Appendix 4.7

TABLE 1 ***VES 1 @ BH 1. INDORAMA COMPLEX ELEME, RIVERS STATE***

VES 1

COMPANY:	***PROJECT:*** ***Environmental Impact Assessment*** ***CLIENT:*** ***INDORAMA UREA FERTILIZER*** ***DATE : 29-09-2017*** ***CONTRACTOR:*** ***ENVIRON & CHEM. SER.*** ***WEATHER : SUNNY***					
	SUBSOIL AVERAGE ELECTRIC RESISTIVITY MEASUREMENT					
CO ORDINATE	ELECTRODE SPACING		CONSTANT	MEASURED RESISTANCE	RESISTIVITY	Depth
	C1C2 (m)	P1P2 (m)	K	(ohm)	(ohm.m)	(m)
N 04^0 49'49.864" E 007^{0}06'.352"	3	0.5	13.744	51	700.944	1
	4.5		31.416	31	973.896	1.5
	6		56.156	10	561.56	2
	9		126.842	4	507.368	3
	12	1	112.312	3	336.936	4
	15		175.929	1.2	211.115	5
	21		345.575	0.8	276.46	7
	30	2	351.858	1.5	527.787	10
	45		793.643	0.7	555.550	15
	60		1412.146	0.6	847.2876	20
	90	10	623.319	0.8	498.6552	30

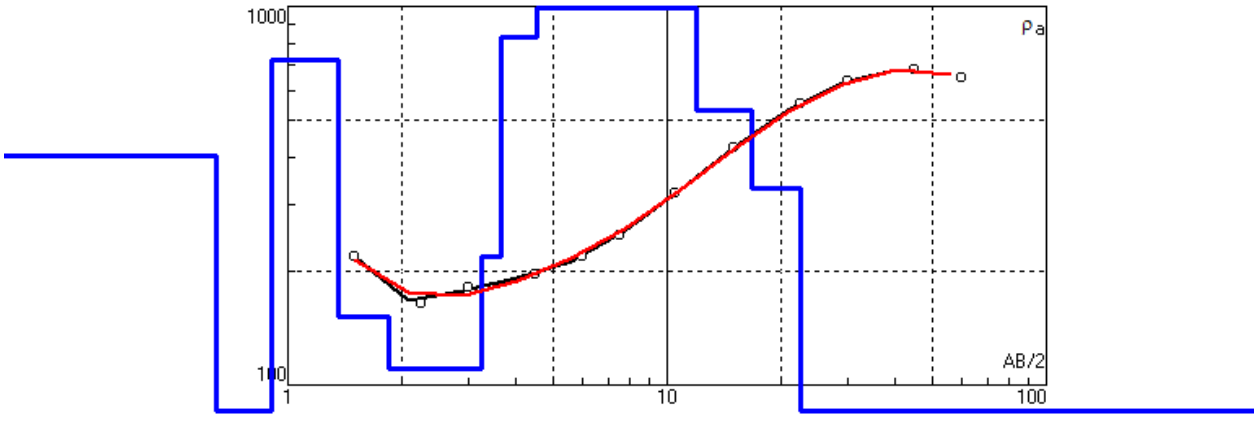


Fig. 1 Schlumberger VES Curve @ VES 1, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

