

GEO TECHNICAL INVESTIGATION REPORT

AT THE SITE FOR

**PROPOSED CONSTRUCTION OF NEW ALL INDIA
INSTITUTE OF MEDICAL SCIENCES AT
GORAKHPUR, UTTAR PRADESH**

SUBMITTED TO

**M/s. HSCC (INDIA) LIMITED,
NODIA**



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REVISIONS NOTES

Rev. No.	Date	Description
R1	15-04-2017	<ul style="list-style-type: none">• SBC for Raft foundation in 2.00 metre, 2.50 metre & 3.00 metre depth added.• SBC for Isolated & strip footing in 2.50 metre & 3.00 metre depth added.



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March 30th, 2017

ACKNOWLEDGEMENTS

We feel pleasure to submit the report of Sub soil investigation conducted at site for proposed construction of various building structures of All India Institute of Medical Sciences (AIIMS) at Gorakhpur, Uttar Pradesh.

We convey hereby our sincere thanks to Mr. Vinod Kumar, Dy. General Manager (Struc.) M/s. HSCC India Limited, NOIDA, for his trust shown to us by awarding the work of Geotechnical investigation. We are also grateful to Mr. S.S. Popli, Dy. General Manager (Proj.), M/s. HSCC India Limited, Nodia for their co-operation and concerned office staff, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing the sketches and typing the report.

for Techpro Engineers Pvt Ltd

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सर्वोदयार्थं सर्वं यत्नमाचरेत्

Geotechnical Investigation for Construction of new AIIMS at Kuraghat, Gorakhpur, Uttar Pradesh.

1. INTRODUCTION:

This report deals with Geo-technical investigation at the site for construction of various buildings in the proposed campus of the All India Institute of Medical Science (AIIMS) at Gorakhpur, Uttar Pradesh. The work of conducting the detailed Geotechnical Investigation has been awarded to us under work order No. HSCC/D&E/AIIMS/Gorakhpur/Soil-Survey/2016/08 on dated 21-11-2016 which includes investigation in field, laboratory testing of bulk samples collected from the site and submission of the test report from the office of M/s. HSCC (India) Limited, NOIDA, Uttar Pradesh.

The scope of work for Geotechnical investigation to be carried out with the locations has been planned by the client. Purpose of the investigation is to determine the nature and properties of soil strata in the bore holes and representing them through log sections showing the levels, nature and properties of various strata to a sufficient depth below the level suitable for foundation, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil.

This report includes the detail of Methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils required for design of foundation and suggesting suitable type of foundation and safe allowable bearing capacity for safe and strong foundation.



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2. SCOPE OF WORK:

For the proposed construction of buildings, it is required to determine the safe allowable bearing capacity together with necessary engineering characteristics of underlying soil strata. Since the safe bearing capacity of soils must be evaluated on the considerations covering shear failure and permissible settlement of sub-soil strata as per IS: 6403-1981, IS: 1904-1978 and IS: 8009 (part-I)-1976 hence the scope of work is as follows:

- 2.1 Boring six numbers of boreholes of 150 mm diameter within the proposed area of construction.
- 2.2 Conducting the Standard Penetration Test (SPT) at every 1.50 metre interval or at change of strata in all the boreholes.
- 2.3 Collecting disturbed soil samples at every 1.50 metre interval or at change of strata from the boreholes.
- 2.4 Collecting undisturbed soil samples from the boreholes at 3.00 metre interval or change of strata.
- 2.5 Collecting water samples from the bore holes and testing them for harmful salts.
- 2.6 Excavating trial pits and conducting field density tests at varying depth.
- 2.7 Conducting ground water investigation by geophysics equipments
- 2.8 Collecting Ground water samples from the bore wells in the nearby area and testing them for potability.
- 2.9 Conducting Plate Load Test at defined location.
- 2.10 Conducting Dynamic Cone Penetration Test at defined location



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- 2.11 Conducting Static Cone Penetration Tests at defined location.
- 2.12 Conducting electrical resistivity test at defined location.
- 2.13 Transporting all the disturbed and undisturbed soil samples collected during the field investigation to our soil mechanics laboratory in Delhi.
- 2.14 Conducting the laboratory test on all the soil samples collected during field investigation for determination of their engineering characteristics.
- 2.15 Compilation of field and laboratory test results, working out the safe allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

Gorakhpur city, ($26^{\circ} 41'$ to $26^{\circ} 50'$ North latitude and $83^{\circ} 20'$ to $83^{\circ} 27'$ East longitude) is situated in the Terai belt of Eastern Uttar Pradesh, India. Due to pleasant climate, it was considered a mini hill station by British. In term of population growth, it is at present the second largest city, after Varanasi, in Eastern Uttar Pradesh. Geographically the city is situated on the left bank of river Rapti at the confluence of the river Rapti and Rohin. After the 1970s with the establishment of various institutions and organization and other infrastructural developments, major changes have taken place in every sectors. It is a major center of socio-economic commercial, cultural and administrative activities of north eastern U.P. To the north-east of the city a large lake named Ramgarh Tal lies and on the east lies a forest tract of kushmi. City is 815 km. north-west from Kolkata, 272 km. north-east from



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Allahabad, 232 km north from Varanasi, 262 km east from Lucknow. The roads radiate from the city to Nautanwa and Sonauli, Maharajganj and Thuthibari (both up to Indo- Nepal border) Kasia (Kushinagar), Gopalganj to Assam in the south-east, to Deoria Siwan- Chapra- Kolkatta; Barhalganj – Allahabad/Varanasi in the south and Lucknow, Kanpur, Delhi in the west. The city is well connected by road and railway from the major cities of the country where as Delhi is connected with air routes. Delhi-Kanpur-Gorakhpur- Barauni- Guwahati/ Kolkatta main line of northern, north east, central north east, and north east frontier railway traverse the city from east to west with Domingarh– Gorakhpur- Gorakhpur cantt. Two branch lines run north ward to Nautanwa and Gonda while other one broad gauge runs north Bihar. The total area of the city is 136.85 km².

3.2. Climate:

The climate in Gorakhpur is referred to as a local steppe climate. There is not much rainfall in Gorakhpur all year long. The temperature here averages 24.9 °C. Precipitation here averages 396 mm.

3.3. Demographics:

According to the 2011 census, Gorakhpur district has a population of 4,436,275, roughly equal to the nation of Croatia or the US state of Kentucky. This gives it a ranking of 40th in India (out of a total of 640). The district has a population density of 1,336 inhabitants per square kilometre (3,460/sq mi). Its population growth rate over the decade 2001–



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2011 was 17.69%. Gorakhpur has a sex ratio of 944 females for every 1000 males, and a literacy rate of 85.97%.

3.4. Topography:

The topography of the city is largely plain with a marginal gradient/ slope from north to south. The slope decreases from the middle of the city to both east and westwards. The height of the city ranges from 72 meters in south and south west to 95 meters in North above the mean sea level. In the north newly developed part of the city has elevation more than 85 metre and decreases toward south. The least elevation is in the southern part of the city which is along the Ramgarh Tal and Hobert embankment and NH 28. Most of the area of northern parts has the elevation between 80 to 85 mts. There are numerous water bodies within the city and the biggest Ramgarh tal is situated in the south eastern part of the city. The elevation is much irregular and gradients are also very uneven. But there are three north-south elongated low lying lands which are deeper having the height less than 80 mts. It seems that these are the older beds of Rapti in west, Gorghoia Nala in east and other channel between them. The areas along river Rohin and Gordhoianala have the height between 75 to 80 mts. The height from eastern bank of Ramgarh Tal to extreme east, up to city boundary, is continuously increasing. The southern part of the city has comparatively lesser height which ranges between 75 to 80 mts. It is lowest part of the city. The Ramgarh Tal and its water covered area has the height around 70 mts. Thus, the southern part



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from Ramgarh Tal to west ward is a low-lying area where height increases from east to west.



Hence according to the height, the city can be divided in two parts- first- northern half part of the city which has more than 79 meters height while second -half southern part has the elevation between 74 to 79 mts., except higher patches of area of civil lines and Dharmshal bazar around railway station. The area along Gordhoian nala to Ramgarh Tal and extreme southern part between river Rapti to Ramgarh Tal has lowest elevation

3.5. Seismicity:

In the earthquake zonal map of India the district lies in zone IV liable to severe damage by earthquakes. Although no major earthquake occurred close to it, the tract being not far from the Great Himalayan Boundary fault, experiences the effects of moderate to great earthquake occurring there. The seismic intensity may not exceed VIII on the Modified Mercalli scale 1931. The forests are generally found in the northern portion of the district, though in the past they extended as far as to the south of Gorakhpur and along the Rapti in south-eastern part of the district.

3.6. Geology:

The geology of the district exposes nothing beyond Ordinary River borne alluvium which is not old. The mineral products are few and unimportant. The minerals of commercial value are the nodular limestone conglomerate known as kankar, brick and saltpetre. The last occurs principally

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in the south and south-east and is manufactured in a crude state in considerable quantities most of it being exported to markets of Bihar. In the Bansgaon tahsil kankar is most abundant and quarries are seen at many places. It is also extracted from some places in Mahrajanj tahsil. Lime is obtained by burning kankar. Brick clay is abundant everywhere and bricks are made all over the district. The soil in the district is light sandy or dense clay of yellowish brown colour. The sand found in the rivers is medium to coarse grained, greyish white to brownish in colour and is suitable for construction purposes.

4. FIELD INVESTIGATION:

The field investigation work at this site was carried out from February 20th, 2017 to February 24th, 2017. The following investigation work was carried out:

4.1. Six numbers of **boreholes** of diameter 150 mm were made within the proposed layout of the building. The boreholes were progressed using power winch driven percussion drilling machines.

Casing was used to keep the borehole stable. The records of achieved depth of bore holes have been given in Para No. 6 (Water Table) and locations of boreholes have been reported in "BOREHOLES LOCATION PLAN" in Appendix A.

4.2. Standard Penetration Tests were conducted at 1.50 metre as per the procedure in IS 2131-1981 in all the bore holes. For conducting the test, the



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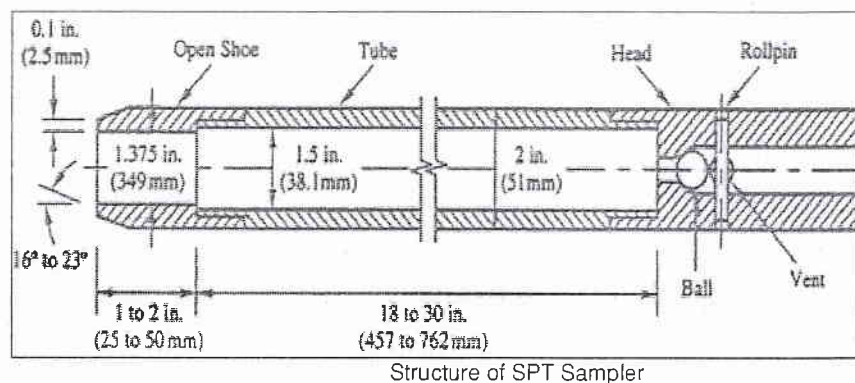
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bottom of the borehole was properly cleaned and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to affect each 15 cm of penetration was recorded. The first 15 cm of drive is considered to be seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is termed the penetration resistance N . The N' values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the



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seating penetration of 15 cm, then breakup of blows count for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with relative of non-cohesive stratum as per BS: 5930 (1999) - for sandy strata and with consistency of cohesive stratum.

CORRELATION FOR CLAY/PLASTIC SILT		CORRELATION FOR SAND/NON-PLASTIC SILT	
Consistency of clays	Penetration Value	Relative Density of sand	Penetration Value
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as refusal.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.



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Terzaghi and peck have recommended a correction for 'N' values in case of saturated silty and fine sand when the 'N' observed in the field is higher than 15.

Modified value 'N' = $15 + (N-15)/2$.

Soil sample obtained from standard spoon sampler for all above standard penetration tests were collected in the polythene bags of suitable size. These samples were property seal, labelled, record and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 6 of Appendix B under the title "SUMMARY OF TEST RESULTS"

4.3. Disturbed soil samples were tried to be collected at every 1.50 metre interval and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon sampler, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 6 of Appendix B under the title "SUMMARY OF TEST RESULTS".



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4.4. **Undisturbed soil samples** were tried to be collected in accordance with IS: 2132-1986. Undisturbed soil samples (UDS) was obtained at every 3.00 metre interval.

Undisturbed samples were collected using 75 mm dia and 450 mm long MS tubes provided with sampler head with ball check arrangement. Collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking and undisturbed sample in a tube, the adapter head was removed along with the disturbed material. The visible ends of the samples shall each be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of just molten wax. More molten wax will then be added to give a total thickness of not less than 25mm. The laboratory test results have been reported in Table 1 to 6 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.5. **Ground water samples** have been collected from all the **bore holes** made during the investigation, the results of which have been listed in table 7 "CHEMICAL TEST RESULTS ON WATER SAMPLES" of Appendix B.

4.6. Two numbers of **Ground water samples** have been collected from the bore wells existing at site which are being used for agriculture purpose. These



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samples have been reported in table 20 "POTABILITY TEST RESULTS ON BORE WELL WATER SAMPLES" in appendix B.

- 4.7. The depth at which ground water is struck during boring was carefully noted and the depth of **water table** was ascertained subsequently in the completed borehole by the following method.
- 4.8. **Dynamic Cone Penetration Test** were performed in accordance with IS 4968 (part 1) -1976 and the results have been reported in table 10 to table 14 "DYNAMIC CONE PENETRATION TEST" of Appendix B.
- 4.9. **Static Cone Penetration Test** were performed in accordance with IS 4968 (part III) -1976 and the results have been reported in table 15 to table 19 "STATIC CONE PENETRATION TEST RESULTS" of Appendix B.
- 4.10. **Plate Load Test** was performed in accordance with IS 1888-1982 and the results have been reported in table 8 "PLATE LOAD TEST" of Appendix B.
- 4.11. **Electrical Resistivity Tests (ERT)** has been conducted as per IS: 3043-1987 at one location. The locations have been marked in Appendix-A "Bore hole location plan". The results have been reported in Table 9: "ELECTRICAL RESISTIVITY TEST" of Appendix B.
- 4.12. **Vertical Electrical sounding tests** at four locations has been conducted for the purpose of finding the quality of water in the underground aquifer and to estimate the yield of the aquifer. Test locations have been assigned by the Engineer Incharge of the client. The detailed methodology, Test locations, test results and conclusion have been given in Appendix G.



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5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

- 5.1. **Field moisture contents** were determined by oven drying method as per IS 2720 (part II)-1973. The results have been reported in table 1 to table 6 "SUMMARY OF TEST RESULTS" of Appendix B.
- 5.2. **Field density** of soil strata were obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975. The results have been reported in table 1 to table 6: "SUMMARY OF TEST RESULTS" of Appendix B.
- 5.3. **Mechanical sieve analysis** test were performed in accordance with IS 2720 (Part IV) - 1985, for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in table 1 to table 6 "SUMMARY OF TEST RESULTS" of appendix B.
- 5.4. **Particle size analysis** test by hydrometer method were performed in accordance with IS 2720 (Part IV) - 1965 on the part of soil samples obtained after the sieve analysis. The results have been reported in table 1 to table 6 "SUMMARY OF TEST RESULTS" of appendix B.
- 5.5. **Atterbergs' limits tests** were performed in accordance with IS 2720 (part V)-1985 and results have been reported in table 1 to table 6 "SUMMARY OF TEST RESULTS" of Appendix B.



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- 5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -1980 and the results have been reported in table 1 to table 6 "SUMMARY OF TEST RESULTS" of Appendix B.
- 5.7. **Direct shear tests** were performed as per IS 2720 (part XI)-1971, on the undisturbed soil samples obtained during the field investigation. Some of the tests were conducted on remoulded samples as undisturbed samples could not be collected. The results and the density of samples have been reported in table 1 to table 6 "SUMMARY OF TEST RESULTS" of Appendix B
- 5.8. **Chemical Tests** on water samples collected from the bore holes, has been conducted in accordance with IS: 2720 (part XVI)-1997 for the purpose of determining the contents of salts harmful to the sub and super structure of the buildings. The results have been reported in Table 7 "CHEMICAL TEST RESULTS ON WATER SAMPLES" of Appendix B.
- 5.9. Potability tests on water samples collected from the bore wells has been conducted in accordance with IS: 10500-1991 for the purpose of determining the suitability for the purpose of drinking. The results have been reported in Table 20 "POTABILITY TESTS RESULTS ON WATER SAMPLES" of Appendix B.

6. WATER TABLE:



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The depth of water table, encountered during the boring operation and the coordinates of the bore holes and other tests locations with the elevations from Mean Sea Level (MSL) have been listed in the table below:

Bore Hole	Co-ordinate			Depth of Borehole (m)	Depth of Water table (m)
	Easting (m)	Northing (m)	Elevation (m)		
BH-1	-445.545	153.376	82.98	20.00	4.90
BH-2	.491.004	51.693	83.72	20.00	5.10
BH-3	-180.444	107.003	83.48	20.00	4.80
BH-4	96.707	136.077	83.54	15.00	4.80
BH-5	101.821	-4.287	82.77	20.00	4.00
BH-6	-51.233	-142.647	83.19	20.00	5.10
DCPT-1	-425.378	-10.961	83.92	-	-
DCPT-2	-231.807	-131.151	83.36	-	-
DCPT-3	-3.917	4.778	83.66	-	-
DCPT-4	200.052	123.952	82.81	-	-
DCPT-5	-166.208	218.628	83.48	-	-
FD-1	-469.853	106.768	83.49	-	-
FD-2	-413.634	26.048	83.14	-	-
FD-3	-155.853	40.637	83.53	-	-
FD-4	88.217	-253.603	81.05	-	-
FD-5	83.830	39.197	83.57	-	-
ERT-1	-116.316	138.717	83.54	-	-
PLT-1	-110.443	-19.351	83.56	-	-



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Bore Hole	Co-ordinate			Depth of Borehole (m)	Depth of Water table (m)
	Easting (m)	Northing (m)	Elevation (m)		
SCPT-1	-494.785	134.485	82.87	-	-
SCPT-2	-185.318	-69.578	83.63	-	-
SCPT-3	36.000	-246.103	89.78	-	-
SCPT-4	149.962	-65.948	81.27	-	-
SCPT-5	57.252	178.542	83.62	-	-
BM-1	0.000	0.000	84.12		

7. DETAILS OF SOIL STRATA:

The classification of soil strata have been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1978. The detailed nature of the soil strata have been reported in table 1 to table 6: "SUMMARY OF TEST RESULTS" of Appendix B.

In general the soils found at this site consist of inorganic silty clays of low to Intermediate plasticity upto the depth of 3.00 meters. After this depth of 3.00 meter soil strata consists of inorganic silty sands of low to none plasticity till the depth of investigation except one bore hole (BH-3) where Silty clays of low plasticity found after the depth of 18.00 meter.

The entire soil stratum exhibits no expansive property and contains no harmful salts.



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8. CALCULATIONS AND RESULTS:

The safe allowable bearing capacity of the foundation for the proposed building structure has been calculated on the shear failure criteria suggested as per IS 6403-1981, IS: 1904-1989 and settlement criteria as per IS: 8009 (part-I)-1976.

Looking at the site condition, sub soil stratification and type of proposed structure, calculations have been done for Raft foundation, isolated and strip footing.

