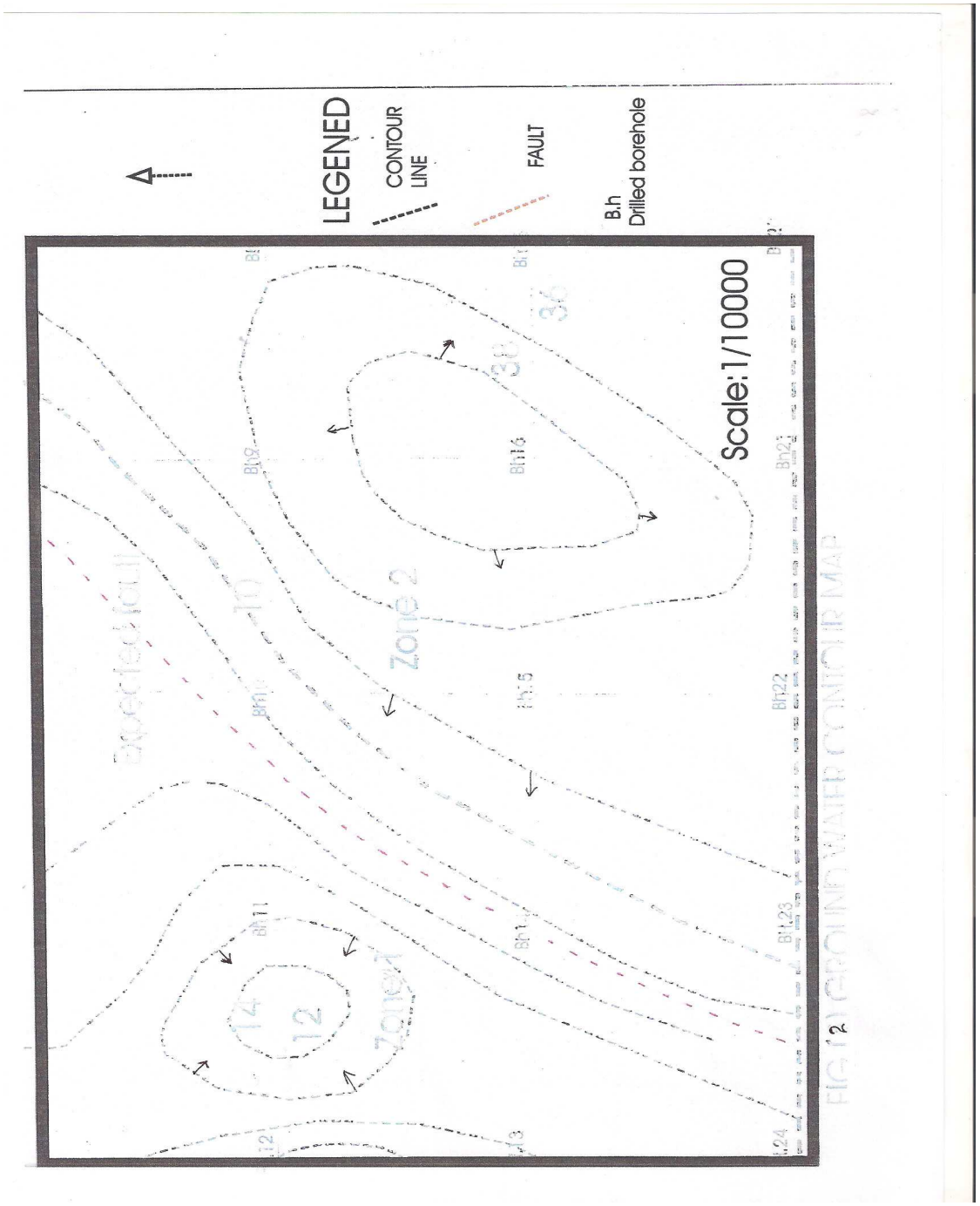
4-Hydrological contour map FigNo,(5).show high variety in shape of contour for zone No,1 to zone No.2.