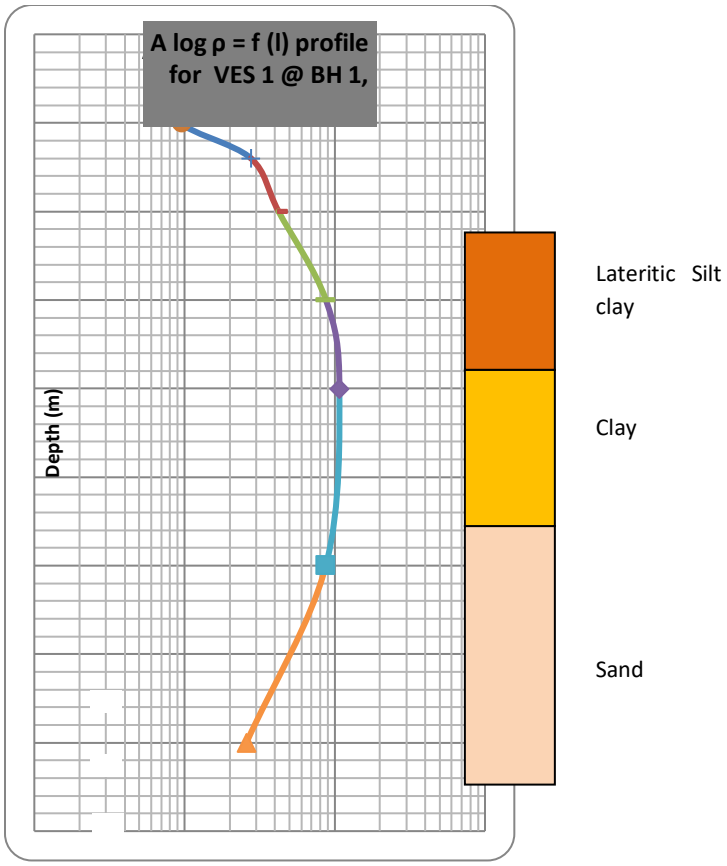


Fig. 2, VES 1; A log ρ = f (l) ***Profile INDORAMA COMPLEX, ELEME, RIVERS STATE***

TABLE 2 ***VES 2 @ BH 2, INDORAMA COMPLEX ELEME*, RIVERS STATE**

VES 2

COMPANY:	***PROJECT:*** ***Environmental Impact Assessment***
	CLIENT: *INDORAMA UREA FERTILIZER* ***DATE : 29-09-2017***
	CONTRACTOR: ENVIRON.&CHEM. SER. ***WEATHER : SUNNY***

SUBSOIL AVERAGE ELECTRIC RESISTIVITY MEASUREMENT

CO ORDINATE	ELECTRODE SPACING		CONSTANT	MEASURED RESISTANCE	RESISTIVITY	Depth
	C1C2 (m)	P1P2 (m)	K	(ohm)	(ohm.m)	(m)
N 04^0 50'.038" E 007$^+$06.587"	3	0.5	13.744	61	838.384	1
	4.5		31.416	35	1099.56	1.5
	6		56.156	15	842.34	2
	9		126.842	7	887.894	3
	12	1	112.312	6	673.872	4
	15		175.929	2.5	439.823	5
	21		345.575	1.2	414.69	7
	30	2	351.858	1.8	633.344	10
	45		793.643	1.1	873.007	15
	60		1412.146	0.7	988.5022	20
	90	10	623.319	0.9	560.9871	30

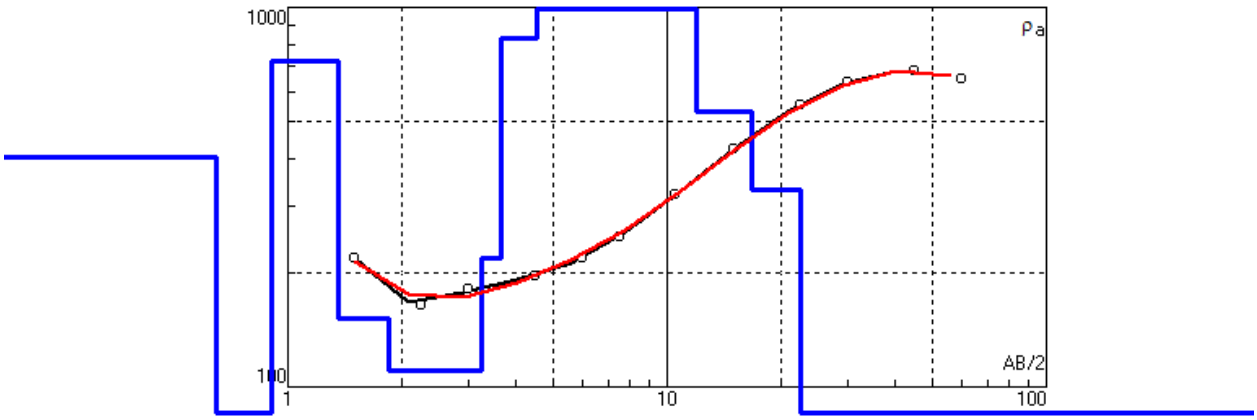


Fig. 3 Schlumberger VES Curve @ VES 2, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