9.1 SHEAR FAILURE CRITERIA:

Based on $C-\phi$ values:

Type of shear failure = Mixed (Interpolation in between General and Local shear failure)

Factor of safety (F.S.) = 2.50

Depth of critical water table = 2.00 meter

Net allowable bearing = q_{na} (kN/m²)

$$q_{na} = (1 / F.S.) [0.667c N_c S_c d_c + q (N_q - 1) S_q d_q + 0.5 B \gamma N_\gamma S_\gamma d_\gamma W']$$

Where,

B = Width of foundation (metre)

D = Depth of foundation (metre)

ϕ = Angle of shearing resistance (degree)

c = Cohesion intercept (kN/m²)

γ = Bulk density of soil above the base of footing (kN/m³)

q = γd = Effective overburden (kN/m²)

N_c, N_q, N_γ = Bearing capacity coefficient based on initial void ratio e_0



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d_c, d_q, d_γ = depth factors

W' = Water table correction factor

9.1.1 Raft Foundation



Shape Factors:

$$S_c = 1.00$$



$$S_q = 1.00$$

$$S_\gamma = 1.00$$

Substituting the values, the value of q_{na} can be calculated as per table below

	<p style="text-align: center;">TECHPRO ENGINEERS PVT.LTD. (AN ISO 9001: 2008 Certified Company)</p>	<p style="text-align: center;">Report No. 1666</p>	
		<p style="text-align: center;">Rev. No.: R1</p>	<p style="text-align: center;">Geotechnical Investigation for Construction of Setting up of new AIIMS at Kuraghat, Gorakhpur, Uttar Pradesh.</p>

Bore Hole no.	B	D	ϕ	c	e_o	γ	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-1	25.00	2.00	18	21.0	0.745	18.470	16.94	9.61	3.18	1.92	1.01	1.01	1.01	0.50	158.53
BH-1	25.00	2.50	22	13.0	0.711	18.680	46.70	12.24	4.78	3.65	1.02	1.01	1.01	0.50	285.94
BH-1	25.00	3.00	22	13.0	0.711	18.680	56.04	12.24	4.78	3.65	1.02	1.01	1.01	0.50	300.73
BH-2	25.00	2.00	24	12.0	0.744	17.280	14.56	12.38	4.85	3.68	1.01	1.01	1.01	0.50	222.60
BH-2	25.00	2.50	26	0.0	0.689	17.080	42.70	16.14	7.49	7.01	1.02	1.01	1.01	0.50	413.29
BH-2	25.00	3.00	26	0.0	0.689	17.080	51.24	16.14	7.49	7.01	1.02	1.01	1.01	0.50	436.28
BH-3	25.00	2.00	15	23.0	0.749	18.950	17.90	8.43	2.51	1.26	1.01	1.01	1.01	0.50	123.62
BH-3	25.00	2.50	23	12.0	0.717	18.270	45.68	12.71	5.10	4.01	1.02	1.01	1.01	0.50	301.49
BH-3	25.00	3.00	23	12.0	0.717	18.270	54.81	12.71	5.10	4.01	1.02	1.01	1.01	0.50	317.14
BH-4	25.00	2.00	21	10.0	0.699	18.500	17.00	12.01	4.64	3.49	1.01	1.01	1.01	0.50	219.89
BH-4	25.00	2.50	28	0.0	0.720	18.290	45.73	16.25	7.53	7.03	1.01	1.01	1.01	0.50	444.07
BH-4	25.00	3.00	28	0.0	0.720	18.290	54.87	16.25	7.53	7.03	1.02	1.01	1.01	0.50	468.84
BH-5	25.00	2.00	27	0.0	0.726	17.250	14.50	15.15	6.75	6.00	1.01	1.01	1.01	0.50	294.07
BH-5	25.00	2.50	28	0.0	0.708	18.550	46.38	16.96	8.08	7.79	1.01	1.01	1.01	0.50	496.09
BH-5	25.00	3.00	28	0.0	0.708	18.550	55.65	16.96	8.08	7.79	1.02	1.01	1.01	0.50	523.33

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Bore Hole no.	B	D	ϕ	c	e_o	γ	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-6	25.00	2.00	27	0.0	0.721	17.500	15.00	15.42	6.95	6.27	1.01	1.01	1.01	0.50	312.05
BH-6	25.00	2.50	27	0.0	0.698	17.200	43.00	16.64	7.86	7.51	1.01	1.01	1.01	0.50	444.38
BH-6	25.00	3.00	27	0.0	0.698	17.200	51.60	16.64	7.86	7.51	1.02	1.01	1.01	0.50	468.85



9.1.2 Isolated Footing

Shape Factors:

$$S_c = 1.30 \quad S_q = 1.20 \quad S_\gamma = 0.80$$

Substituting the values, the value of q_{na} can be calculated as per table below

Bore Hole no.	B	D	ϕ	c	e_o	γ	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-1	2.00	2.50	22	13.0	0.711	18.680	46.70	12.24	4.78	3.65	1.20	1.10	1.10	0.50	171.56
BH-1	2.00	3.00	22	13.0	0.711	18.680	56.04	12.24	4.78	3.65	1.24	1.12	1.12	0.50	194.71
BH-2	2.00	2.50	26	0.0	0.689	17.080	42.70	16.14	7.49	7.01	1.19	1.09	1.09	0.50	166.50
BH-2	2.00	3.00	26	0.0	0.689	17.080	51.24	16.14	7.49	7.01	1.23	1.11	1.11	0.50	198.97
BH-3	2.00	2.50	23	12.0	0.717	18.270	45.68	12.71	5.10	4.01	1.20	1.10	1.10	0.50	175.13
BH-3	2.00	3.00	23	12.0	0.717	18.270	54.81	12.71	5.10	4.01	1.24	1.12	1.12	0.50	199.39

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Bore Hole no.	B	D	ϕ	c	e_o	γ	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-4	2.00	2.50	28	0.0	0.720	18.290	45.73	16.25	7.53	7.03	1.19	1.09	1.09	0.50	179.33
B-4-4	2.00	3.00	28	0.0	0.720	18.290	54.87	16.25	7.53	7.03	1.22	1.11	1.11	0.50	214.31
B-4-5	2.00	2.50	28	0.0	0.708	18.550	46.38	16.96	8.08	7.79	1.18	1.09	1.09	0.50	197.48
BH-5	2.00	3.00	28	0.0	0.708	18.550	55.65	16.96	8.08	7.79	1.22	1.11	1.11	0.50	235.86
BH-6	2.00	2.50	27	0.0	0.698	17.200	43.00	16.64	7.86	7.51	1.19	1.09	1.09	0.50	177.40
BH-6	2.00	3.00	27	0.0	0.698	17.200	51.60	16.64	7.86	7.51	1.22	1.11	1.11	0.50	211.91

9.1.3 Strip Footing

Shape Factors:

$$S_c = 1.00 \quad S_q = 1.00 \quad S_\gamma = 1.00$$

Substituting the values, the value of q_{na} can be calculated as per table below

Bore Hole no.	B	D	ϕ	c	e_o	γ	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-1	1.00	2.50	22	13.0	0.711	18.680	46.70	12.24	4.78	3.65	1.40	1.20	1.20	0.50	152.57
BT-1	1.00	3.00	22	13.0	0.711	18.680	56.04	12.24	4.78	3.65	1.48	1.24	1.24	0.50	176.65
BT-2	1.00	2.50	26	0.0	0.689	17.080	42.70	16.14	7.49	7.01	1.38	1.19	1.19	0.50	145.92



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Bore Hole no.	B	D	ϕ	c	e_o	γ	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-2	1.00	3.00	26	0.0	0.689	17.080	51.24	16.14	7.49	7.01	1.45	1.23	1.23	0.50	177.71
BH-3	1.00	2.50	23	12.0	0.717	18.270	45.68	12.71	5.10	4.01	1.40	1.20	1.20	0.50	155.52
BH-3	1.00	3.00	23	12.0	0.717	18.270	54.81	12.71	5.10	4.01	1.48	1.24	1.24	0.50	180.61
BH-4	1.00	2.50	28	0.0	0.720	18.290	45.73	16.25	7.53	7.03	1.37	1.19	1.19	0.50	157.16
BH-4	1.00	3.00	28	0.0	0.720	18.290	54.87	16.25	7.53	7.03	1.45	1.22	1.22	0.50	191.40
BH-5	1.00	2.50	28	0.0	0.708	18.550	46.38	16.96	8.08	7.79	1.37	1.18	1.18	0.50	172.80
BH-5	1.00	3.00	28	0.0	0.708	18.550	55.65	16.96	8.08	7.79	1.44	1.22	1.22	0.50	210.30
BH-6	1.00	2.50	27	0.0	0.698	17.200	43.00	16.64	7.86	7.51	1.37	1.19	1.19	0.50	155.31
BH-6	1.00	3.00	27	0.0	0.698	17.200	51.60	16.64	7.86	7.51	1.45	1.22	1.22	0.50	189.06



9.2 SETTLEMENT CRITERIA:

Soil strata at this site mainly consists of silts of low plasticity, Silty sands and poorly graded sands, hence the Settlement of the soil layers below the base of footing has been calculated on the basis of SPT values obtained during the field Investigation.

$$\text{Settlement for applied pressure } (S_f) = (q_s \times S_u \times D_f) / (W' \times 100)$$

Where, S_f is in mm

q_s = Permissible pressure (kN/m²)

S_u = Settlement for unit pressure of 1.00 kg/cm²

W' = Water table correction factor

N = Corrected average SPT value

B = Base width

D = Depth of footing

D_f = depth factor

The settlement of isolated footing at different depth and base width can be calculated as per the following table: Keeping in mind that actual width of the footing may be more than used in shear failure consideration, settlement calculations have been made for double width of the footing

9.2.1 Raft Foundation

BORE NO.	B	D	N	S_u	W'	q_s	d_f	S_f
BH-1	25.00	2.00	12.51	30.0	0.50	158.53	0.98	75
BH-1	25.00	2.50	12.51	30.0	0.50	161.08	0.97	75
BH-1	25.00	3.00	12.67	30.0	0.50	162.76	0.96	75
BH-2	25.00	2.00	13.22	29.0	0.50	164.94	0.98	75





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BORE NO.	B	D	N	S_u	W'	q_s	d_f	s_f
BH-2	25.00	2.50	13.22	29.0	0.50	166.64	0.97	75
BH-2	25.00	3.00	12.85	29.0	0.50	168.37	0.96	75
BH-3	25.00	2.00	16.23	21.0	0.50	123.62	0.98	41
BH-3	25.00	2.50	16.23	21.0	0.50	230.12	0.97	75
BH-3	25.00	3.00	15.74	21.0	0.50	232.51	0.96	75
BH-4	25.00	2.00	16.40	21.0	0.50	219.89	0.98	72
BH-4	25.00	2.50	16.40	21.0	0.50	230.12	0.97	75
BH-4	25.00	3.00	16.34	21.0	0.50	232.51	0.96	75
BH-5	25.00	2.00	19.63	18.0	0.50	265.73	0.98	75
BH-5	25.00	2.50	19.63	18.0	0.50	268.47	0.97	75
BH-5	25.00	3.00	20.33	18.0	0.50	271.27	0.96	75
BH-6	25.00	2.00	18.14	19.0	0.50	251.75	0.98	75
BH-6	25.00	2.50	18.14	19.0	0.50	254.34	0.97	75
BH-6	25.00	3.00	18.23	19.0	0.50	256.99	0.96	75

The settlement is within the allowable limit of 75 mm.

9.2.2 Isolated Footing

BORE NO.	B	D	N	S_u	W'	q_s	d_f	s_f
BH-1	4.00	2.50	12.09	30	0.50	101.63	0.82	50
BH-1	4.00	3.00	12.09	30	0.50	108.23	0.77	50
BH-2	4.00	2.50	12.71	27	0.50	112.92	0.82	50
BH-2	4.00	3.00	12.71	27	0.50	120.25	0.77	50
BH-3	4.00	2.50	15.49	21	0.50	145.18	0.82	50
BH-3	4.00	3.00	15.49	21	0.50	154.61	0.77	50
BH-4	4.00	2.50	15.71	20	0.50	152.44	0.82	50
BH-4	4.00	3.00	15.71	20	0.50	162.34	0.77	50
BH-5	4.00	2.50	15.10	21	0.50	145.18	0.82	50
BH-5	4.00	3.00	15.10	21	0.50	154.61	0.77	50
BH-6	4.00	2.50	17.26	17	0.50	177.40	0.82	49

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BORE NO.	B	D	N	S _u	W'	q _s	d _f	s _f
BH-6	4.00	3.00	17.26	17	0.50	190.99	0.77	50

The settlement is within the allowable limit of 50 mm

9.2.3 Strip Footing

BORE NO.	B	D	N	S _u	W'	q _s	d _f	s _f
BH-1	2.00	2.50	12.18	25	0.50	152.57	0.70	53
BH-1	2.00	3.00	12.18	25	0.50	176.65	0.66	58
BH-2	2.00	2.50	13.98	22	0.50	145.92	0.70	45
BH-2	2.00	3.00	13.98	22	0.50	177.71	0.66	52
BH-3	2.00	2.50	15.78	18	0.50	155.52	0.70	39
BH-3	2.00	3.00	15.78	18	0.50	180.61	0.66	43
BH-4	2.00	2.50	19.21	15	0.50	157.16	0.70	33
BH-4	2.00	3.00	19.21	15	0.50	191.40	0.66	38
BH-5	2.00	2.50	15.44	19	0.50	172.80	0.70	46
BH-5	2.00	3.00	15.44	19	0.50	210.30	0.66	53
BH-6	2.00	2.50	12.87	24	0.50	155.31	0.70	52
BH-6	2.00	3.00	12.87	24	0.50	189.06	0.66	60

The settlement is within the allowable limit of 60 mm

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10 RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1 Raft Foundation:



Raft foundation shall be provided for building structures to be constructed on RCC framed columns. The depth and corresponding safe allowable bearing capacity shall be as follows:

Depth of foundation (m)	Safe bearing capacity (kN/m ²)
2.00	125.00
2.50	160.00
3.00	162.00

10.2 Isolated Column footings:

Isolated footings may be provided for building structures to be constructed on RCC framed columns. The depth and corresponding safe allowable bearing capacity shall be as follows:

Depth of foundation (m)	Safe bearing capacity (kN/m ²)
2.50	100.00
3.00	110.00

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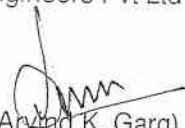
10.3 Strip footings:

Alternative strip footing may also be provided for building structures to be constructed on RCC framed columns. The depth and corresponding safe allowable bearing capacity shall be as follows:

Depth of foundation (m)	Safe bearing capacity (kN/m ²)
2.50	145.00
3.00	175.00

10.4 If any loose pocket/ strata are found during the excavation, the foundation shall be laid only after ensuring that the same has been cleared and appropriate remedial measures have been adopted

for Techpro Engineers Pvt Ltd


 (Arvind K. Garg)
 B.Tech (Civil), M.Tech.
 Principal Consultant &
 Managing Director



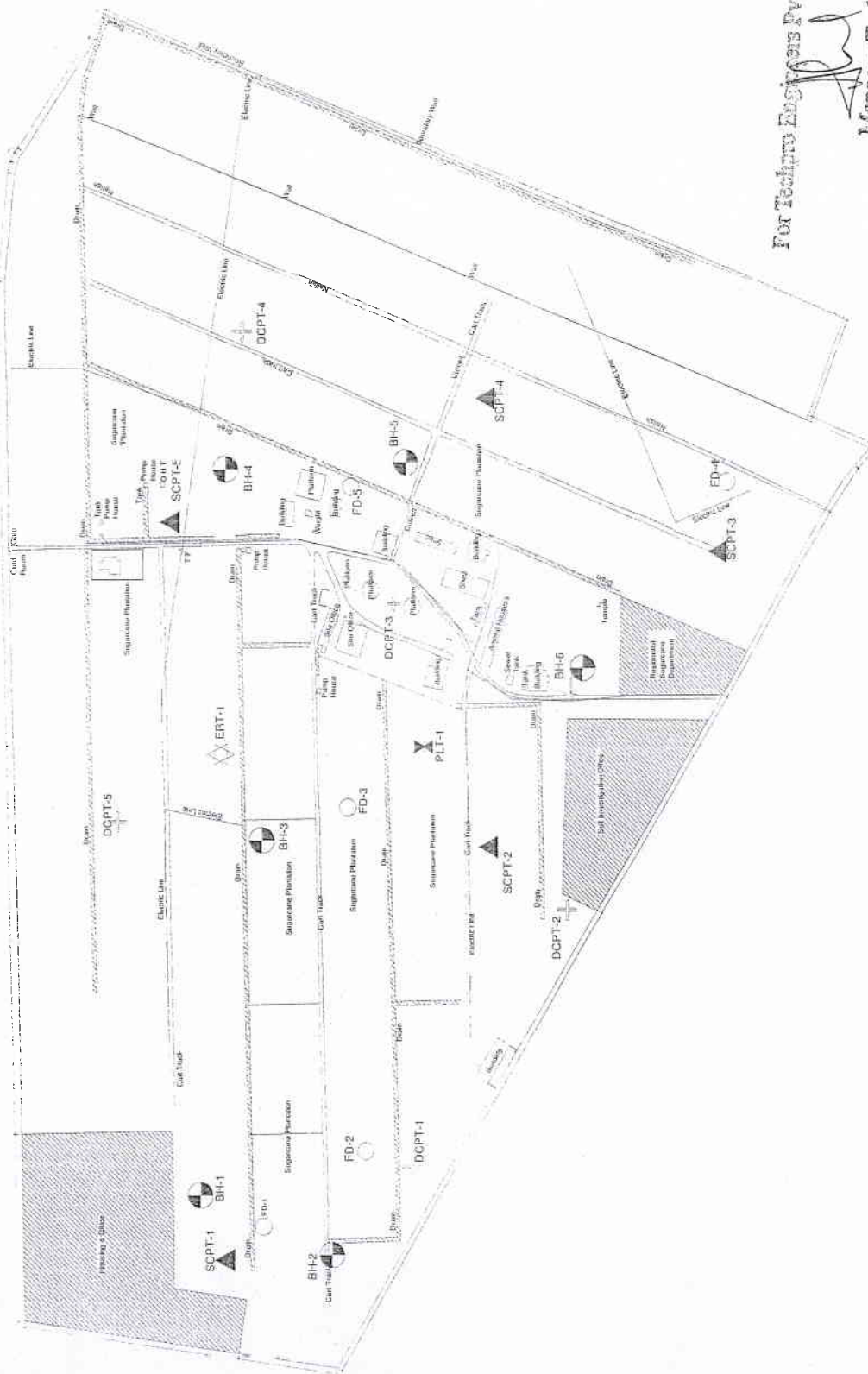
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APPENDIX - A



For Terms Enquire Vol. 22.