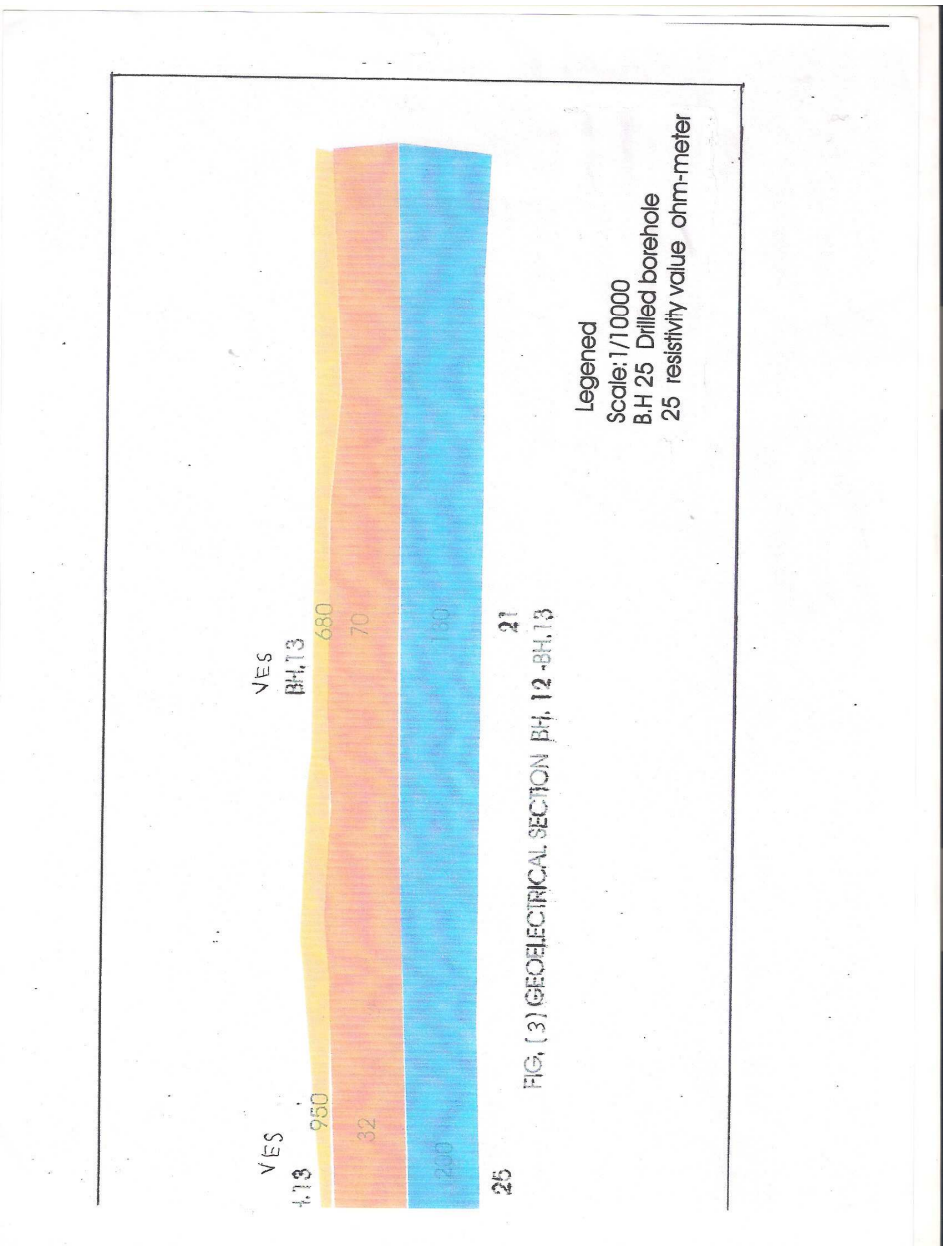
General Recommendation

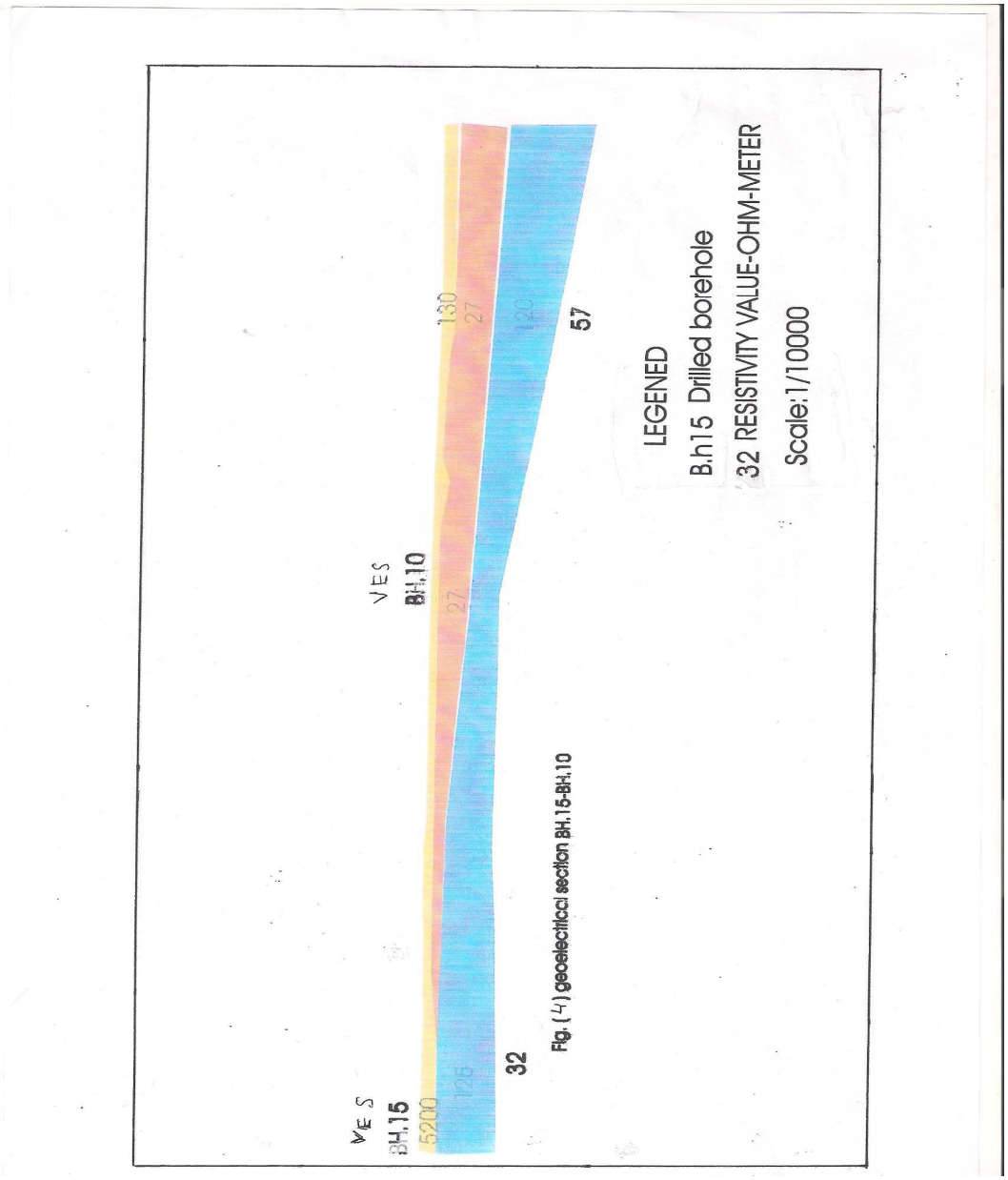
1-The different elements of conclusion deduced from geology,engineering geology, Hydrology,and geophysical works lead us to interpreted fact that the site can be divided into two zones as shown in the plan given where zone(1) is of inferior rock mass due to many rock physical defects,while zone(2)is of more stable and uniform,it is the preferable zone for heavy structure.