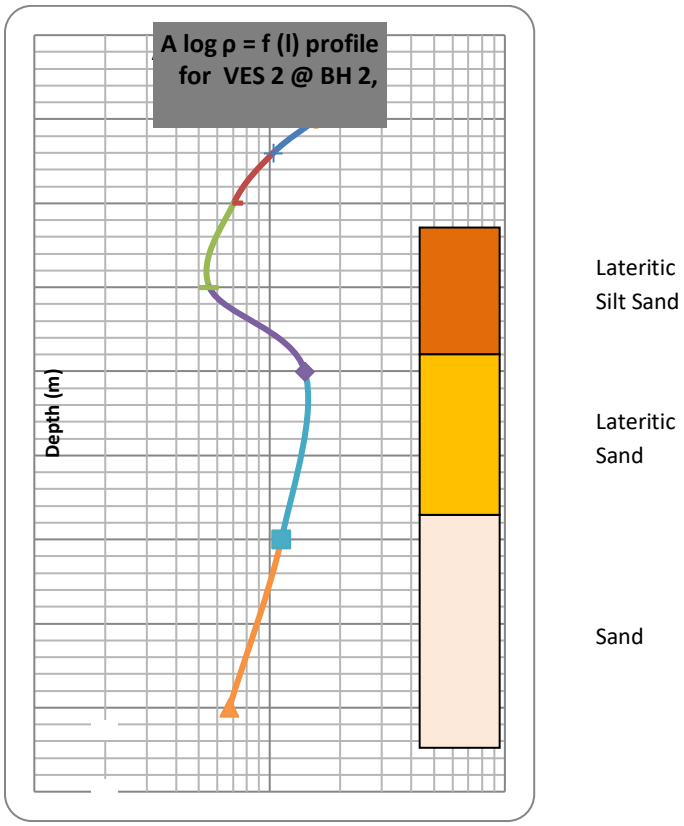


Fig. 4, VES 2; A log ρ = f (l) profile, ***INDORAMA COMPLEX ELEME, RIVERS STATE***

TABLE 3 ***VES 3 @ BH 3, INDORAMA COMPLEX, ELEME, RIVERS STATE***

VES 2

COMPANY:	***PROJECT:*** ***Environmental Impact Assessment***
	CLIENT: ***INDORAMA UREA FERTILIZER*** ***DATE : 29-09-2017***
	CONTRACTOR: ENVIRON. & CHEM.SER. ***WEATHER : SUNNY***

SUBSOIL AVERAGE ELECTRIC RESISTIVITY MEASUREMENT

CO ORDINATE	ELECTRODE SPACING		CONSTANT	MEASURED RESISTANCE	RESISTIVITY	Depth
	C1C2 (m)	P1P2 (m)	K	(ohm)	(ohm.m)	(m)
N 04^0 50''.038" E 007$^+$06.226"	3	0.5	13.744	84	1154.496	1
	4.5		31.416	34	1068.144	1.5
	6		56.156	14	786.184	2
	9		126.842	9	1141.578	3
	12	1	112.312	4.5	505.404	4
	15		175.929	2.1	369.451	5
	21		345.575	1.8	622.035	7
	30	2	351.858	1.2	422.230	10
	45		793.643	0.9	714.2797	15
	60		1412.146	0.7	988.5022	20
	90	10	623.319	1.1	685.6509	30