Manager Technical

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APPENDIX 'B'
TABLE 01: SUMMARY OF TEST RESULTS

Bore No.: 01
Diameter of Bore hole: 150 mm
Water Level:- 4.90 Metre
Ground Elevation: 82.98
Bore Retained using: Casing
Casing Lowered: 18.00 metre
Method of drilling: Percussion drilling
Starting Date: 23-02-2017
Ending Date: 23-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT														Shrinkage/ Swelling									
FL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic					
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N' (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio	PRECONSOLIDATION PRESSURE (kg/cm ²)	Free Swell Index	Shrinkage Limit	Swell Pressure
1.00	U	1	1	-	-	-	-	-	Inorganic clays of intermediate plasticity		CI	0	0	1	4	76	19	20.70	1.847	1.530	44	24	20	2.67	DST	21	18	0.14	0.745	-	6.67	16.2	-
1.50	D	2	2	3	5	7	12	17.17			-	-	-	-	-	-	-	-	22.10	-	-	-	-	-	-	-	-	-	-	-	-	-	
2.50	U	3	3	-	-	-	-	-	Inorganic silt of low plasticity		ML	0	0	1	30	68	1	20.10	1.868	1.555	26	23	3	2.66	DST	13	22	-	0.711	-	-	-	-
3.00	D	4	4	4	4	5	9	10.76				SM	0	0	0	66	34	0	14.50	-	-	Non-Plasticity	-	-	-	-	-	-	-	-	-	-	-
4.50	D	5	5	3	5	6	11	11.66	Silty sands		SM	0	0	1	54	43	2	29.00	1.950	1.512 [#]	Non-Plasticity	Non-Plasticity	Non-Plasticity	2.65	RDST	0	28	-	-	-	-	-	-
6.00	D	7	7	4	6	7	13	12.53				SP-ML	0	0	0	92	8	0	20.20	-	-	Non-Plasticity	Non-Plasticity	Non-Plasticity	-	-	-	-	-	-	-	-	-
7.50	D	8	8	4	7	9	16	13.78	Poorly graded sand and silts of non plasticity		SP-ML	0	0	0	94	6	0	24.90	1.924	1.541 [#]	Non-Plasticity	Non-Plasticity	Non-Plasticity	2.64	RDST	0	30	-	-	-	-	-	-
9.00	D	10	10	3	6	11	17	13.25				-	-	-	-	-	-	-	25.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.50	D	11	11	2	7	10	17	12.43				SP-ML	0	0	0	95	5	0	22.30	1.893	1.548 [#]	Non-Plasticity	Non-Plasticity	Non-Plasticity	2.64	RDST	0	31	-	-	-	-	-

Ending Date: 23-02-2017

Cashing Lowered: 18.00 metre

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APPENDIX 'B'


TABLE 01: SUMMARY OF TEST RESULTS



Bore No.: 01
Diameter of Bore hole: 150 mm
Water Level:- 4.90 Metre
Ground Elevation: 82.98
Bore Retained using: Casing
Casing Lowered: 18.00 metre
Method of drilling: Percussion drilling
Starting Date: 23-02-2017
Ending Date: 23-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT										Shrinkage/ Swelling										
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristic			
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N' (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) Φ	C _c	Void Ratio	PRECONSOLIDATION PRESSURE (kg/cm ²)
12.00	D	13	6	7	7	14	10.25	poorly graded sand and silts of non plasticity		SP-ML	14	1	2	74	9	0	22.40	1.924	1.572	Non-Plasticity	2.64	RDST	0	31						
13.50	D	14	4	9	13	22	12.81													23.40										
15.00	D	16	5	8	15	23	12.49																							
16.50	D	17	7	12	23	35	15.64	Silty sands		SM	0	0	1	82	17	0	22.40	1.909	1.560	Non-Plasticity	2.64	RDST	0	29						
18.00	D	19	6	9	16	25	11.93							0	0	0	92	8	0	21.10			Non-Plasticity							
20.00	D	20	7	11	19	30	12.63	poorly graded sand and silts of non plasticity									20.90													

Ending Date: 23-02-2017

Note:-
 DST: Direct Shear Test
 RDST: Direct Shear test on remoulded sample
 #: indicate assumed density



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APPENDIX 'B'
TABLE 02: SUMMARY OF TEST RESULTS

Bore No.: 02
 Diameter of Bore hole: 150 mm
 Water Level:- 5.10 Metre
 Ground Elevation: 83.72
 Bore Retained using: Casing
 Casing Lowered: 16.50 metre
 Method of drilling: Percussion drilling
 Starting Date: 24-02-2017
 Ending Date: 24-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT														Ending Date: 24-02-2017										
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristic			Shrinkage/ Swelling				
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N' (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio,	PRECONSOLIDATION PRESSURE (kg/cm ²)	Free Swell Index	Shrinkage Limit	Swell Pressure	
	1.00	U	1	-	-	-	-	-	Inorganic silts and clays of low plasticity		CL-ML	0	0	0	33	62	5	13.30	1.728	1.525	25	19	6	2.66	DST	12	24	0.12	0.744	-	-	17		
	1.50	D	2	2	5	5	10	14.53					-	-	-	-	-	-	18.90	-	-	-	-	-	-	-	-	-	-	-	-	-		
	2.50	U	3	-	-	-	-	-	Silty sands		SM	0	0	0	73	27	0	9.30	1.708	1.563	Non-Plasticity		2.64	RDST	0	26	-	0.689	-	-	-	-	-	
	3.00	D	4	4	7	7	14	17.15					-	-	-	-	-	13.20	-	-	Non-Plasticity		2.64	RDST	0	27	-	-	-	-	-	-		
	4.50	D	5	3	6	7	13	14.17			SM	2	0	0	68	30	0	20.60	1.846	1.531 [#]	Non-Plasticity		2.64	RDST	0	27	-	-	-	-	-	-	-	
	6.00	D	7	4	7	9	16	15.40					-	-	-	-	-	-	24.60	-	-	Non-Plasticity		2.64	RDST	0	27	-	-	-	-	-	-	
	7.50	D	8	3	3	7	10	9.19	Poorly graded sand and silts of non plasticity		SP-ML	0	0	0	91	9	0	26.30	1.895	1.501 [#]	Non-Plasticity		2.64	RDST	0	30	-	-	-	-	-	-	-	-
	9.00	D	10	3	6	9	15	12.87					-	-	-	-	-	-	25.70	-	-	Non-Plasticity		2.64	RDST	0	30	-	-	-	-	-	-	
	10.50	D	11	2	6	8	9	7.26				SP-ML	2	0	0	93	5	0	21.10	1.831	1.512 [#]	Non-Plasticity		2.64	RDST	0	32	-	-	-	-	-	-	-

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APPENDIX 'B'
TABLE 02: SUMMARY OF TEST RESULTS



Bore No.: 02
Diameter of Bore hole: 150 mm
Water Level:- 5.10 Metre
Ground Elevation: 83.72
Bore Retained using: Casing
Casing Lowered: 16.50 metre
Method of drilling: Percussion drilling
Starting Date: 24-02-2017
Ending Date: 24-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT										Shrinkage/ Swelling													
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result				Description of Soil	Mapping	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristic			Free Swell Index	Shrinkage Limit	Swell Pressure		
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)				N (Correct N)	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) Φ	C _c				Void Ratio,	PRECONSOLIDATION PRESSURE (kg/cm ²)
12.00	D	13	2	8	11	19	12.95	Poorly graded sand and silts of non plasticity	Mapping	-	-	-	-	-	-	-	26.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
13.50	D	14	4	7	10	17	11.56			SP-ML	5	0	0	88	7	0	-	24.60	1.895	1.521 [#]	Non-Plasticity	2.64	RDST	0	31	-	-	-	-	-	-	-	-
15.00	D	16	6	9	15	24	13.40			-	-	-	-	-	-	-	-	7.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.50	D	17	8	12	21	33	15.73			SP	2	0	1	93	4	0	-	15.50	1.822	1.578 [#]	Non-Plasticity	2.64	RDST	0	33	-	-	-	-	-	-	-	-
18.00	D	19	7	11	16	27	13.15	Poorly graded sand and silts of non plasticity	Mapping	SP-ML	2	0	0	91	7	0	20.60	-	-	Non-Plasticity	-	-	-	-	-	-	-	-	-	-	-	-	-
20.00	D	20	9	17	21	38	15.66			-	-	-	-	-	-	-	-	18.80	-	-	Non-Plasticity	-	-	-	-	-	-	-	-	-	-	-	-

Note:-
 DST: Direct Shear Test
 RDST: Direct Shear test on remoulded sample
 #: Indicate assumed density

For Techpro Engineers Pvt. Ltd.



 Manager Technical

	TECHPRO ENGINEERS PVT.LTD. (AN ISO 9001: 2008 Certified Company)	Report No. 1666 Rev. No.: R1
		
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APPENDIX 'B'
TABLE 03: SUMMARY OF TEST RESULTS

Bore No.: 03
 Diameter of Bore hole: 150 mm
 Water Level:- 4.80 Metre
 Ground Elevation: 83.48
 Bore Retained using: Casing
 Casing Lowered: 17.00 metre
 Method of drilling: Percussion drilling
 Starting Date: 23-02-2017
 Ending Date: 23-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT													Ending Date: 23-02-2017									
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result				Description of soil	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristic		Shrinkage/ Swelling					
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)			N (Correct N)	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio	PRECONSOLIDATION PRESSURE (kg/cm ²)	Free Swell Index	Shrinkage Limit	Swell Pressure
1.00	U	1	1	-	-	-	-	Inorganic clays of intermediate plasticity	CI	0	1	1	17	73	14	23.70	1.895	1.532	37	21	16	2.68	DST	23	15	-	0.749	-	0	14	-	
1.50	D	2	2	3	4	6	10	Inorganic clays of low plasticity	CL	0	0	0	32	62	6	18.00	1.827	1.549	25	16	9	2.66	DST	12	23	-	0.717	-	-	-	-	
2.50	U	3	3	-	-	-	-	Silty sands	SM	0	0	0	72	28	0	17.40	-	-	Non-Plasticity	-	-	-	-	-	-	-	-	-	-	-	-	-
3.00	D	4	4	6	6	12	18	Poorly graded sand and silts of non plasticity	SP-ML	0	0	0	90	10	0	16.00	1.830	1.578	Non-Plasticity	-	-	-	-	RDST	0	27	-	0.673	-	-	-	-
4.50	D	5	5	5	6	7	13	Poorly graded sands	SP	0	0	0	95	5	0	23.80	1.895	1.531 [#]	Non-Plasticity	-	-	-	-	RDST	0	32	-	-	-	-	-	-
5.00	U	6	6	-	-	-	-			-	-	-	-	-	-	21.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6.00	D	7	7	5	7	9	16			-	-	-	-	-	-	21.60	-	-	Non-Plasticity	-	-	-	-	RDST	0	32	-	-	-	-	-	-
7.50	D	8	8	6	7	7	14			-	-	-	-	-	-	21.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	D	10	10	10	11	13	24			-	-	-	-	-	-	24.10	1.966	1.585 [#]	Non-Plasticity	-	-	-	-	RDST	0	32	-	-	-	-	-	-
10.50	D	11	11	9	11	18	29			-	-	-	-	-	-	21.20	-	-	Non-Plasticity	-	-	-	-	RDST	0	32	-	-	-	-	-	-
12.00	D	13	13	6	7	10	17			-	-	-	-	-	-	22.50	1.978	1.615 [#]	Non-Plasticity	-	-	-	-	RDST	0	32	-	-	-	-	-	-
13.50	D	14	14	7	16	19	35			-	-	-	-	-	-	22.50	1.978	1.615 [#]	Non-Plasticity	-	-	-	-	RDST	0	32	-	-	-	-	-	-

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APPENDIX 'B'
TABLE 03: SUMMARY OF TEST RESULTS



Bore No.: 03
 Diameter of Bore hole: 150 mm
 Water Level:- 4.80 Metre
 Ground Elevation: 83.48
 Bore Retained using: Casing
 Casing Lowered: 17.00 metre
 Method of drilling: Percussion drilling
 Starting Date: 23-02-2017
 Ending Date: 23-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT																								
RL in Meter		Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage/ Swelling		
					N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio _v	PRECONSOLIDATION PRESSURE (kg/cm ²)			
	15.00	D		16	11	19	30	49	21.25	Inorganic clays of low plasticity		SP	-	-	-	-	-	20.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15.50	D		17	10	22	37	59	23.39			CL	3	0	1	92	4	0	21.20	2.000	1.651 [#]	Non-Plasticity	-	2.64	RDST	0	33	-	-	-	-	-	-	-
	13.00	D		19	6	9	15	24	11.76			CL	13	2	4	14	59	9	15.90	-	-	30	18	12	-	-	-	-	-	-	-	-	-	-
	23.00	D		20	9	12	17	29	12.49			CL	0	1	2	13	74	10	18.50	-	-	31	19	12	-	-	-	-	-	-	-	-	-	-

Note:-
 DST: Direct Shear Test
 RDST: Direct Shear test on remoulded sample
 #: Indicate assumed density

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APPENDIX 'B'
TABLE 04: SUMMARY OF TEST RESULTS

Bore No.: 04
 Diameter of Bore hole: 150 mm
 Water Level:- 4.80 Metre
 Ground Elevation: 83.54
 Bore Retained using: Casing
 Casing Lowered: 17.00 metre
 Method of drilling: Percussion drilling
 Starting Date: 20-02-2017
 Ending Date: 20-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT										Ending Date: 20-02-2017												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristics			Shrinkage/ Swelling		
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N' (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m²)	Angle of Friction (Degree) ϕ	G _c	Void Ratio,	PRECONSOLIDATION PRESSURE (kg/cm²)	Free Swell Index	Shrinkage Limit
1.50	D	2	3	4	7	10.50	Inorganic silts and clays of low plasticity	CL-MI	0	0	0	36	58	6	18.20	1.850	1.565	25	19	6	2.66	RDST	10	21	-	0.699	-	-	-	-		
2.50	U	3	-	-	-	-	Poorly graded sand and silts of non plasticity	SP-ML	0	0	0	96	4	0	19.20	1.829	1.535	Non-Plasticity			2.64	RDST	0	28	-	0.720	-	-	-	-		
3.00	D	4	4	7	7	14	Silty sands	SM	0	0	0	82	18	0	23.90	-	-	Non-Plasticity			-	-	-	-	-	-	-	-	-	-		
4.50	D	5	4	9	12	21		-	-	-	-	-	-	-	22.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5.50	U	6	-	-	-	-		SM	0	0	0	85	15	0	22.70	1.902	1.550	Non-Plasticity			2.64	RDST	0	29	-	0.703	-	-	-	-		
6.00	D	7	5	10	13	18.20	-	-	-	-	-	-	-	-	22.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.50	D	8	6	8	21	19.43	Poorly graded sand and silts of non plasticity	SP-ML	0	0	0	91	9	0	22.30	1.954	1.598	Non-Plasticity			2.64	RDST	0	31	-	-	-	-	-	-	-	
9.00	D	10	3	5	7	9.86		-	-	-	-	-	-	-	23.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10.50	D	11	5	8	10	12.71		-	-	-	-	-	-	-	-	25.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

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APPENDIX 'B'
TABLE 04: SUMMARY OF TEST RESULTS



Bore No.: 04
 Diameter of Bore hole: 150 mm
 Water Level:- 4.80 Metre
 Method of drilling: Percussion drilling
 Starting Date: 20-02-2017
 Ending Date: 20-02-2017
 Ground Elevation: 83.54
 Bore Retained using: Casing
 Casing Lowered: 17.00 metre

FIELD TEST RESULT										LABORATORY TEST RESULT																								
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage/ Swelling			
				N1 (Sealing Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N' (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio	PRECONSOLIDATION PRESSURE (kg/cm ²)	Free Swell Index	Shrinkage Limit	Swell Pressure	
11.50	U	12									SP-ML	0	0	0	95	5	0	9.73	1.745	1.590	Non-Plasticity			2.64	RDST	0	33	0.660						
12.00	D	13		4	6	8	14	10.57	Poorly graded sand and silts of non plasticity								23.60																	
13.50	D	14		14	22	30	52	23.96		SP-ML	0	0	0	90	10	0	18.00	1.937	1.642	Non-Plasticity						2.64	RDST	0	32					
15.00	D	16		7	12	13	25	13.60										18.40																

Note:-
 DST: Direct Shear Test
 RDST: Direct Shear test on remoulded sample
 #: Indicate assumed density

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APPENDIX 'B'
TABLE 05: SUMMARY OF TEST RESULTS

Bore No.: 05
 Diameter of Bore hole: 150 mm
 Water Level:- 4.00 Metre
 Ground Elevation: 82.77
 Bore Retained using: Casing
 Casing Lowered: 15.00 metre
 Method of drilling: Percussion drilling
 Starting Date: 21-02-2017
 Ending Date: 22-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT														Ending Date: 22-02-2017									
FL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristic			Shrinkage/ Swelling			
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N' (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio,	PRECONSOLIDATION PRESSURE (kg/cm ²)	Free Swell Index	Shrinkage Limit	Swell Pressure
1.00		U	1	-	-	-	-	-	Silty sands		SM	0	0	0	58	42	0	12.40	1.725	1.535	Non-Plasticity	2.65	RDST	0	27	-	0.726	-	-	-	-		
1.50		D	2	4	3	4	7	10.18			-	-	-	-	-	-	16.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.50		U	3	-	-	-	-	-			SM	0	0	0	80	20	0	20.10	1.855	1.545	Non-Plasticity	2.64	RDST	0	28	-	0.709	-	-	-	-	-	
3.00		D	4	3	4	6	10	11.98			SM	0	0	0	76	24	0	25.70	-	-	Non-Plasticity	-	-	-	-	-	-	-	-	-	-	-	
4.50		D	5	4	6	10	16	16.46			-	-	-	-	-	-	22.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
5.00		U	6	-	-	-	-	-	Poorly graded sand and silts of non plasticity		SM	0	0	0	88	12	0	19.10	1.867	1.568	Non-Plasticity	2.64	RDST	0	27	-	0.684	-	-	-	-	-	-
6.00		D	7	4	7	13	20	16.87			-	-	-	-	-	-	26.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7.50		D	8	6	10	12	22	16.45			SP-ML	0	0	0	90	10	0	21.80	1.917	1.574 [#]	Non-Plasticity	2.64	RDST	0	30	-	-	-	-	-	-	-	-
9.00		D	10	5	7	12	19	14.08			-	-	-	-	-	-	20.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

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APPENDIX 'B'
TABLE 05: SUMMARY OF TEST RESULTS

Bore No.: 05
 Diameter of Bore hole: 150 mm
 Water Level:- 4.00 Metre
 Ground Elevation: 82.77
 Bore Retained using: Casing
 Casing Lowered: 15.00 metre
 Method of drilling: Percussion drilling
 Starting Date: 21-02-2017
 Ending Date: 22-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT														Shrinkage/ Swelling										
FL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Soil Classification	Grain Size Analysis								Index Property					Shear Strength Parameters			Consolidation Characteristic		Free Swell Index	Shrinkage Limit	Swell Pressure			
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N (Correct N)			Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio,				PRECONSOLIDATION PRESSURE (kg/cm ²)		
10.50	D	11	5	9	14	23	14.76	Poorly graded sand and silts of non plasticity	SP-ML	0	0	0	95	5	0	19.04	1.876	1.576	Non-Plasticity	-	-	2.64	RDST	0	33	-	-	-	-	-	-	-		
12.00	D	13	8	19	44	63	28.55			-	-	-	-	-	-	21.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13.50	D	14	8	14	27	41	19.39	Poorly graded sand and silts of non plasticity	SM	3	1	1	78	17	0	11.80	1.820	1.628	Non-Plasticity	-	-	2.64	RDST	0	30	-	-	-	-	-	-	-	-	
15.00	D	16	10	21	34	55	23.01			-	-	-	-	-	-	18.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
16.50	D	17	9	20	45	65	25.02		SP-ML	0	0	0	93	7	0	21.70	1.989	1.635	Non-Plasticity	-	-	2.64	RDST	0	33	-	-	-	-	-	-	-	-	
18.00	D	19	12	28	49	77	27.43	Poorly graded sand and silts of non plasticity	SP-ML	0	0	0	94	6	0	21.20	-	-	Non-Plasticity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20.00	D	20	11	25	37	62	21.60			-	-	-	-	-	-	20.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Ending Date: 22-02-2017

Sampling Completed: 13:00 mhr

Note:-
 DST: Direct Shear Test
 RDST: Direct Shear test on remoulded sample
 #: Indicate assumed density

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APPENDIX 'B'
TABLE 06: SUMMARY OF TEST RESULTS

Bore No.: 06
Diameter of Bore hole: 150 mm
Water Level:- 5.10 Metre
Ground Elevation: 83.19
Bore Retained using: Casing
Casing Lowered: 18.00 metre
Method of drilling: Percussion drilling
Starting Date: 22-02-2017
Ending Date: 22-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT										Ending Date: 22-02-2017												
RL in Metre	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result				Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristic		Shrinkage/ Swelling				
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)				N (Correct N)	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio,	PRECONSOLIDATION PRESSURE (kg/cm ²)	Free Swell Index	Shrinkage Limit
	1.00	U	1	-	-	-	-	Silty sands		SM	0	0	0	58	42	0	13.70	1.750	1.539	Non-Plasticity	2.65	RDST	0	27	-	0.721	-	-	-	-		
	1.50	D	2	3	4	6	10		14.49			-	-	-	-	-	9.99	-	-	-	-	-	-	-	-	-	-	-	-	-		
	2.50	U	3	-	-	-	-		-	SM	0	0	0	60	40	0	10.30	1.720	1.559	Non-Plasticity	2.65	RDST	0	27	-	0.698	-	-	-	-	-	
	3.00	D	4	4	6	8	14		17.12		SM	0	0	0	76	24	0	9.70	-	-	Non-Plasticity	-	-	-	-	-	-	-	-	-	-	
	4.50	D	5	3	5	7	12		13.05		-	-	-	-	-	-	20.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	5.00	U	6	-	-	-	-	-		SM	0	0	0	86	14	0	16.20	1.844	1.587	Non-Plasticity	2.64	RDST	0	29	-	0.664	-	-	-	-	-	
	6.00	D	7	3	5	5	10	9.68		-	-	-	-	-	-	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	7.50	D	8	5	5	8	13	11.61	Poorly graded sand and silts of non plasticity	SP-ML	0	0	0	93	7	0	25.40	1.913	1.526 [#]	Non-Plasticity	2.64	RDST	0	31	-	-	-	-	-	-	-	-
	9.00	D	10	8	13	21	34	20.39			-	-	-	-	-	-	19.00	-	-	Non-Plasticity	2.64	RDST	0	-	-	-	-	-	-	-	-	-