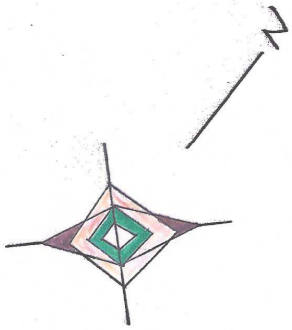
2-Extra drilling and core studies are suggested along the footing of the plant layout together with(ves)and gravity investigation carried out at the construction site such that any final ground defects should it be uncovered can be treated.

3-At the construction site where the bed rock can be reached by shallow excavation,it is recommended to leach out this defected mantle soil and founding the plant on the appropriate bed revealed in the geotechnical section of the bore holes.


LEGENED
CONTOUR LINE
FAULT
B.h Drilled borehole
Scale:1/10000
Zone 2
Zone1
FIG 12 GROUNDWATER CONTOUR MAP

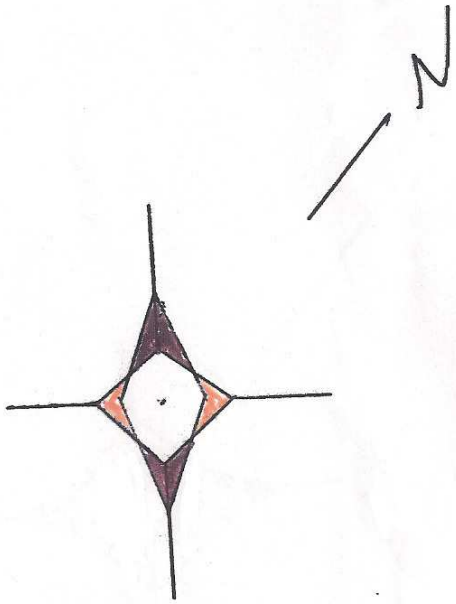

Legened
Scale:1/10000
B.H 25 Drilled borehole
25 resistivity value ohm-meter
VES
BH.13
680
70
180
21
VES
BH.13
250
32
200
25
FIG. (3) GEOELECTRICAL SECTION BH. 12 -BH.13


LEGENED
B.h15 Drilled borehole
32 RESISTIVITY VALUE-OHM-METER
Scale:1/10000
VES
BH.15
VES
BH.10
Fig. (4) geoelectricci section BH.15-BH.10