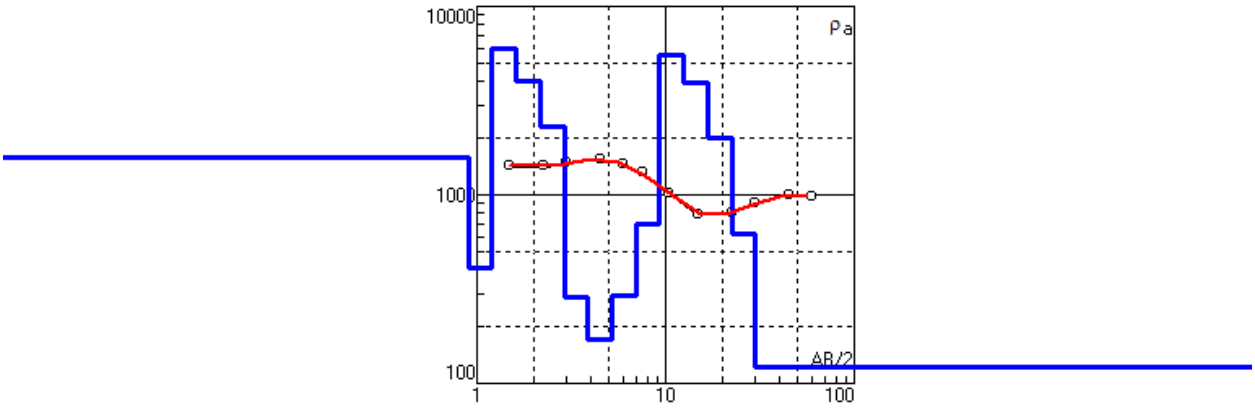


Fig. 5 Schlumberger VES Curve @ VES 3, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

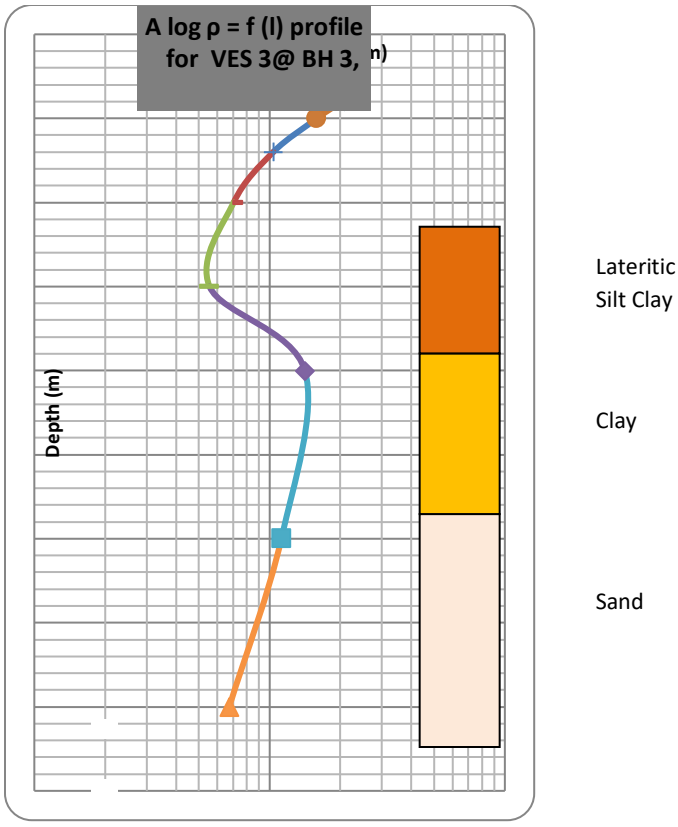


Fig. 6, VES 2; A log ρ = f (l) profile, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