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APPENDIX 'B'
TABLE 06: SUMMARY OF TEST RESULTS

Bore No.: 06
 Diameter of Bore hole: 150 mm
 Water Level:- 5.10 Metre
 Ground Elevation: 83.19
 Bore Retained using: Casing
 Casing Lowered: 18.00 metre
 Method of drilling: Percussion drilling
 Starting Date: 22-02-2017
 Ending Date: 22-02-2017

FIELD TEST RESULT										LABORATORY TEST RESULT										Ending Date: 22-02-2017											
Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Description of soil	Mapping	Soil Classification	Grain Size Analysis						Index Property						Shear Strength Parameters			Consolidation Characteristic			Shrinkage/ Swelling		
			N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT N (N2+N3)	N' (Correct N)				Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity Gs	Type of Test	Cohesion C (kN/m ²)	Angle of Friction (Degree) ϕ	C _c	Void Ratio	PRECONSOLIDATION PRESSURE (kg/cm ²)	Free Swell Index	Shrinkage Limit
0.50	D	11	5	13	18	34	19.13	Poorly graded sand and silts of non plasticity																							
1.00	U	12	-	-	-	-	-	Silty sands		SM	0	0	0	83	17	0	17.40	1.89	1.610	Non-Plasticity		0	29		0.640						
12.00	D	13	12	21	46	67	29.84									20.40															
13.50	D	14	12	27	36	63	26.85	Poorly graded sands		SP	0	0	0	96	4	0	18.90	1.961	1.650	Non-Plasticity		0	34								
15.00	D	16	8	17	28	45	19.60									21.10															
16.50	D	17	11	23	36	59	22.99			SP-ML	0	0	0	95	5	0	20.50	2.001	1.661	Non-Plasticity		0	33								
18.00	D	19	9	14	21	35	14.81	Poorly graded sand and silts of non plasticity		SP-ML	0	0	0	94	6	0	23.70			Non-Plasticity											
20.00	D	20	8	13	17	30	12.53			SP-ML	0	0	0	94	6	0	23.30			Non-Plasticity											

Note:-
 DST: Direct Shear Test, RDST: Direct Shear test on remoulded sample, #: Indicate assumed density

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APPENDIX-B
TABLE-7 : CHEMICAL TEST RESULTS ON WATER SAMPLE

Bore No.	Depth of Sample (m)	p ^H	Salt (mg/litre)	
			Sulphates	Chlorides
BH-1	4.90	7.40	220	260
BH-2	5.10	7.50	230	270
BH-3	4.80	7.40	220	260
BH-4	4.80	7.50	230	270
BH-5	4.00	7.54	220	270
BH-6	5.10	7.50	235	260

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APPENDIX 'B'
TABLE 08: PLATE LOAD TEST (PLT-1)

FIELD INVESTIGATION METHOD:

A test plate 75 cm x 75 cm square was used as a model for the prototype foundation. The plate was placed at 1.50 metre below natural ground level and subjected to incremental loading. Settlement at each increment of load was measured and load-settlement curves plotted. The bearing capacity and the settlement of the foundation were determined with the help of the load-settlement curves for the test plate. The test was conducted as per IS: 1888-1982

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
3.00	1.00	1.00
6.00	0.63	1.63
9.00	2.90	4.53
12.00	2.57	7.10
15.00	6.49	13.59
17.00	12.21	25.80

Calculations:

From Load Settlement curve:


Ultimate Load: 17.00 T

Ultimate Bearing Capacity: $17.00 / (0.75 \times 0.75) = 30.22 \text{ T/m}^2$

Factor of Safety = 2.5

Safe bearing capacity: $30.22 / 2.5 = 12.08 \text{ T/m}^2$

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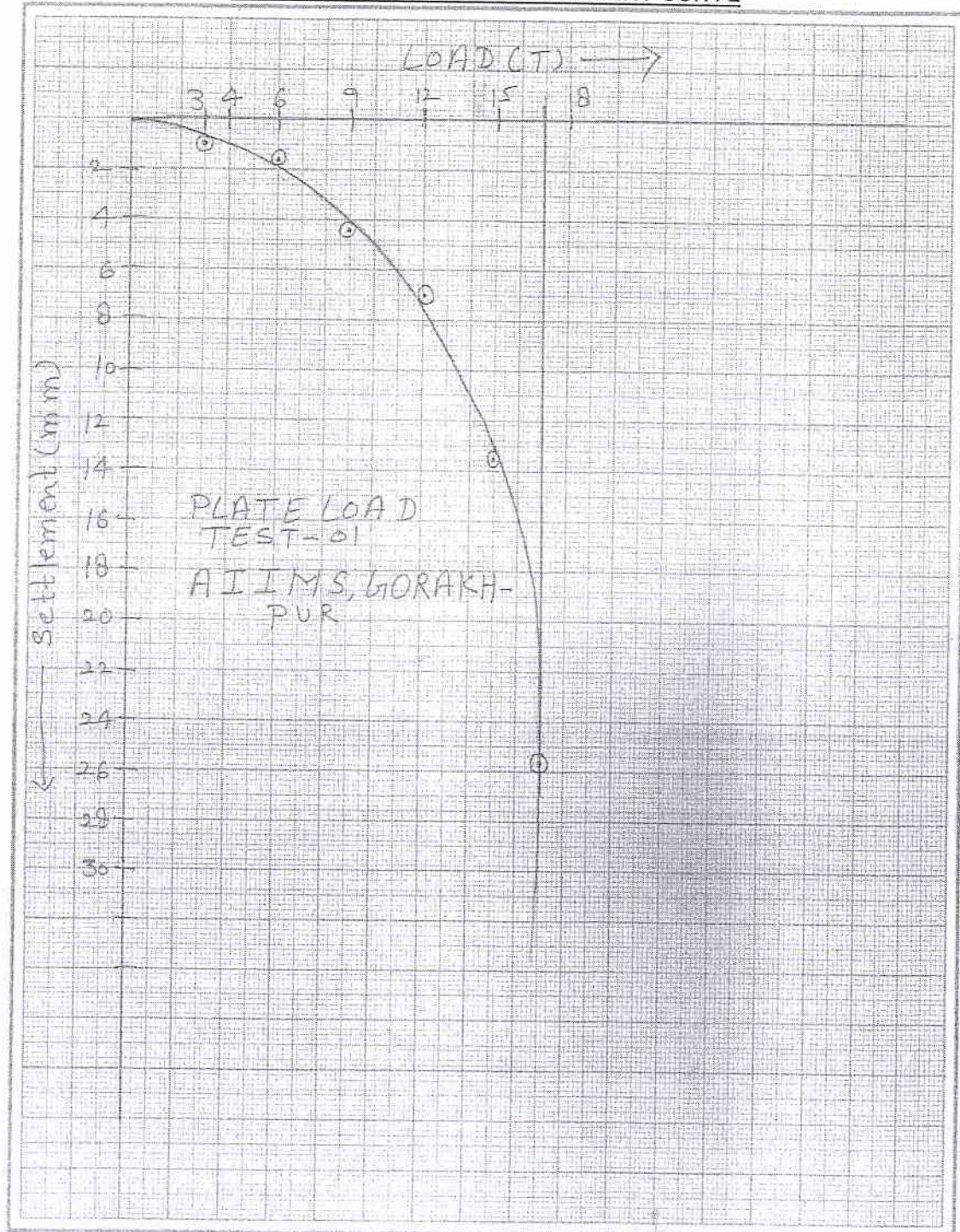
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LOAD VS CUMULATIVE SETTLEMENT CURVE





Jain Brothers

Branch office: 131, Patparganj Industrial Area, Delhi- 110 092 Phone: 011- 43519098

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APPENDIX-B
TABLE 9: ELECTRICAL RESISTIVITY TEST

The term "earth resistivity" expressed in ohm-meters (abbreviated ohm-m) is one basic variable affecting resistance to earth of an electrode system. But the actual value of earth resistivity need not be measured to check the electrode earth resistance. Consider other fields where the value of resistivity is measured; also some of the factors affecting it that are of interest in earth testing.

Earth resistivity measurements can be used conveniently for geophysical prospecting to locate ore bodies, clays, and water-bearing gravel beneath the earth's surface. The measurement can also be used to determine depth to bed rock and thickness of glacial drift. Measurements of earth resistivity are useful also for finding the best location and depth for low resistance electrodes.


Such studies are made, for example, when a new electrical unit is being constructed; a generating station, substation, transmission tower, or telephone central office. Finally, earth resistivity may be used to indicate the degree of corrosion to be expected in underground pipelines for water, oil, gas, gasoline, etc. In general, spots where the resistivity values are low tend to increase corrosion. This same kind of information is a good guide for installing cathodic protection

Type	Resistivity range (Ω -cm)
Clay and saturated silt	0-10
Sandy clay and wet silty sand	10-25
Clayey sand and saturated sand	25-50
Sand	50-150

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Type	Resistivity range (Ω -cm)
Gravel	150-500
Weathered rock	100-200
Sound rock	150-4000

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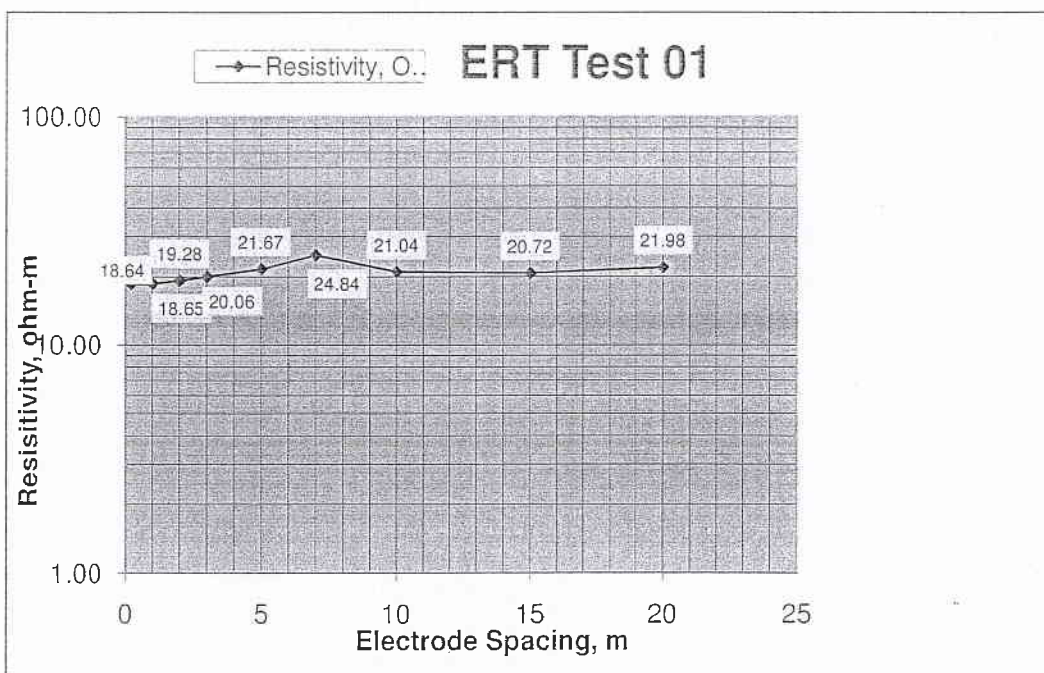
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APPENDIX-B
PLOT-1-ERT RESISTIVITY TEST (ERT-1)

Electrode Spacing, M	Resistance, Ohm. (North/South)	Resistance, Ohm. (East/West)	Resistance, Ohm. (Average)	Resistivity, Ohm-M
0.50	6.74	5.13	5.94	18.64
1.00	3.43	2.51	2.97	18.65
2.00	1.16	1.91	1.54	19.28
3.00	1.05	1.08	1.07	20.06
5.00	0.73	0.65	0.69	21.67
7.00	0.56	0.57	0.57	24.84
10.00	0.33	0.34	0.34	21.04
15.00	0.17	0.27	0.22	20.72
20.00	0.14	0.21	0.18	21.98



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APPENDIX 'B'
TABLE-10: DYNAMIC CONE PENETRATION TEST (DCPT-01)

Diameter of Cone: 65 mm	Weight of Hammer: 65 Kg	
	Testing No.	01

DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
26-02-2017	0.00	0.30	3	4	3	10
	0.30	0.60	3	2	1	6
	0.60	0.90	1	1	2	4
	0.90	1.20	1	2	2	5
	1.20	1.50	2	2	2	6
	1.50	1.80	1	2	2	5
	1.80	2.10	3	2	2	7
	2.10	2.40	3	3	3	9
	2.40	2.70	3	4	4	11
	2.70	3.00	4	4	4	12
	3.00	3.30	4	4	4	12
	3.30	3.60	4	4	4	12
	3.60	3.90	4	4	4	12
	3.90	4.20	5	6	6	17
	4.20	4.50	6	5	6	17
	4.50	4.80	5	5	7	17



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DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
26-02-2017	4.80	5.10	5	6	6	17
	5.10	5.40	6	6	6	18
	5.40	5.70	5	5	6	16
	5.70	6.00	6	6	7	19
	6.00	6.30	6	7	7	20
	6.30	6.60	6	7	8	21
	6.60	6.90	7	8	8	23
	6.90	7.20	7	9	10	26
	7.20	7.50	7	10	11	28
	7.50	7.80	9	12	14	35
	7.80	8.10	9	11	16	36
	8.10	8.40	11	15	19	45
	8.40	8.70	12	18	23	53
	8.70	9.00	13	17	25	55
	9.00	9.30	15	22	25	62
	9.30	9.60	17	24	31	72
	9.60	9.90	18	26	31	75

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APPENDIX 'B'

TABLE-11: DYNAMIC CONE PENETRATION TEST (DCPT-02)

Diameter of Cone: 65 mm	Weight of Hammer: 65 Kg	
	Testing No.	02

DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
26-02-2017	0.00	0.30	1	2	3	6
	0.30	0.60	4	4	3	11
	0.60	0.90	3	3	3	9
	0.90	1.20	3	2	3	8
	1.20	1.50	2	2	2	6
	1.50	1.80	1	2	3	6
	1.80	2.10	2	3	4	9
	2.10	2.40	3	3	4	10
	2.40	2.70	4	3	4	11
	2.70	3.00	3	4	5	12
	3.00	3.30	5	4	4	13
	3.30	3.60	5	5	5	15
	3.60	3.90	4	5	5	14
	3.90	4.20	6	7	7	20
	4.20	4.50	7	7	7	21
	4.50	4.80	4	5	5	14



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DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
	4.80	5.10	4	6	6	16
	5.10	5.40	5	5	6	16
	5.40	5.70	5	6	7	18
26-02-2017	5.70	6.00	6	7	7	20
	6.00	6.30	6	7	8	21
	6.30	6.60	6	8	9	23
	6.60	6.90	7	8	9	24
	6.90	7.20	7	9	11	27
	7.20	7.50	7	10	12	29
	7.50	7.80	8	11	14	33
	7.80	8.10	10	13	16	39
	8.10	8.40	10	14	18	42
	8.40	8.70	9	15	19	43
	8.70	9.00	11	17	22	50
	9.00	9.30	13	21	29	63
	9.30	9.60	16	27	33	76

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APPENDIX 'B'

TABLE-12: DYNAMIC CONE PENETRATION TEST (DCPT-03)

Diameter of Cone: 65 mm	Weight of Hammer: 65 Kg
Testing No.	03

DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
25-02-2017	0.00	0.30	8	5	4	17
	0.30	0.60	3	3	3	9
	0.60	0.90	2	2	3	7
	0.90	1.20	3	3	3	9
	1.20	1.50	3	4	3	10
	1.50	1.80	2	3	3	8
	1.80	2.10	3	3	3	9
	2.10	2.40	3	3	3	9
	2.40	2.70	4	3	3	10
	2.70	3.00	3	5	5	13
	3.00	3.30	5	4	4	13
	3.30	3.60	4	4	4	12
	3.60	3.90	4	4	4	12
	3.90	4.20	4	3	4	11
	4.20	4.50	4	5	5	14
	4.50	4.80	4	5		

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DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
25-02-2017	4.80	5.10	5	4	5	14
	5.10	5.40	4	5	4	13
	5.40	5.70	6	6	5	17
	5.70	6.00	6	6	6	18
	6.00	6.30	6	6	7	19
	6.30	6.60	7	7	7	21
	6.60	6.90	7	8	10	25
	6.90	7.20	8	10	10	28
	7.20	7.50	10	11	12	33
	7.50	7.80	11	13	15	39
	7.80	8.10	12	16	17	45
	8.10	8.40	14	18	18	50
	8.40	8.70	14	18	17	49
	8.70	9.00	16	21	25	62
	9.00	9.30	19	26	30	75

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APPENDIX 'B'

TABLE-13: DYNAMIC CONE PENETRATION TEST (DCPT-04)

Diameter of Cone: 65 mm	Weight of Hammer: 65 Kg
Testing No.	04

DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
25-02-2017	0.00	0.30	11	13	13	37
	0.30	0.60	11	8	7	26
	0.60	0.90	6	4	4	14
	0.90	1.20	3	3	3	9
	1.20	1.50	2	2	2	6
	1.50	1.80	2	1	2	5
	1.80	2.10	2	2	2	6
	2.10	2.40	2	3	3	8
	2.40	2.70	3	2	3	8
	2.70	3.00	3	3	3	9
	3.00	3.30	2	3	3	8
	3.30	3.60	3	2	3	8
	3.60	3.90	4	5	4	13
	3.90	4.20	4	5	5	14
	4.20	4.50	5	5	5	15
	4.50	4.80	6	5		

For Techpro Engineers Pvt. Ltd.

Manager Technical



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DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
25-02-2017	4.80	5.10	6	7	6	19
	5.10	5.40	6	7	6	19
	5.40	5.70	5	5	6	16
	5.70	6.00	5	5	6	16
	6.00	6.30	6	8	8	22
	6.30	6.60	8	10	9	27
	6.60	6.90	10	10	10	30
	6.90	7.20	12	9	11	32
	7.20	7.50	11	12	12	35
	7.50	7.80	12	13	16	41
	7.80	8.10	17	17	16	50
	8.10	8.40	17	19	17	53
	8.40	8.70	17	18	18	53
	8.70	9.00	13	13	13	39
	9.00	9.30	14	14	13	41
	9.30	9.60	16	22	23	61
	9.60	9.90	23	25	28	76

For Techpro Engineers Pvt. Ltd.

Manager Technical



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Gorakhpur, Uttar Pradesh.