Each cm=50 Ω m

Figure No.1 CVES Graphical Elliptical Diagram For Bore Hole No.1



Each Cm=50

No.2CVES Graphical Elliptical Diagram
For Bore Hole No.11

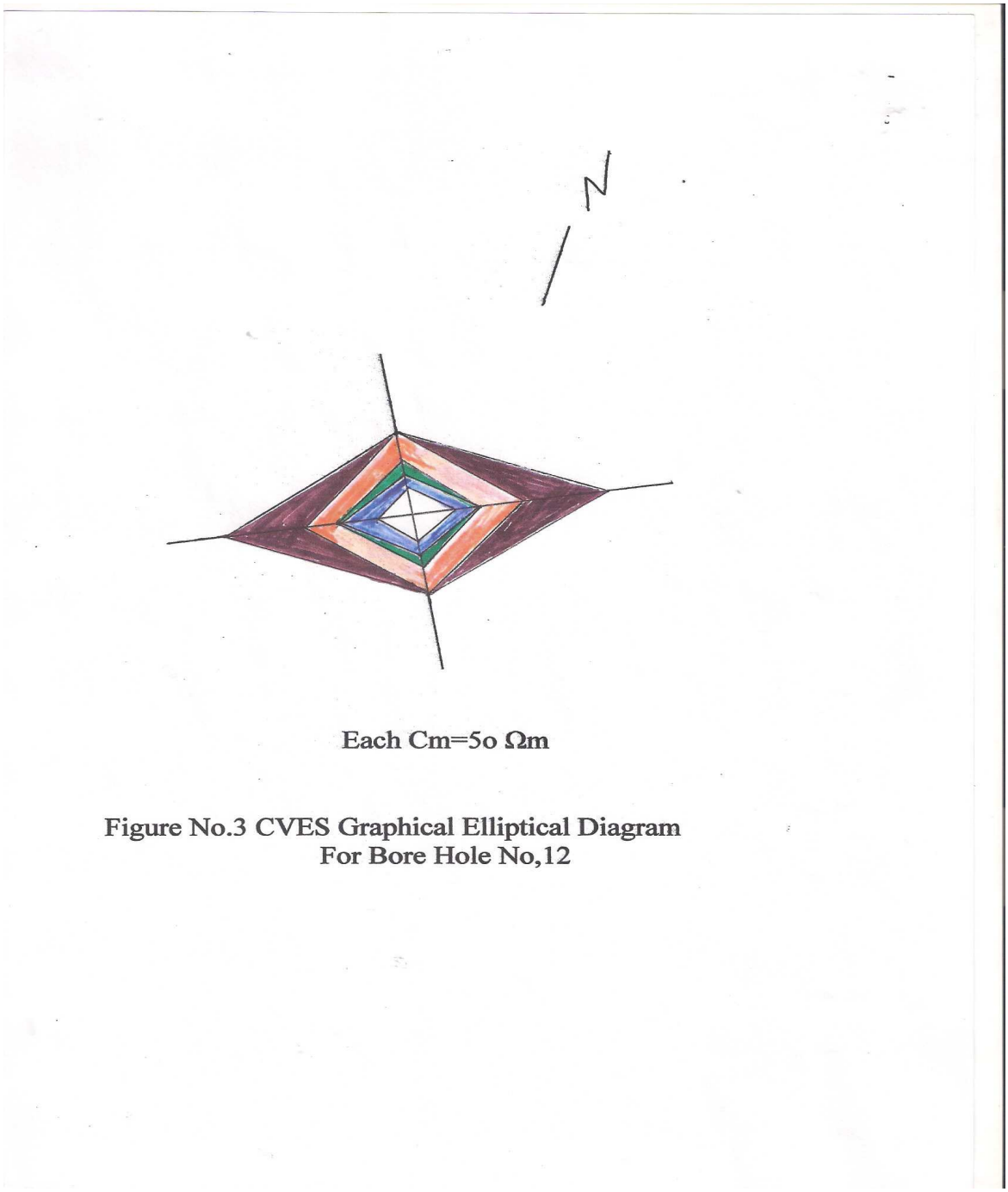
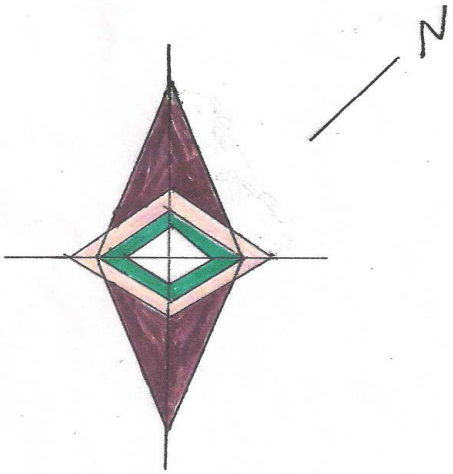


Figure No.3 CVES Graphical Elliptical Diagram
For Bore Hole No,12



Each Cm=50 Ωm

Figure No.4 CVES Graphical Elliptical Diagram
For Bore Hole No.14

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