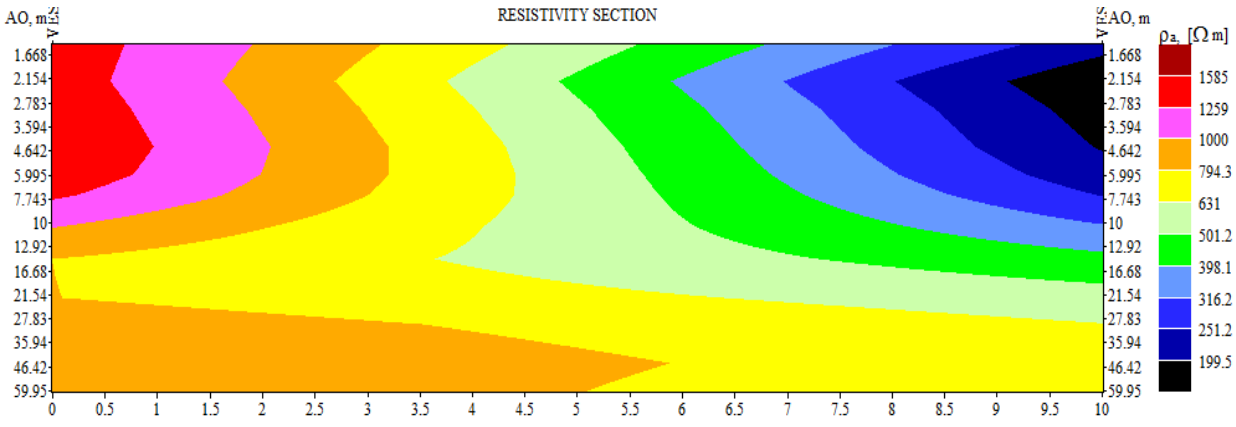


Fig. 7, Pseudo cross section for VES 1 & 3, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

TABLE 4 ***RESISTIVITY RANGE OF SELECTED GEOLOGICAL MATERIAL***

S/N	Geological and Moisture Characteristics	Resistivity given in ohm.m at 20^0C
1	Graphites	0.0001
2	Conducting mineral	0.01 – 0.1
3	Wet Graphic Schists	0.5 – 1
4	Dry Graphic Schists	3.5
5	Brine	2-6
6	Ferrous Clay – Wet marls – Wet clays	4 – 10
7	Wet clay sand – Wet gypsum	50
8	Sand + clay in alternate layers	20 – 100
9	Dry humus – clayey schists	20 – 100
10	Clayey soils	100 – 600
11	Sandy Soils (dry)	700 – 2000
12	Wet sand + gravel	100 – 1500
13	Clays mixed with dry sand	80 – 200
14	Dry peats	150 – 300
15	Wet Peat	10 - 50
16	Wet sand	200 – 500
17	Loose Sands	1000 - 90000
18	Dry gypsum, dry sand, dry gravel	1000
19	Alluvium	10 - 800
20	Petroleum, halite	10^5 - 10^7

Modified from Reynolds J.M (1998)

Table. 5:

SOIL ELECTRICAL RESISTIVITY CLASSIFICATION

ACCORDING TO THE BRITISH STANDARD BS – 1377

Soil Resistivity (ohm –m)	Soil corrosivity
Under 10	Severe
10 – 50	Corrosive
50 – 100	Moderately corrosive
Above 100	Slightly corrosive

APPENDIX

LABORATORY TEST RESULTS

UNDRAINED TRIAXIAL COMPRESSION TESTS

LOCATION:

Bore-Hole No	Depth Sample(m)	Natural Moisture Content (%)	Undrained Cohesion (KN/m^2)	Friction angle ϕ(Degree)	Description of Sample
1	1.5	25	22	2	Soft Grayish sandy clay

CLASSIFICATION TEST

ATTERBERG LIMIT
LOCATION:

Borehole No.	Depth(m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Bulk Unit Weight\ γ (KN/m^3)
3	2	43.8	20	23.8	19.6
2	4.0	35.9	17.4	18.5	

CONSOLIDATION (ONE –DIMENSIONAL)