APPENDIX 'B'

TABLE-14: DYNAMIC CONE PENETRATION TEST (DCPT-05)

Diameter of Cone: 65 mm	Weight of Hammer: 65 Kg	
	Testing No.	05

DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
27-02-2017	0.00	0.30	6	4	2	12
	0.30	0.60	2	2	2	6
	0.60	0.90	2	3	3	8
	0.90	1.20	4	4	5	13
	1.20	1.50	4	3	4	11
	1.50	1.80	4	4	3	11
	1.80	2.10	4	3	4	11
	2.10	2.40	3	3	4	10
	2.40	2.70	5	4	4	13
	2.70	3.00	4	7	4	15
	3.00	3.30	4	4	5	13
	3.30	3.60	4	5	4	13
	3.60	3.90	4	3	3	10
	3.90	4.20	4	5	5	14
	4.20	4.50	4	5	5	14
	4.50	4.80	4	4	4	12



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DATE	Depth (meter)		Nos. of blows for each 100 mm penetration			Total Nos. of blows (N1+N2+N3)
	FROM	TO	N1	N2	N3	
27-02-2017	4.80	5.10	3	4	5	12
	5.10	5.40	5	6	6	17
	5.40	5.70	6	6	7	19
	5.70	6.00	9	9	6	24
	6.00	6.30	7	6	7	20
	6.30	6.60	7	7	6	20
	6.60	6.90	7	8	7	22
	6.90	7.20	7	8	6	21
	7.20	7.50	8	8	9	25
	7.50	7.80	8	9	9	26
	7.80	8.10	8	7	8	23
	8.10	8.40	8	8	8	24
	8.40	8.70	7	8	8	23
	8.70	9.00	7	7	8	22
	9.00	9.30	8	9	10	27
	9.30	9.60	10	12	13	35
	9.60	9.90	15	15	15	45
	9.90	10.20	16	15	16	47

For Techpro Engineers Pvt. Ltd.

Manager Technical



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APPENDIX 'B'
TABLE-15: STATIC CONE PENETRATION TEST (SCPT-01)

Result Awaited

For Techpro Engineers Pvt. Ltd.

 Manager Technical



	TECHPRO ENGINEERS PVT.LTD. (AN ISO 9001: 2008 Certified Company)	Report No. 1666	
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APPENDIX 'B'
TABLE-16: STATIC CONE PENETRATION TEST (SCPT-02)

Result Awaited


For Techpro Engineers Pvt. Ltd.




 Manager Technical

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APPENDIX 'B'
TABLE-17: STATIC CONE PENETRATION TEST (SCPT-03)

Result Awaited

For Techpro Engineers Pvt. Ltd.

 Manager Technical



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APPENDIX 'B'
TABLE-18: STATIC CONE PENETRATION TEST (SCPT-04)

Result Awaited

For Techpro Engineers Pvt. Ltd.



 Manager Technical



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APPENDIX 'B'
TABLE-19: STATIC CONE PENETRATION TEST (SCPT-05)

Result Awaited


For Techpro Engineers Pvt. Ltd.


 Manager Technical

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APPENDIX 'B'
TABLE-20: POTABILITY TEST RESULT ON BORE WELL WATER SAMPLE

Result Awaited

For Techpro Engineers Pvt. Ltd.

 Manager Technical



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APPENDIX-C
CHART-1: BORE LOG CHART (BH-01)

Techpro Engineers Pvt. Ltd.										Bore/ Drill Log				Description
Project: Geotechnical Investigation work for Proposed AIIMS, Kuraghat (Gorakhpur)										Bore Hole No.: 01				
Location: Kuraghat (Gorakhpur)										Ground Elevation: 6.50				
Method of Boring/ Drilling: Auger & shell										Water Level (Static): 4.90M.				
Boring/ Drilling Equipments: Power winch										Dia. Of Boring/ Drilling: 150MM.				
Casing Lowered: 18 Mtr										Date: From 23/11 to 23/11				
Date (dd/mm)	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min) & Hrs	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
23/11	0.00	0.50	0.50	0.50	D	Bored Manually				0.15	—	—	—	Brownish silty sand
	0.50	1.00	0.50	—	—	Boring & cleaning				0.08	—	—	—	- do -
	1.00	1.30	0.30	U	—	Collected				0.07	—	—	—	- do -
	1.30	1.50	0.20	—	—	Boring & cleaning				—	—	—	—	- do -
	1.50	1.95	0.45	P/D	3	5	7	12	—	—	—	—	—	yellow silty sand
	1.95	2.50	0.55	—	—	Boring & cleaning				—	—	—	—	- do -
	2.50	2.80	0.30	U	—	Collected				—	—	—	—	- do -
	2.80	3.00	0.20	—	—	Boring & cleaning				—	—	—	—	- do -
	3.00	3.45	0.45	P/D	4	4	5	9	—	—	—	—	—	- do -
	3.45	4.50	1.05	—	—	Boring & cleaning				—	—	—	—	- do -
	4.50	4.95	0.45	P/D	3	5	6	11	—	—	—	—	—	- do -
	4.95	5.00	0.05	—	—	Bore cleaning				—	—	—	—	- do -
	5.00	5.80	0.80	U	—	Slipped				—	—	—	—	- do -
	5.00	6.00	1.00	—	—	Boring & cleaning				—	—	—	—	- do -
	6.00	6.45	0.45	P/D	4	6	7	13	—	—	—	—	—	Fine sand
	6.45	7.50	1.05	—	—	Boring & cleaning				—	—	—	—	- do -
	7.50	7.95	0.45	P/D	4	7	9	16	—	—	—	—	—	- do -
	7.95	8.00	0.05	—	—	Bore cleaning				—	—	—	—	- do -
	8.00	8.00	0.00	U	—	Slipped				—	—	—	—	- do -
	8.00	9.00	1.00	—	—	Boring & cleaning				—	—	—	—	- do -
	9.00	9.45	0.45	P/D	3	6	11	17	—	—	—	—	—	Fine sand
	9.45	10.50	1.05	—	—	Boring & cleaning				—	—	—	—	- do -

Abbreviation Used: U - Undisturbed Sample C - Core Sample D - Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) > 100)

Manager Technical



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APPENDIX-C
CHART-2: BORE LOG CHART (BH-01)

Project: Geotechnical Investigation work for proposed AIIMS,

Location: Kuraghat (Gorakhpur),

Method of Boring/ Drilling: Auger & Shell

Boring/ Drilling Equipments: Power auger

Casing Lowered: 18 Mtr.

Bore/ Drill Log

Bore Hole No.: 01

Ground Elevation: _____

Water Level (Static): 41.90 m

Dia. Of Boring/ Drilling: 150 mm

Date: From 23/11/17 to 23/11/17

Date (dd/mm)	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description	
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value						
	10.50	10.95	0.45	P/D		2	7	10	17						Fine sand
	10.95	11.00	0.05		- Bore cleaning										- do -
	11.00	11.00	0.00	U	- Skipped										- do -
	11.00	12.00	1.00		- Boring & cleaning										- do -
	12.00	12.45	0.45	P/D		6	7	7	14						Fine sand with gravel
	12.45	13.50	1.05		- Boring & cleaning										- do -
	13.50	13.95	0.45	P/D		4	9	13	22						- do -
	13.95	14.00	0.05		- Bore cleaning										- do -
	14.00	14.00	0.00	U	- Skipped										- do -
	14.00	15.00	1.00		- Boring & cleaning										- do -
	15.00	15.45	0.45	P/D		5	8	15	23						- do -
	15.45	16.50	1.05		- Boring & cleaning										- do -
	16.50	16.95	0.45	P/D		7	12	23	35						- do -
	16.95	17.00	0.05		- Bore cleaning										- do -
	17.00	17.00	0.00	U	- Skipped										- do -
	17.00	18.00	1.00		- Boring & cleaning										Clayey silt with gravel
	18.00	18.45	0.45	P/D		6	9	16	25						- do -
	18.45	20.00	1.55		- Boring & cleaning										- do -
	20.00	20.45	0.45	P/D		7	11	19	30						- do -

For Techpro Engineers Pvt. Ltd.

Rajendra Kumar

On Site Supervisor

Abbreviation Used: U - Undisturbed Sample C-Core Sample D-Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) >100)

For Techpro Engineers Pvt. Ltd.



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APPENDIX-C
CHART-3: BORE LOG CHART (BH-02)

Techpro Engineers Pvt. Ltd.													
Project: Geotechnical (SPT) work for AIIMS													
Location: Kuraghat Gorakhpur (UP)													
Method of Boring/ Drilling: Auger & Shell													
Boring/ Drilling Equipments: Power operated													
Casing Lowered: 16.50 mtr													
Bore/ Drill Log													
Bore Hole No.: 02													
Ground Elevation: 0.80													
Water Level (Static): 5.10 mtr													
Dia. Of Boring/ Drilling: 150 mm													
Date: From 24/2/17 to 24/2/17													
Date (dd/mm)	Elevation (m)	Depth/ RUN (m)	Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To		0-15 cm	15-30 cm	30-45 cm	N Value					
24/2	0.80	0.50	0.50	U	Manually								Brownish silty sand
"	0.50	1.00	0.50	-	Bore & cleaning								-do-
"	1.00	1.30	0.30	U	Collected								-do-
"	1.30	1.50	0.20	-	Bore & cleaning								-do-
"	1.50	1.55	0.05	P	2	3	5	10					Yellow silty sand
"	1.55	2.50	0.95	-	Bore & cleaning								-do-
"	2.50	2.80	0.30	U	Collected								-do-
"	2.80	3.00	0.20	-	Bore & cleaning								-do-
"	3.00	3.45	0.45	P	4	7	7	14					-do-
"	3.45	4.50	1.05	-	Bore & cleaning								-do-
"	4.50	4.95	0.45	P	3	6	7	13					fine sand
"	4.95	5.00	0.05	-	Bore & cleaning								-do-
"	5.00	5.00	0.00	U	Slipped								-do-
"	5.00	6.00	1.00	-	Bore & cleaning								-do-
"	6.00	6.45	0.45	P	4	7	9	13					-do-
"	6.45	7.50	1.05	-	Bore & cleaning								-do-
"	7.50	7.95	0.45	P	3	3	7	10					-do-
"	7.95	8.00	0.05	-	Bore & cleaning								-do-
"	8.00	8.00	0.00	U	Slipped								-do-
"	8.00	9.00	1.00	-	Bore & cleaning								-do-
"	9.00	9.45	0.45	P	3	6	9	15					fine sand
24/2	9.45	10.50	1.05	-	Bore & cleaning								-do-

Abbreviation Used: U - Undisturbed Sample C - Core Sample D - Disturbed Sample P - Standard Penetration Test
S - SPT (Standard Penetration Test) (20, 30, 40)

For Techpro Engineers Pvt. Ltd.



TECHPRO ENGINEERS PVT. LTD.
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APPENDIX-C
CHART-4: BORE LOG CHART (BH-02)

Techpro Engineers Pvt. Ltd.
Project: Geotechnical (Soil) work for AIIMS
Location: Kuraghat, Gorakhpur (UP)
Method of Boring/ Drilling: Auger shell
Boring/ Drilling Equipment: Power Operated
Casing lowered: 16.50 mtr

Bore/ Drill Log
Bore Hole No.: 02
Ground Elevation: 0.00
Water Level (Static): 5.10 mtr
Dia. Of Boring/ Drilling: 1.50 mtr
Date: From 24/2/17 to 24/3/17

Bore (BH) name	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
24/2/17		10.50	10.95	0.45	P/S	6	8	9	23		-	-	-	Fine sand
11		10.95	11.00	0.05	-	Bore	x	cleaning			-	-	-	- do -
10		11.00	11.00	0.00	U	slipped					-	-	-	- do -
10		11.00	12.00	1.00	-	Bore	x	cleaning			-	-	-	- do -
11		12.00	12.45	0.45	P/S	2	8	11	19		-	-	-	- do -
10		12.45	13.50	1.05	-	Bore	x	cleaning			-	-	-	Fine sand with gravel
11		13.50	13.95	0.45	P/S	4	7	10	14		-	-	-	- do -
10		13.95	14.00	0.05	-	Bore	x	cleaning			-	-	-	- do -
12		14.00	14.00	0.00	U	slipped					-	-	-	- do -
11		14.00	15.00	1.00	-	Bore	x	cleaning			-	-	-	- do -
11		15.00	15.45	0.45	P/S	6	9	15	24		-	-	-	- do -
11		15.45	16.50	1.05	-	Bore	x	cleaning			-	-	-	- do -
12		16.50	16.95	0.45	P/S	8	12	21	33		-	-	-	- do -
12		16.95	17.00	0.05	-	Bore	x	cleaning			-	-	-	- do -
12		17.00	17.00	0.00	U	slipped					-	-	-	- do -
11		17.00	18.00	1.00	-	Bore	x	cleaning			-	-	-	clayey silt with gravel
11		18.00	18.45	0.45	P/S	7	11	16	24		-	-	-	- do -
11		18.45	20.00	1.55	-	Bore	x	cleaning			-	-	-	- do -
24/3/17		20.00	20.45	0.45	P/S	9	17	21	36		-	-	-	- do -

For Techpro Engineers Pvt. Ltd.
Rajiv Kumar
Site Supervisor

Abbreviation used: H: Undisturbed Sample, C: Core Sample, D: Disturbed Sample, P: Standard Penetration Test
R: Refusal (Standard Penetration Test (N) >100)

For Techpro Engineers Pvt. Ltd.

Geotechnical Investigation for Construction of Setting up of new AIIMS at Kuraghat, Gorakhpur, Uttar Pradesh.

APPENDIX-C
CHART-5: BORE LOG CHART (BH-03)

Techpro Engineers Pvt. Ltd.										Bore/Drill Log Sheet (1)				
Project: Geotechnical (Soil) work for AIIMS										Bore Hole No.: 03				
Location: Wazirpur Bypass (UP)										Ground Elevation: - 0.50				
Method of Boring/Drilling: Auger & Shell										Water Level (Static): 4.80 mtr				
Boring/Drilling Equipments: Power Drilled										Dia. Of Boring/Drilling: 150 mm				
Casing Lowered: 1.8 mtr										Date: From 23/2/17 to 23/2/17				
Date (dd/mm)	Elevation (m)	Depth RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
23/2	0.00	0.50	0.50	0.50	D	Small	Manually				-	-	-	clayey silt with gravel
"	0.50	1.00	0.50	0.50	-	Boring &	cleaning				-	-	-	-do-
"	1.00	1.30	0.30	0.30	U	Collected					-	-	-	-do-
"	1.30	1.50	0.20	0.20	-	Boring &	cleaning				-	-	-	-do-
"	1.50	1.95	0.45	0.45	P/O	3	4	6	10		-	-	-	-do-
"	1.95	2.50	0.55	0.55	-	Boring &	cleaning				-	-	-	yellow silty sand
"	2.50	2.80	0.30	0.30	U	Collected					-	-	-	-do-
"	2.80	3.00	0.20	0.20	-	Boring &	cleaning				-	-	-	-do-
"	3.00	3.45	0.45	0.45	P/O	4	6	6	12		-	-	-	-do-
"	3.45	4.50	1.05	1.05	-	Boring &	cleaning				-	-	-	-do-
"	4.50	4.95	0.45	0.45	P/O	5	6	4	13		-	-	-	-do-
"	4.95	5.00	0.05	0.05	-	Boring &	cleaning				-	-	-	-do-
"	5.00	5.30	0.30	0.30	U	Collected					-	-	-	-do-
"	5.30	6.00	0.70	0.70	-	Boring &	cleaning				-	-	-	-do-
"	6.00	6.45	0.45	0.45	P/O	5	4	3	16		-	-	-	yellow fine sand
"	6.45	7.50	1.05	1.05	-	Boring &	cleaning				-	-	-	-do-
"	7.50	7.95	0.45	0.45	P/O	6	4	4	14		-	-	-	fine sand
"	7.95	8.00	0.05	0.05	-	Boring &	cleaning				-	-	-	-do-
"	8.00	8.00	0.00	0.00	U	Slipped					-	-	-	-do-
"	8.00	9.00	1.00	1.00	-	Boring &	cleaning				-	-	-	-do-
"	9.00	9.45	0.45	0.45	P/O	10	11	13	24		-	-	-	-do-
23/2	9.45	10.50	1.05	1.05	-	Boring &	cleaning				-	-	-	-do-



TECHPRO ENGINEERS PVT. LTD.
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Geotechnical Investigation for Construction of Setting up of new AIIMS at Kuraghat, Gorakhpur, Uttar Pradesh.

APPENDIX-C
CHART-6: BORE LOG CHART (BH-03)

Engineers Pvt. Ltd.
Geotechnical (Soil) WORK FOR AIIMS

Location: Kuraghat, Gorakhpur (U.P.)

Method of Boring/ Drilling: Auger & Shell

Boring/ Drilling Equipments: Power operated

Casing Lowered: 18 ft

Bore/ Drill Log Sheet (2)

Bore Hole No.: 03

Ground Elevation: - 0.50

Water Level (Static): 4.80 mtr.

Dis. Of Boring/ Drilling: 150 M. R.

Date: From 28/4/17 to 23/4/17

Date (dd/mm/yy)	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
28/4/17	10.50	10.95	0.45	1/0		9	11	18	29		-	-	-	Fine sand
"	10.95	11.00	0.05	-	Boring & cleaning						-	-	-	- do -
"	11.00	11.00	0.00	U	Slipped						-	-	-	- do -
"	11.00	12.00	1.00	-	Boring & cleaning						-	-	-	- do -
"	12.00	12.45	0.45	1/0		6	7	10	17		-	-	-	- do -
"	12.45	13.50	1.05	-	Boring & cleaning						-	-	-	- do -
"	13.50	13.95	0.45	1/0		7	16	19	35		-	-	-	Fine sand with gravels
"	13.95	14.00	0.05	-	Boring & cleaning						-	-	-	- do -
"	14.00	14.00	0.00	U	Slipped						-	-	-	- do -
"	14.00	15.00	1.00	-	Boring & cleaning						-	-	-	- do -
"	15.00	15.45	0.45	1/0		11	19	30	49		-	-	-	- do -
"	15.45	16.50	1.05	-	Boring & cleaning						-	-	-	- do -
"	16.50	16.95	0.45	1/0		10	22	34	59		-	-	-	- do -
"	16.95	17.00	0.05	-	Boring & cleaning						-	-	-	- do -
"	17.00	18.00	1.00	U	Slipped						-	-	-	- do -
"	18.00	18.00	0.00	-	Boring & cleaning						-	-	-	- do -
"	18.00	19.45	1.45	1/0		6	9	15	24		-	-	-	Clayey silt with gravels
"	19.45	20.00	0.55	-	Boring & cleaning						-	-	-	- do -
23/4/17	20.00	20.45	0.45	1/0		9	12	27	29		-	-	-	- do -

For Techpro Engineers Pvt. Ltd.

Kuraghat

Sr. Site Supervisor

Abbreviation Used: U - Undisturbed Sample C-Core Sample D-Disturbed Sample P - Standard Penetration Test
R. Refusal (Standard Penetration Test (N) > 100)

For Techpro Engineers Pvt. Ltd.



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APPENDIX-C
CHART-7: BORE LOG CHART (BH-04)

Techpro Engineers Pvt. Ltd. work for New AIIMS Gorakhpur Bore/ Drill Log sheet (1)
Project: Geotechnical (soil) work for New AIIMS
Bore Hole No.: 04
Location: Gorakhpur CUP
Ground Elevation:
Method of Boring/ Drilling: Auger & settlement
Water Level (Static): 4.80 mtr
Boring/ Drilling Equipments: Power operated
Dia. Of Boring / Drilling: 150 mm
Casing Lowered: 15 mtr
Date From 20/9/17 to 24/9/17

Date (dd/mm)	Elevation (m)	Depth/RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. B. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
17/9	0.00	0.50	0.50	0.50	U	-	-	-	-	10.35				Brown silty sand.
	0.50	1.50	1.00			-	-	-	-					Bore clogging.
11	1.50	1.95	0.45	0.45	U	3	4	3	7	10.50				Yellow silty sand.
	1.95	2.50	0.55			-	-	-	-					Bore clogging.
11	2.50	2.95	0.45	0.45	U					10.59	-	-	-	Collected.
	2.95	3.00	0.05			-	-	-	-					Bore clogging.
11	3.00	3.45	0.45	0.45	U	4	7	7	14	11.15				do.
11	3.45	4.50	1.05			-	-	-	-					Bore clogging.
	4.50	4.95	0.45	0.45	U	4	9	12	21	11.04				greyish fine sand
11	4.95	5.50	0.55			-	-	-	-					Bore clogging.
	5.50	5.95	0.45	0.45	U					11.52	-	-	-	Collected.
11	5.95	6.00	0.05			-	-	-	-					Bore clogging.
11	6.00	6.45	0.45	0.45	U	5	10	13	23	12.08				do.
11	6.45	7.50	1.05			-	-	-	-					Bore clogging.
	7.50	7.95	0.45	0.45	U	6	8	21	29	12.23				do.
11	7.95	8.50	0.55			-	-	-	-					Bore clogging.
11	8.50	8.95	0.45	0.45	U					12.40	-	-	-	Silted
	8.95	9.00	0.05			-	-	-	-					Bore clogging.
11	9.00	9.45	0.45	0.45	U	3	5	7	12	12.13				do.
11	9.45	10.50	1.05			-	-	-	-					Bore clogging.
11	10.50	10.95	0.45	0.45	U	5	8	10	18	9.40				do.
17/9	10.95	11.50	0.55			-	-	-	-					Bore clogging.

Abbreviation Used: U - Undisturbed Sample C - Core Sample D - Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) > 100)

For Techpro Engineers Pvt. Ltd.



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Gorakhpur, Uttar Pradesh.

APPENDIX-C CHART-8: BORE LOG CHART (BH-04)

Project: Geotechnical (Soil) work for AIIMS Gorakhpur

Location: Gorakhpur (U.P.)

Method of Boring/Drilling: Auger & shaft Percussion

Boring/Drilling Equipments: Power operated

Casing Lowered: 1.5 m/y

Bore/Drill Log sheet (2)

Bore Hole No.: 04

Ground Elevation:

Water Level (Static): 4.80 mtr

Dia. Of Boring/Drilling: 150 mm

Date: From 20/2/17 to 20/2/17

Date (dd/mm)	Elevation (m)	Depth/RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
20/2	11.50	11.95	4.5	URS						3.0	-	-	-	Collected
11	11.95	12.00	0.05											Bore clogging
11	12.00	12.45	4.45	SPT		4	6	8	14	3.17				Fine sand
11	12.45	13.50	1.05											Bore clogging
11	13.50	13.95	4.5	SPT		14	22	30	52	3.52				- do -
11	13.95	14.50	5.5											Bore clogging
11	14.50	14.55	4.5	URS						4.25				Slipped
11	14.55	15.00	0.45											Bore clogging
20/2	15.00	15.45	4.5	SPT		7	12	10	25	5.33				fine sand

For Techpro Engineers Pvt. Ltd.

S. Site Supervisor

20/2/17

Client

Abbreviation Used: U - Undisturbed Sample C - Core Sample D - Disturbed Sample P - Standard Penetration Test
R - Refusal (Standard Penetration Test (N) > 100)

For Techpro Engineers Pvt. Ltd.



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APPENDIX-C
CHART-9: BORE LOG CHART (BH-05)

Techpro Engineers Pvt. Ltd.														Bore Drill Log Sheet (1)	
Project: GEOTECHNICAL (Soil) WORK FOR NEW AIIMS GORAKHPUR														Bore Hole No.: 05	
Location: GORAKHPUR (U.P.)														Ground Elevation: - 100 Mtr	
Method of Boring/Drilling: Auger + Percussion														Water Level (Static): 4.00 Mtr	
Boring/Drilling Equipments: Power operated														Dia. Of Boring/Drilling: 150 M.M.	
Casing Lowered: 15 Mtr														Date: From 21/9/17 to 22/9/17	
Date (dd/mm)	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R.O.D. (%)	Description	
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value						
21/9		0.00	0.50	0.50	PS	-	-	-	-	22:35				Brown silty sand	
11		0.50	1.00	0.50		Bore clogging.									
11		1.00	1.45	0.45	U2S	-	-	-	-	12:45				collected	
11		1.45	1.50	0.05		Bore clogging.									
11		1.50	1.95	0.45	PS	4	3	4	7	12:58				Yellow silty sand	
11		1.95	2.50	0.55		Bore clogging								- do -	
11		2.50	2.95	0.45	U2S	-	-	-	-	1:15				collected	
11		2.95	3.00	0.05		Bore clogging								- do -	
11		3.00	3.45	0.45	PS	3	4	6	10	1:35				- do -	
11		3.45	4.50	1.05		Bore clogging									
22/9		4.50	4.95	0.45	PS	4	6	10	16	1:51				Yellow fine sand	
11		4.95	5.80	0.85		Bore clogging.								- do -	
11		5.80	5.45	0.35	U2S	-	-	-	-	2:03				collected	
11		5.45	6.00	0.55		Bore clogging									
11		6.00	6.45	0.45	PS	4	7	13	20	2:12				medium fine sand	
11		6.45	7.50	1.05		Bore clogging								- do -	
11		7.50	7.95	0.45	PS	6	10	12	22	2:33				- do -	
11		7.95	8.00	0.05		Bore clogging								- do -	
11		8.00	8.45	0.45	U2S	-	-	-	-	2:48				SLIPPED	
11		8.45	9.00	0.55		Bore clogging									
11		9.00	9.45	0.45	PS	5	7	12	19	3:05				Pine sand with	
22/9		9.45	10.50	1.05		Bore clogging.								gravels	

Abbreviation Used: U - Undisturbed Sample C - Core Sample D - Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) > 100)

For Techpro Engineers Pvt. Ltd.



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APPENDIX-C
CHART-10: BORE LOG CHART (BH-05)

Techpro Engineers Pvt. Ltd.
Project: Geotechnical (soil) work for New AIIMS Gorakhpur Bore/ Drill Log
Bore Hole No.: 05
Location: Gorakhpur (UP)
Method of Boring/ Drilling: Auger + Percussion
Boring/ Drilling Equipments: Power Drilled
Casing Lowered: 15 ft
Ground Elevation: - 1.00 mtr
Water Level (Static): 4.00 mtr
Dia. Of Boring/ Drilling: 150 mm
Date: From 21/2/17 to 22/2/17

Date (dd/mm)	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
21/2/17	10.50	10.95	4.5	4.5	5	5	24	23	320					fine sand with gravel
	10.95	11.00	0.5		Bore clogging									- do -
	11.00	11.45	4.5	4.5					340					Slipped
	11.45	12.00	5.5		Bore clogging									- do -
21/2/17	12.00	12.45	4.5	4.5	8	19	44	63	410					fine sand with gravel
	12.45	13.50	10.5		Bore clogging									- do -
22/2/17	13.50	13.95	4.5	4.5	8	14	27	41	610					- do -
	13.95	14.00	0.5		Bore clogging									- do -
	14.00	14.45	4.5	4.5					624					Slipped
	14.45	15.00	5.5		Bore clogging									
	15.00	15.45	4.5	4.5	10	21	34	55	655					fine sand with gravel
	15.45	16.50	10.5		Bore clogging									- do -
	16.50	16.95	4.5	4.5	9	20	45	65	720					- do -
	16.95	17.00	0.5		Bore clogging									- do -
	17.00	17.45	4.5	4.5					755					Slipped
	17.45	18.00	5.5		Bore clogging									
	18.00	18.15	4.5	4.5	12	28	49	77	825					- clay silt with
	18.15	20.00	11.5		Bore clogging									- do -
22/2/17	20.00	20.45	4.5	4.5	11	25	37	62	905					clay silt with gravel

For Techpro Engineers Pvt. Ltd.
 For Techpro Engineers Pvt. Ltd.
 Sr. Site Supervisor

Abbreviation Used: U - Undisturbed Sample C - Core Sample O - Disturbed Sample P - Standard Penetration Test
N - Refusal (Standard Penetration Test (N) > 100)

For Techpro Engineers Pvt. Ltd.



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APPENDIX-C CHART-11: BORE LOG CHART (BH-06)

Techpro Engineers Pvt. Ltd.										Bore/Drill Log Sheet-①				
Project: <u>Geotechnical (Soil) work for AIIMS</u>										Bore Hole No.: <u>06</u>				
Location: <u>Kuraghat, Gorakhpur, CUP</u>										Ground Elevation: <u>0.50</u>				
Method of Boring/Drilling: <u>Auger drill</u>										Water Level (Static): <u>5.10 m</u>				
Boring/Drilling Equipments: <u>Power drilled</u>										Dia. Of Boring/Drilling: <u>150 mm</u>				
Casing lowered: <u>13 m</u>										Date: From <u>22/2/17</u> to <u>22/2/17</u>				
Date (dd/mm)	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
22/2		0.00	0.50	0.50	D	Drilled manually								Light greenish silty sand
"		0.50	1.00	0.50		Boring & cleaning								-do-
"		1.00	1.30	0.30	U	Collected								-do-
"		1.30	1.50	0.20		Boring & cleaning								-do-
"		1.50	1.95	0.45	P/S	3	4	6	10					-do-
"		1.95	2.50	0.55		Boring & cleaning								-do-
"		2.50	2.80	0.30	U	Collected								-do-
"		2.80	3.00	0.20		Boring & cleaning								-do-
"		3.00	3.45	0.45	P/S	4	6	8	14					Yellow silty sand
"		3.45	4.50	1.05		Boring & cleaning								-do-
"		4.50	4.95	0.45	P/S	3	5	7	12					Fine sand
"		4.95	5.00	0.05		Boring & cleaning								-do-
"		5.00	5.30	0.30	U	Collected								-do-
"		5.30	6.00	0.70		Boring & cleaning								-do-
"		6.00	6.45	0.45	P/S	3	5	5	10					-do-
"		6.45	7.50	1.05		Boring & cleaning								-do-
"		7.50	7.95	0.45	P/S	5	5	8	13					Fine sand with gravel
"		7.95	8.00	0.05		Boring & cleaning								-do-
"		8.00	8.00	0.00	U	SLP test								-do-
"		8.00	9.00	1.00		Boring & cleaning								-do-
"		9.00	9.45	0.45	P/S	8	13	21	34					-do-
22/2		9.45	10.50	1.05		Boring & cleaning								-do-

Abbreviation Used: U - Undisturbed Sample C - Core Sample D - Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) > 100)

For Techpro Engineers Pvt. Ltd.



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APPENDIX-C
CHART-12: BORE LOG CHART (BH-06)

echpro Engineers Pvt. Ltd.
Project: Geotechnical (Soil) work for AIIMS

Location: Kuraghat Gorakhpur (U.P.)

Method of Boring/ Drilling: Auger & small

Boring/ Drilling Equipments: Power operated

Casing lowered: 18 mtr.

Bore/ Drill Log Sheet ①

Bore Hole No.: 6

Ground Elevation: 0.50

Water Level (Static): 5.10 mtr

Dia. Of Boring/ Drilling: 150 mm.

Date: From 22/2/17 to 22/2/17

Date (dd/mm)	Elevation (m)	Depth/ RUN (m)		Length (m)	Nature of Sampling	SPT: No. of blows				Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		From	To			0-15 cm	15-30 cm	30-45 cm	N Value					
22/2/17	10.50	10.50	10.95	0.45	P/O	19	18	34	52	-	-	-	-	Fine sand with gravel
"	10.95	11.00	11.00	0.05	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	11.00	11.30	11.30	0.30	U	collected	-	-	-	-	-	-	-	- do -
"	11.30	11.00	11.00	0.70	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	11.00	12.45	12.45	0.45	P/O	12	21	46	67	-	-	-	-	- do -
"	12.45	12.50	12.50	0.05	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	12.50	13.95	13.95	0.45	P/O	12	27	36	63	-	-	-	-	- do -
"	13.95	14.00	14.00	0.05	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	14.00	14.00	14.00	0.00	U	Slipped	-	-	-	-	-	-	-	- do -
"	14.00	15.00	15.00	1.00	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	15.00	15.45	15.45	0.45	P/O	8	17	28	45	-	-	-	-	- do -
"	15.45	16.50	16.50	1.05	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	16.50	16.95	16.95	0.45	P/O	11	23	36	59	-	-	-	-	- do -
"	16.95	17.00	17.00	0.05	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	17.00	17.00	17.00	0.00	U	Slipped	-	-	-	-	-	-	-	- do -
"	17.00	18.00	18.00	1.00	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
"	18.00	18.45	18.45	0.45	P/O	9	14	21	35	-	-	-	-	clay silt with gravel
"	18.45	20.00	20.00	1.55	-	Boring & cleaning	-	-	-	-	-	-	-	- do -
22/2/17	20.00	20.45	20.45	0.45	P/O	8	13	17	30	-	-	-	-	- do -

For Techpro Engineers Pvt. Ltd.

Paige R. R.

Site Supervisor



Abbreviation Used: U - Undisturbed Sample C-Core Sample D- Disturbed Sample P - Standard Penetration Test
R- Refusal (Standard Penetration Test (N) > 100)

For Techpro Engineers Pvt. Ltd.

Branch office: 131, Patparganj Industrial Area, Delhi- 110 092 Phone: 011- 4351 0098

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APPENDIX-D
FIELD DENSITY TEST

Field Density No.	Soil Description	Soil classification	Grain Size Analysis						Density and Moisture			Atterberg Limits		
			Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)
FD-1	Inorganic clays of low plasticity	CL	0	0	0	31	62	7	11.60	2.049	1.836	25	15	10
FD-2	Inorganic silts and clays of low plasticity	CL-ML	0	0	0	30	66	4	12.33	1.973	1.756	26	21	5
FD-3	Inorganic clays of low plasticity	CL	0	0	0	13	58	11	16.05	1.955	1.685	31	22	9
FD-4	Silty sands	SM	0	0	0	55	43	2	13.74	2.030	1.784	Non-Plastic		
FD-5	Inorganic silts and clays of low plasticity	CL-ML	0	0	0	30	65	5	13.78	1.879	1.651	27	21	6

For Techpro Engineers Pvt. Ltd.

[Signature]

Manager Technical



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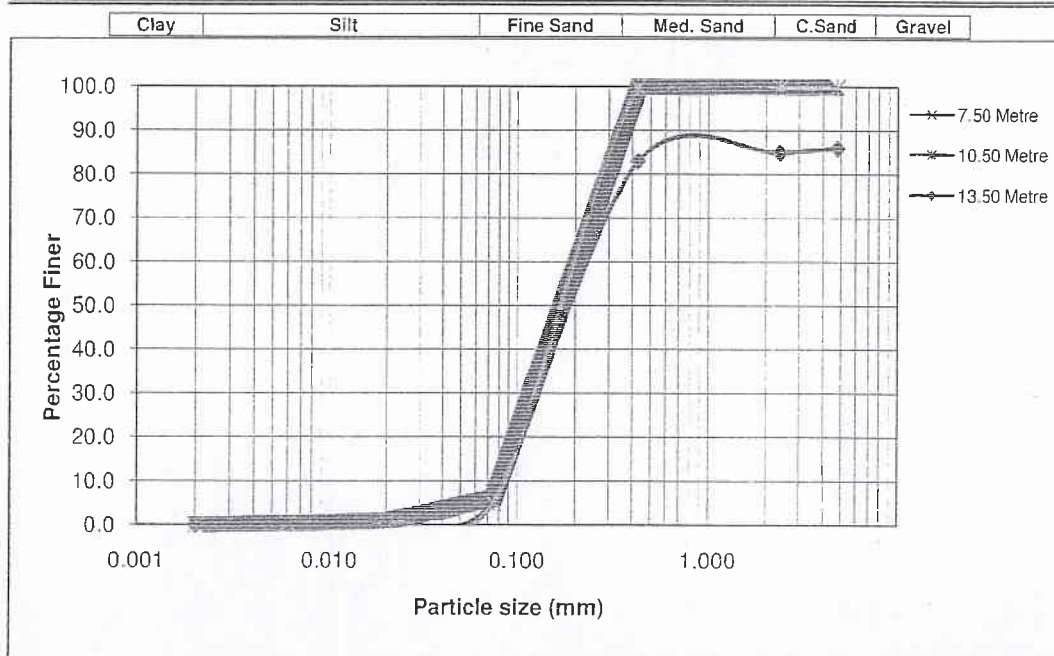
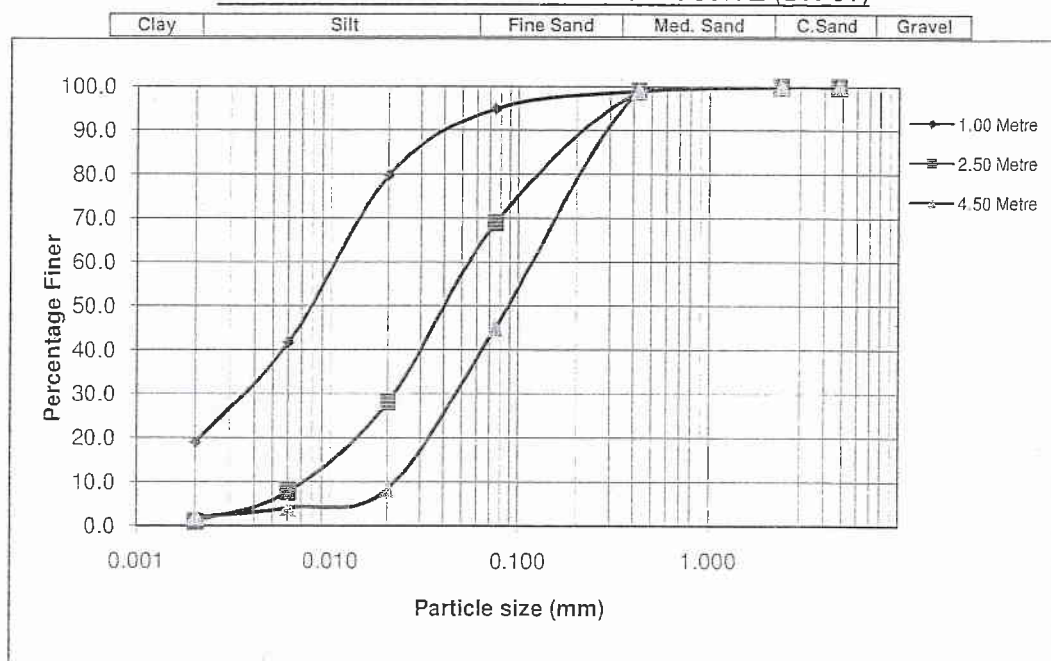
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APPENDIX-E
GRAPH-1: PARTICLE GRADATION CURVE (BH-01)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand	: 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm



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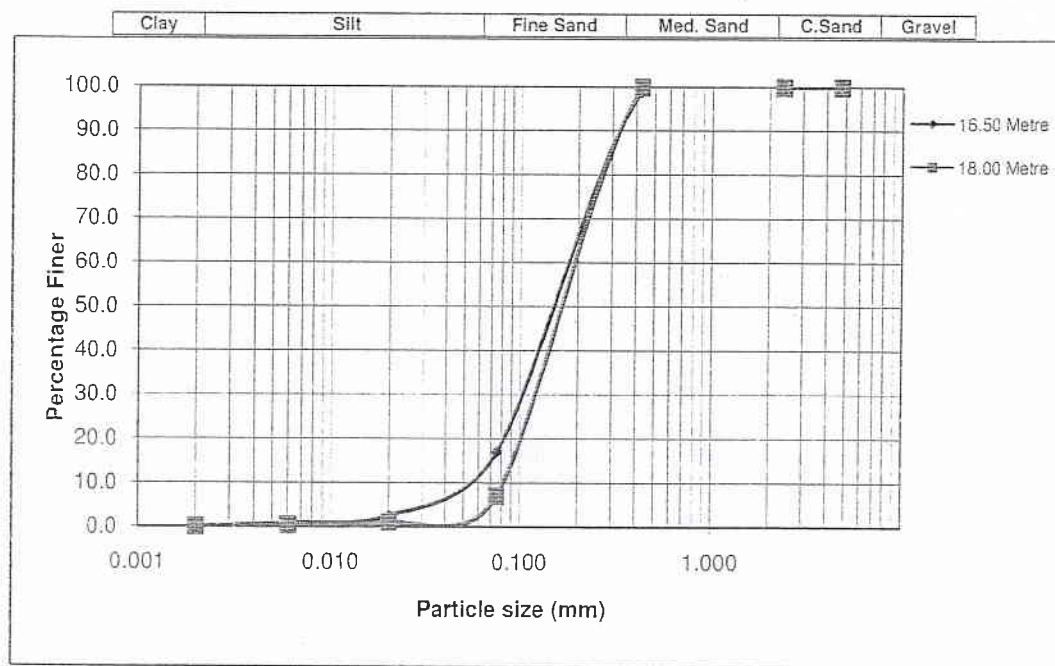
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APPENDIX-E
GRAPH-2: PARTICLE GRADATION CURVE (BH-01)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand:	2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm