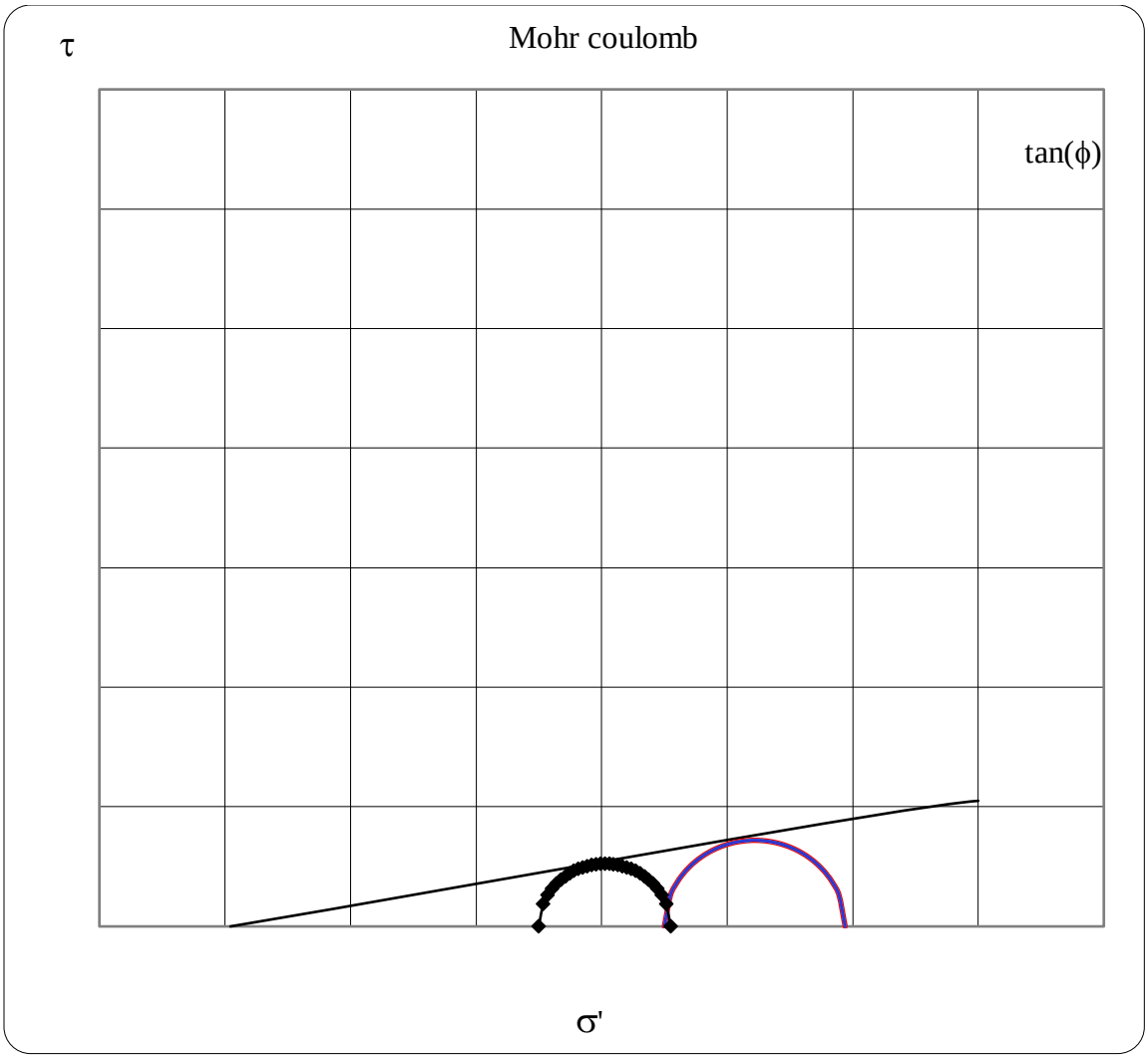
COMPRESSIBILITY PARAMETER.

Bore-Hole Nos	Depth (m)	Pressure Range (Kpa)	Coefficient of Consolidation Cv(m^2/yr)	Coefficient of Volume Compressibility Mv 10^{-4}	Coefficient of Permeabilty K 10^{-8}cm/s
2	4.0	0-25 25-50 50-100 100-200 200-400 400-800	**Error! Not a valid link.**	**Error! Not a valid link.**	**Error! Not a valid link.**

Triaxial

BH 2, 4.0m

Minor Principal Stress	100KN/m^2	300KN/m^2
Deviator Stress	201KN/m^2	288KN/m^2
Major Principal Stress	301KN/m^2	588KN/m^2


τ
Mohr coulomb
tan(ϕ)
σ'