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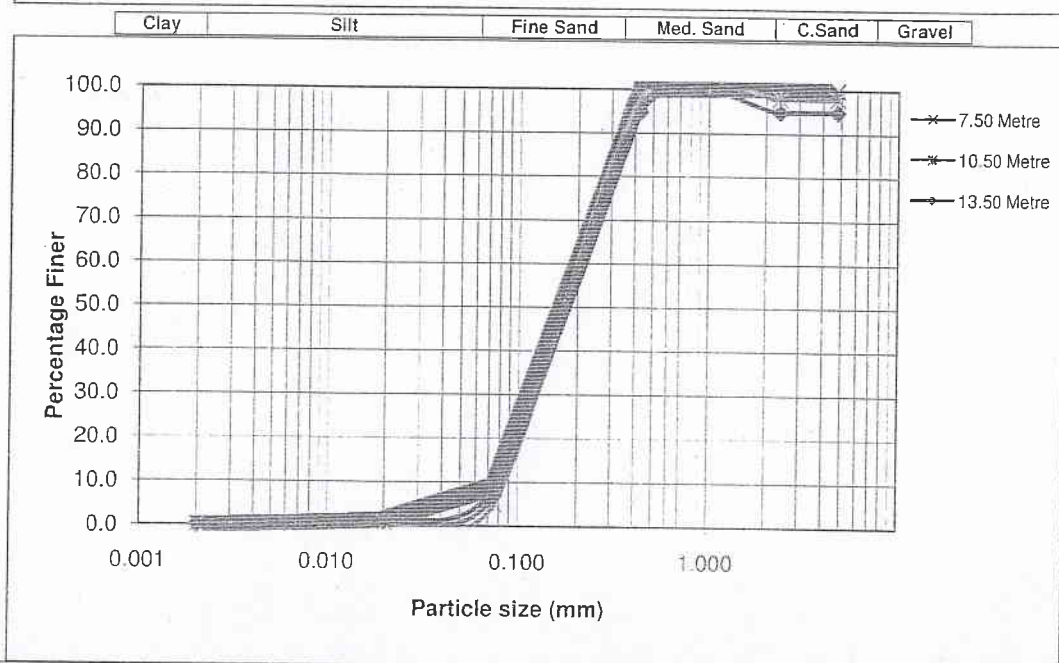
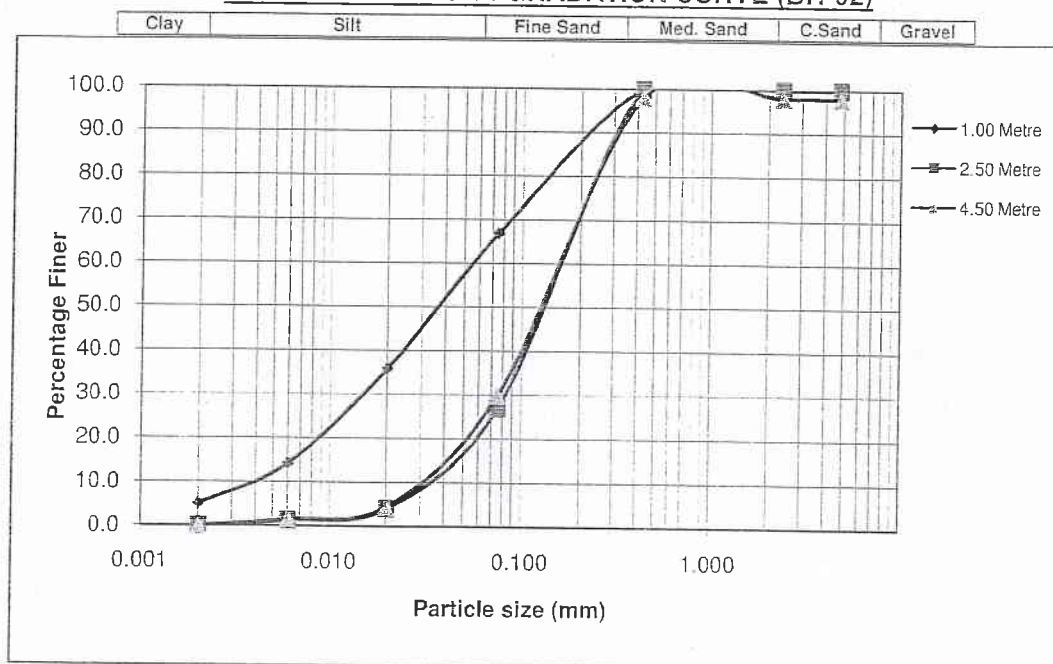
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APPENDIX-E
GRAPH-3: PARTICLE GRADATION CURVE (BH-02)



Gravel : Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sa : 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand : 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm



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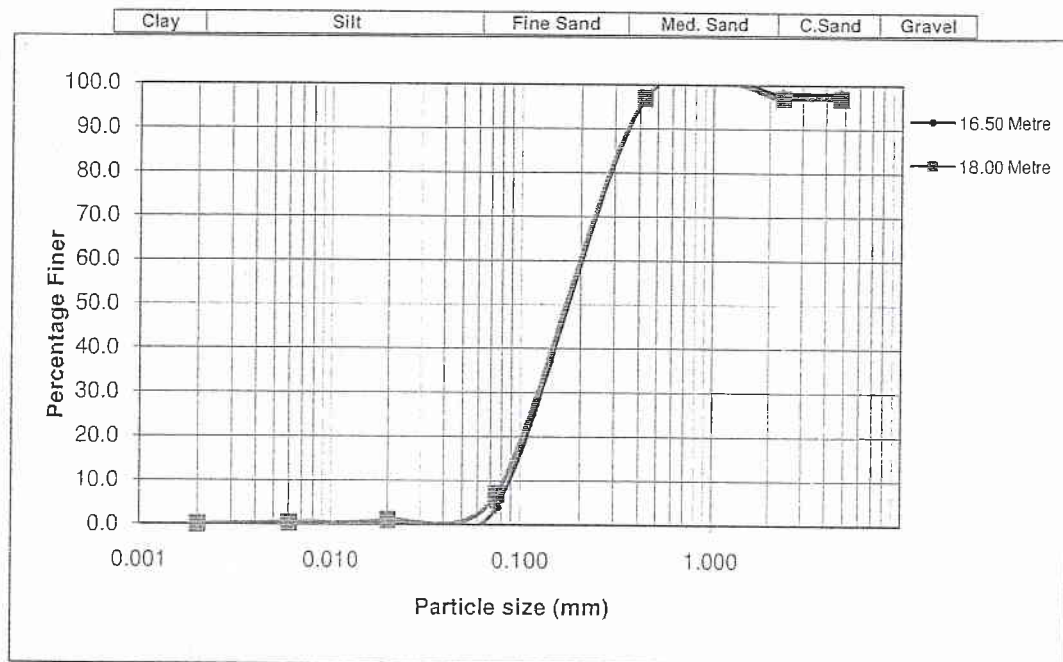
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APPENDIX-E
GRAPH-4: PARTICLE GRADATION CURVE (BH-02)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand	: 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm

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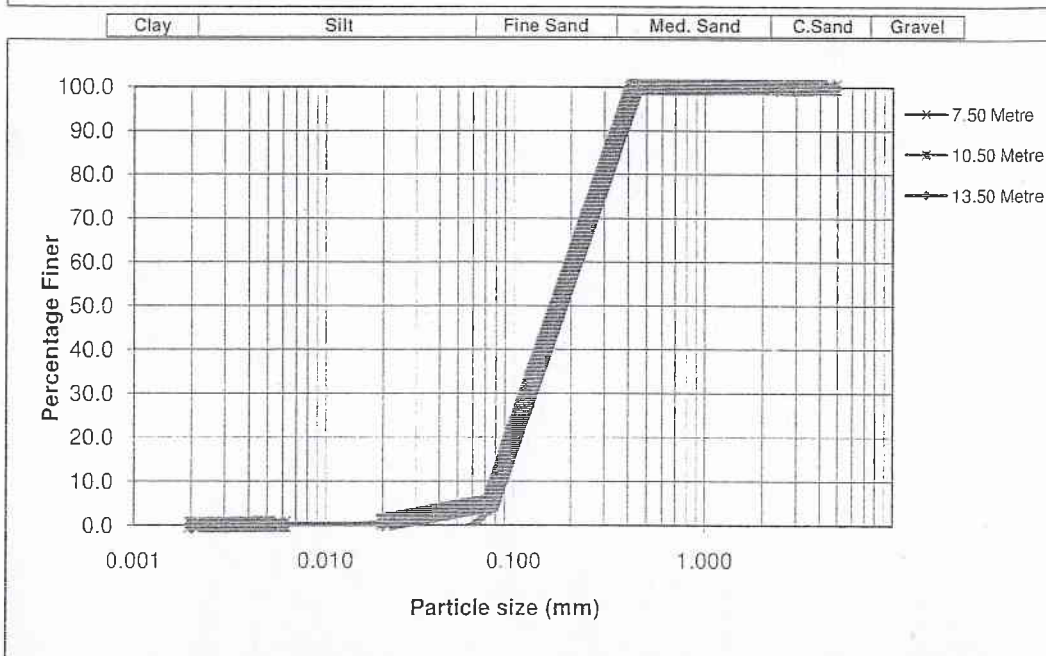
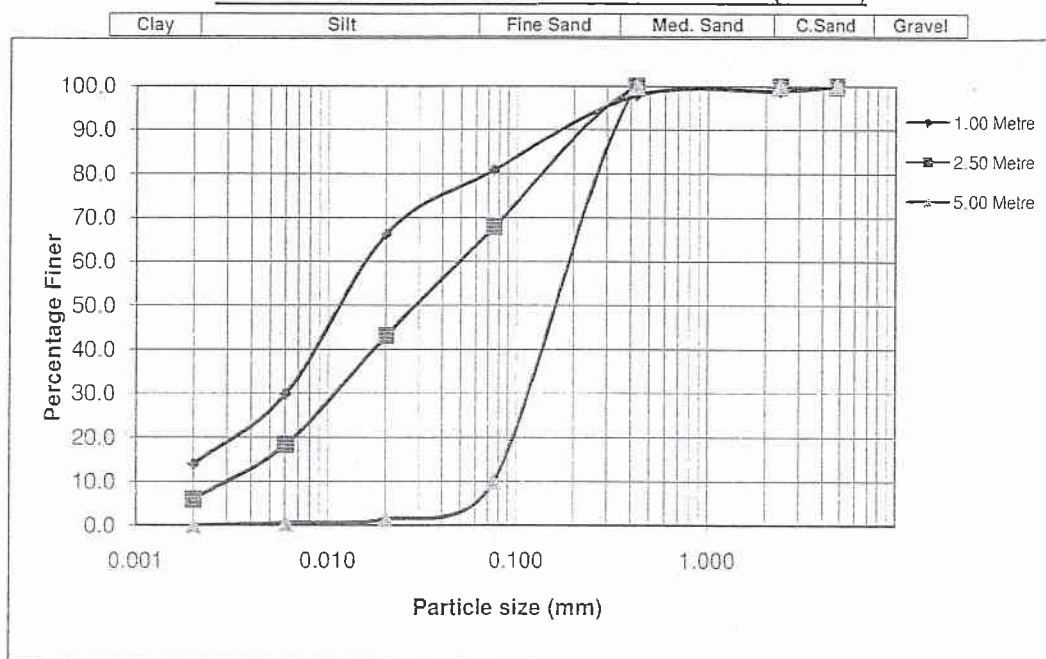
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APPENDIX-E
GRAPH-5: PARTICLE GRADATION CURVE (BH-03)



Gravel : Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand : 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand : 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm



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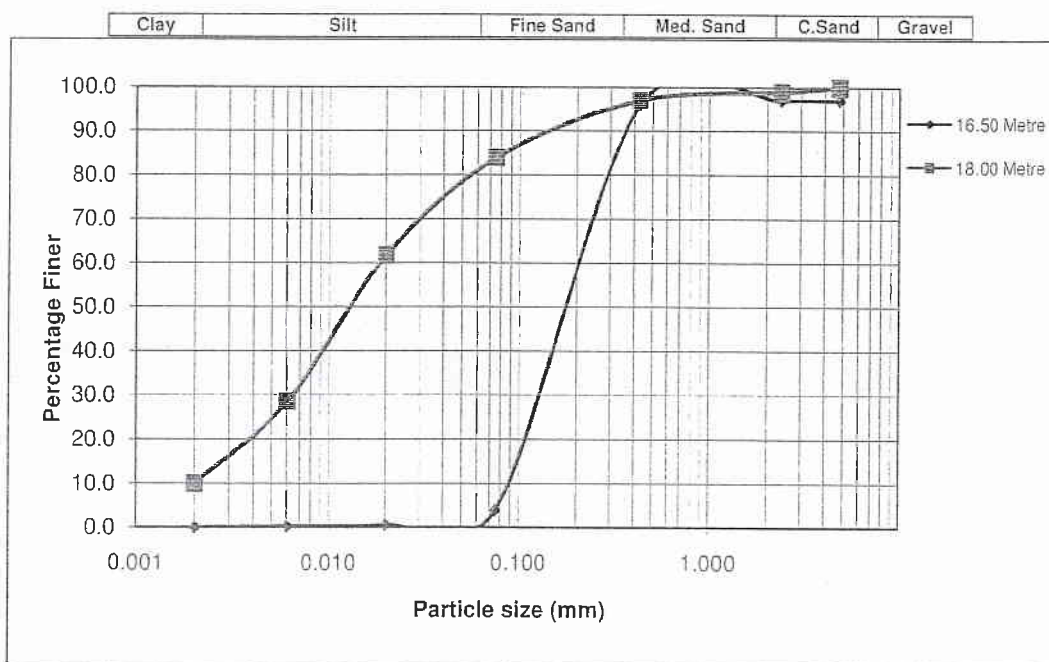
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APPENDIX-E
GRAPH-6: PARTICLE GRADATION CURVE (BH-03)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand	: 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm

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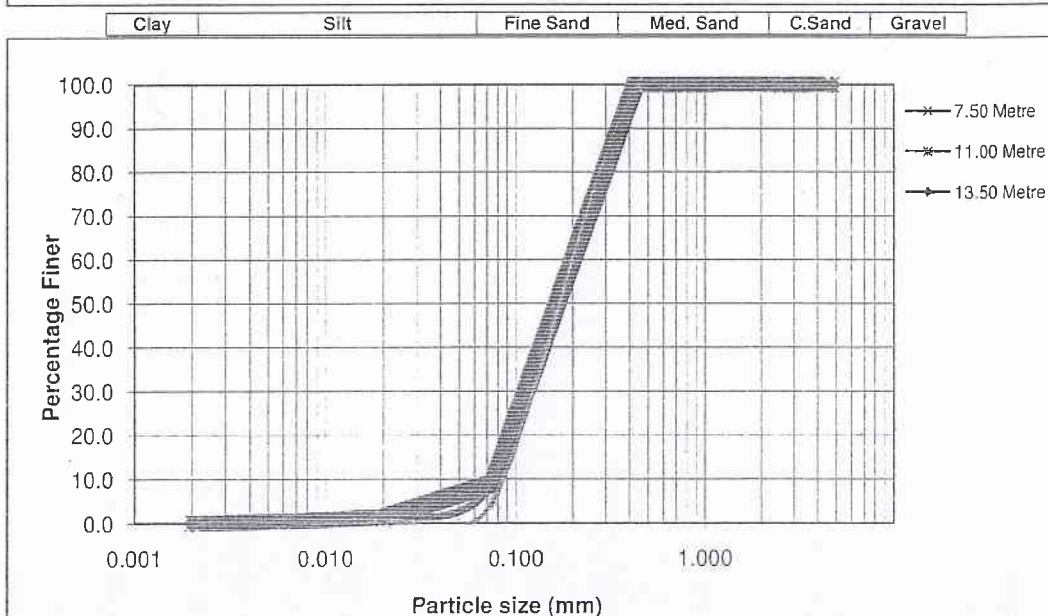
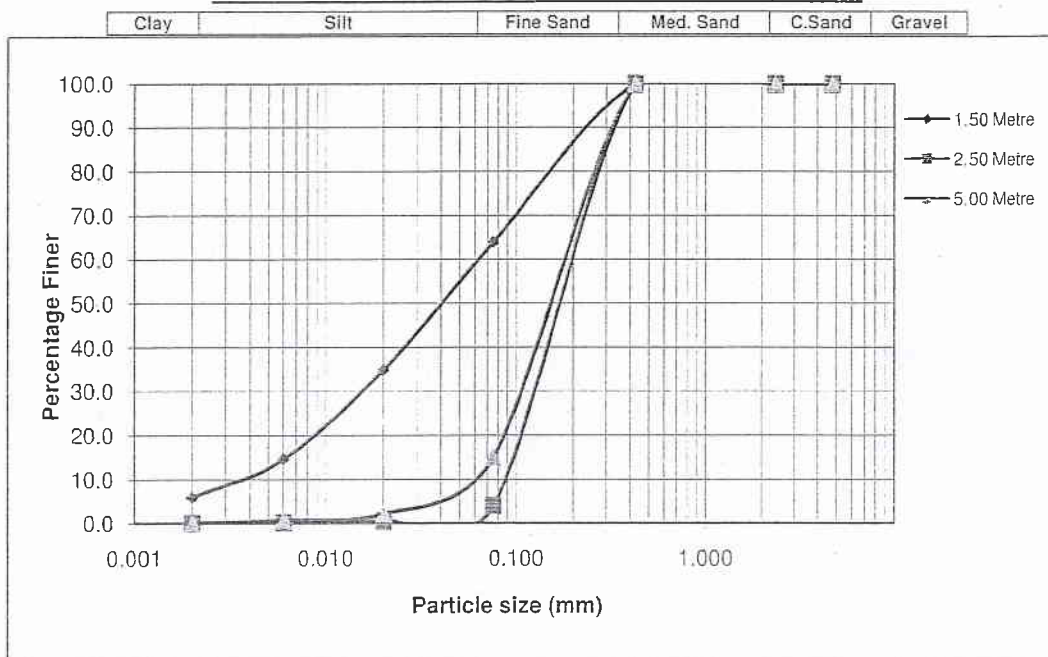
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APPENDIX-E
GRAPH-7: PARTICLE GRADATION CURVE (BH-04)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand	: 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm



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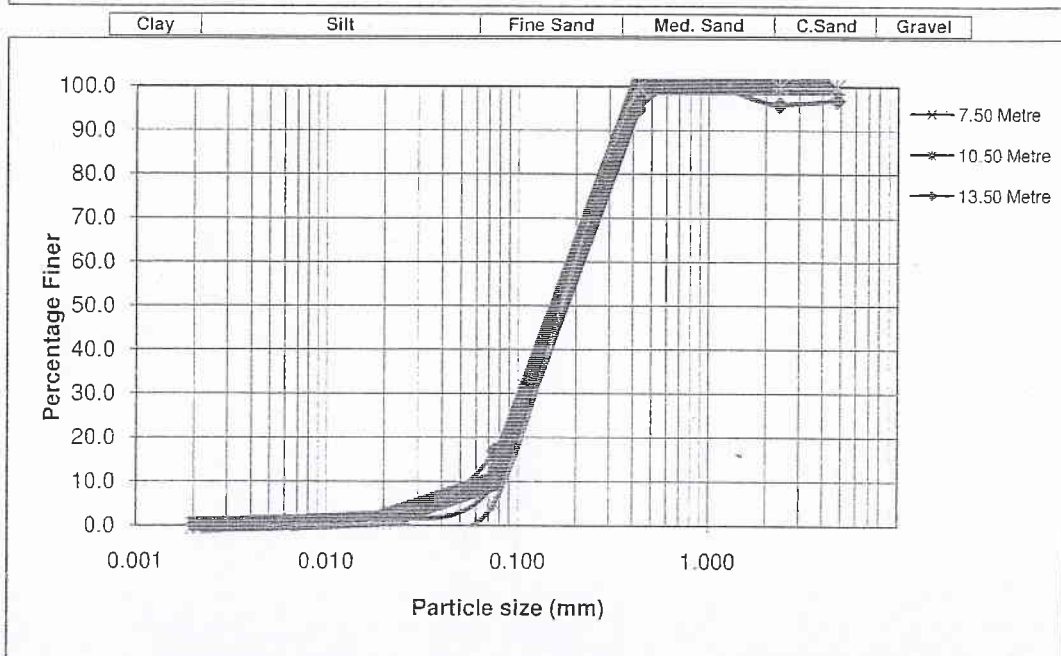
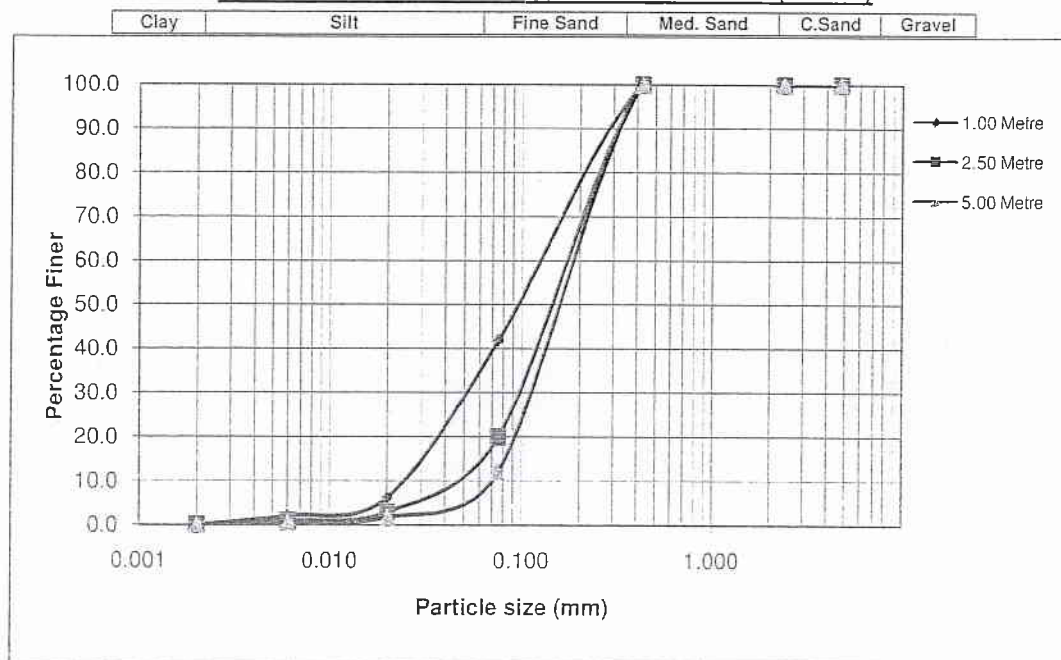
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APPENDIX-E
GRAPH-8: PARTICLE GRADATION CURVE (BH-05)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand	: 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm



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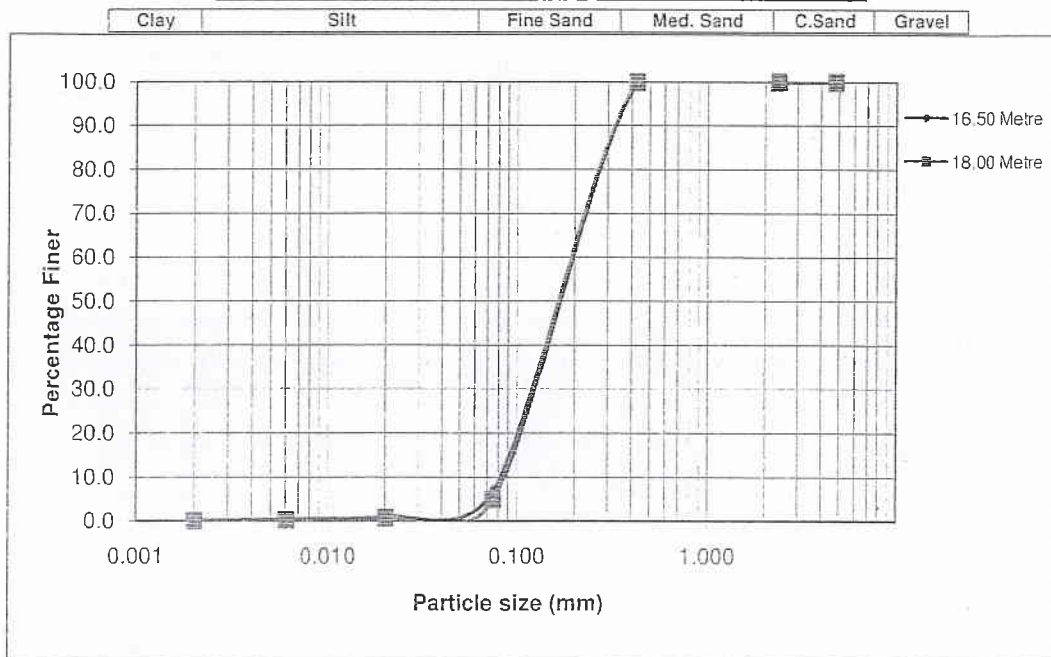
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APPENDIX-E
GRAPH-9: PARTICLE GRADATION CURVE (BH-05)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand	: 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm

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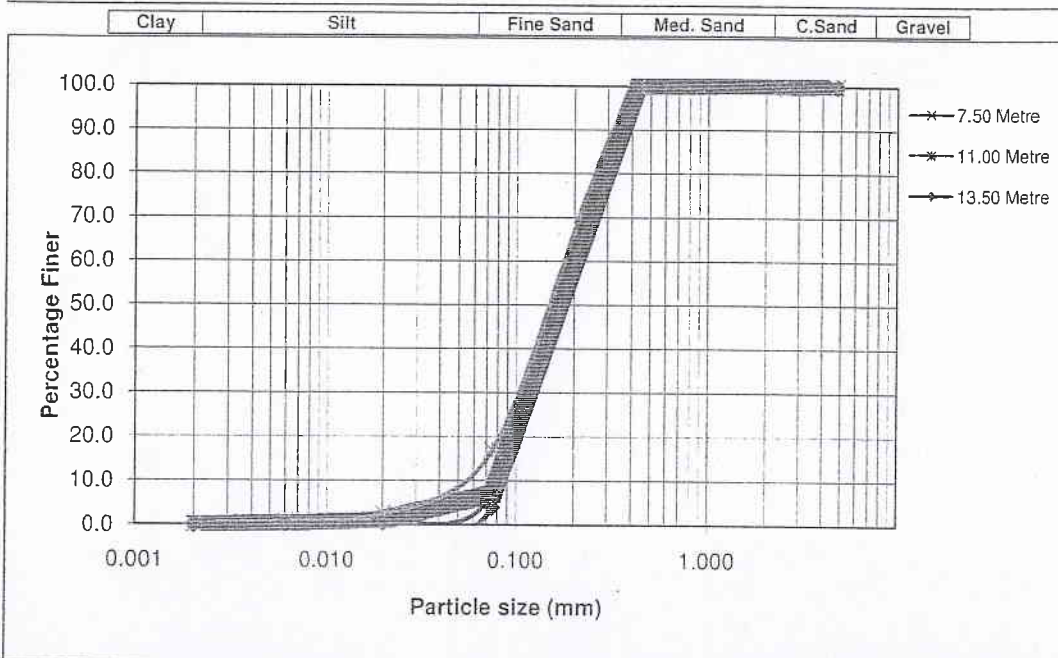
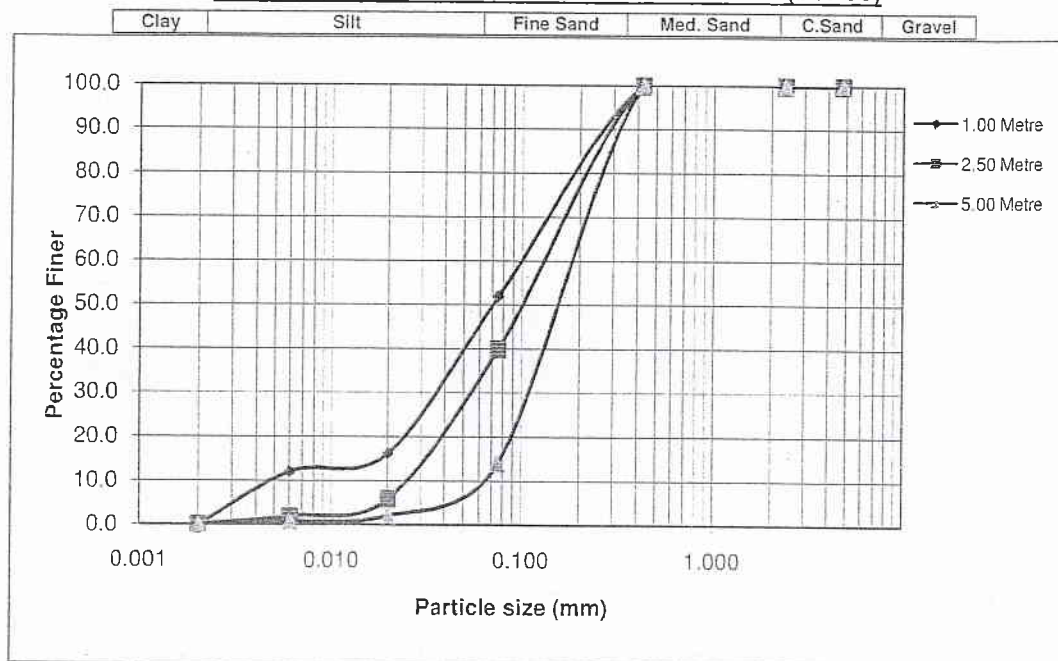
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Geotechnical Investigation for Construction of Setting up of new AIIMS at Kuraghat, Gorakhpur, Uttar Pradesh.

APPENDIX-E
GRAPH-10: PARTICLE GRADATION CURVE (BH-06)



Gravel : Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand : 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand : 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm

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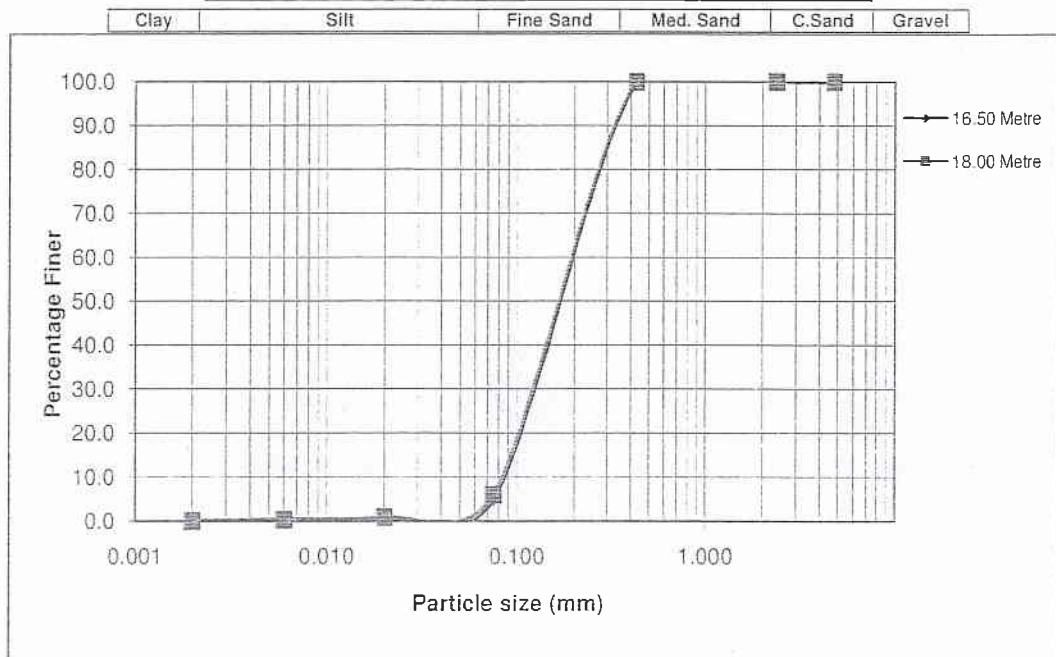
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Geotechnical Investigation for Construction of Setting up of new AIIMS at Kuraghat,
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APPENDIX-E
GRAPH-11: PARTICLE GRADATION CURVE (BH-06)



Gravel	: Particle Size >4.75 mm	Fine Sand: 0.075mm< Particle Size ≤0.425 mm
Coarse Sand	: 2.00mm< Particle Size ≤4.75 mm	Silt : 0.002mm< Particle Size ≤0.075 mm
Medium Sand	: 0.425mm< Particle Size ≤2.00 mm	Clay : <0.002 mm

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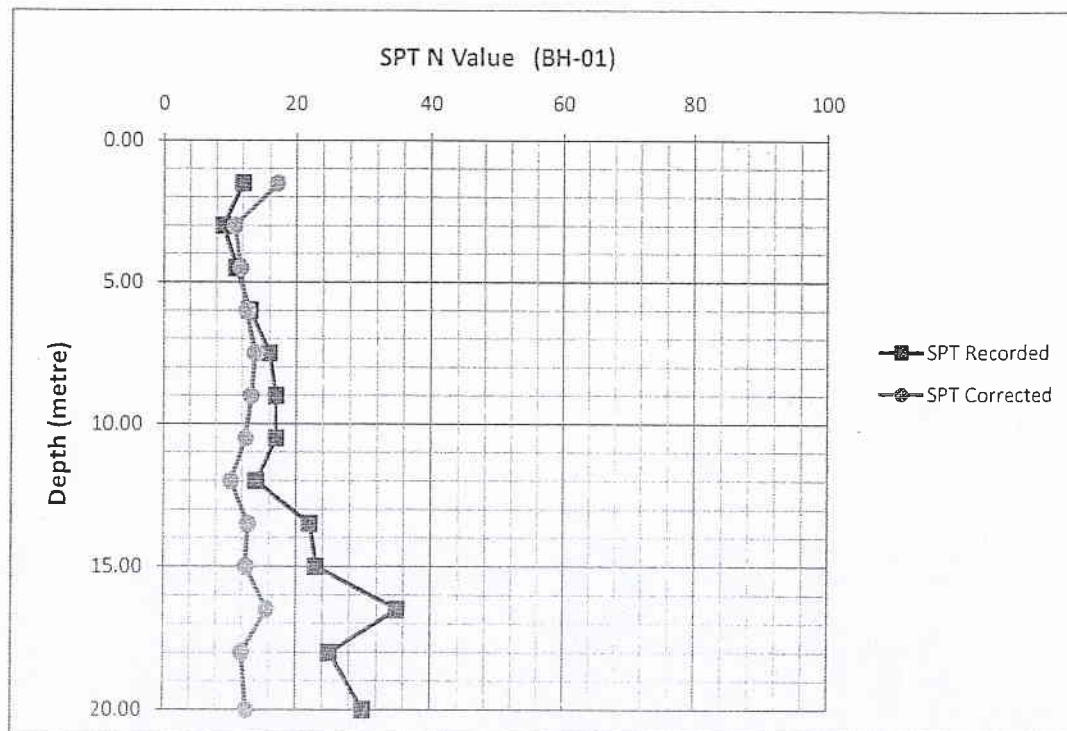
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Geotechnical Investigation for Construction of Setting up of new AIIMS at Kuraghat,
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APPENDIX -F
GRAPH-1: SPT CORRECTION & PLOT FOR BORE No. 01

Bore Hole No. : 01				Depth of water table: 4.90 m			
Depth of sample	Type of Soil	SPT Recorded	Bulk density (t/m ³)	Overburden Pressure (t/m ³)	SPT after dilatancy	Correction Factor	SPT Corrected
1.50		12	1.847	2.770	12.00	1.43	17.17
3.00		9	1.868	5.603	9.00	1.20	10.76
4.50		11	1.868	8.404	11.00	1.06	11.66
6.00		13	1.868	11.205	13.00	0.96	12.53
7.50		16	1.868	14.007	15.50	0.89	13.78
9.00		17	1.868	16.808	16.00	0.83	13.25
10.50		17	1.868	19.609	16.00	0.78	12.43
12.00		14	1.868	22.411	14.00	0.73	10.25
13.50		22	1.868	25.212	18.50	0.69	12.81
15.00		23	1.868	28.013	19.00	0.66	12.49
16.50		35	1.868	30.815	25.00	0.63	15.64
18.00		25	1.868	33.616	20.00	0.60	11.93
20.00		30	1.868	37.351	22.50	0.56	12.63



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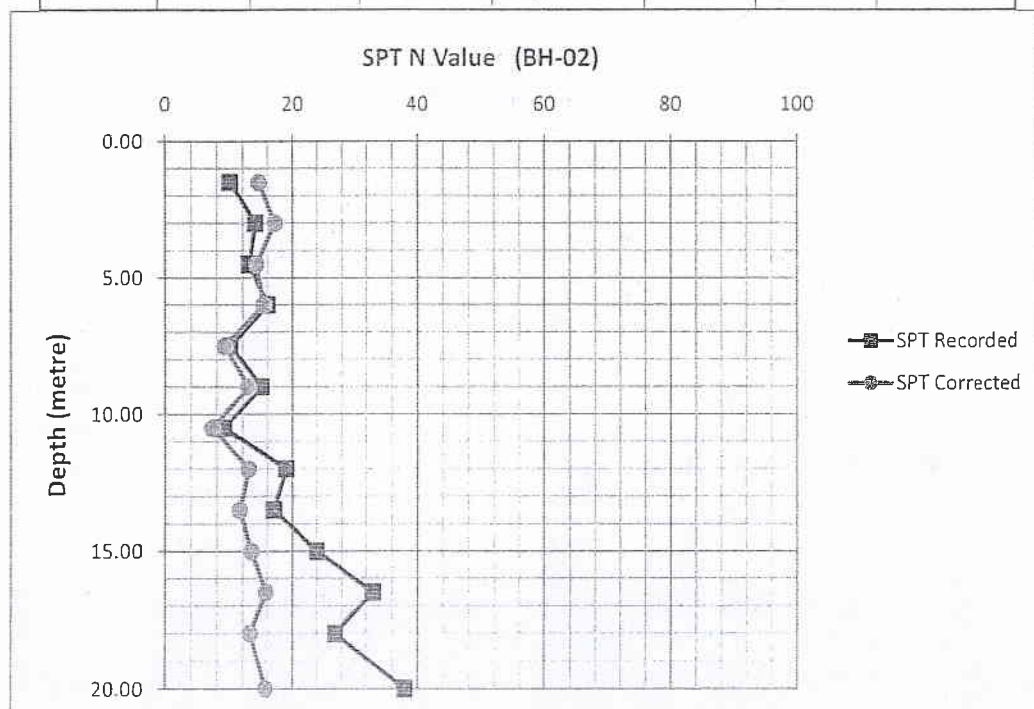
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Gorakhpur, Uttar Pradesh.

APPENDIX -F
GRAPH-2: SPT CORRECTION & PLOT FOR BORE No. 02

Bore Hole No. : 02				Depth of water table: 4.90 m			
Depth of sample	Type of Soil	SPT Recorded	Bulk density (t/m^3)	Overburden Pressure (t/m^3)	SPT after dilatancy	Correction Factor	SPT Corrected
1.50		10	1.728	2.592	10.00	1.45	14.53
3.00		14	1.708	5.125	14.00	1.23	17.15
4.50		13	1.708	7.688	13.00	1.09	14.17
6.00		16	1.708	10.250	15.50	0.99	15.40
7.50		10	1.708	12.813	10.00	0.92	9.19
9.00		15	1.708	15.375	15.00	0.86	12.87
10.50		9	1.708	17.938	9.00	0.81	7.26
12.00		19	1.708	20.500	17.00	0.76	12.95
13.50		17	1.708	23.063	16.00	0.72	11.56
15.00		24	1.708	25.625	19.50	0.69	13.40
16.50		33	1.708	28.188	24.00	0.66	15.73
18.00		27	1.708	30.750	21.00	0.63	13.15
20.00		38	1.708	34.167	26.50	0.59	15.66



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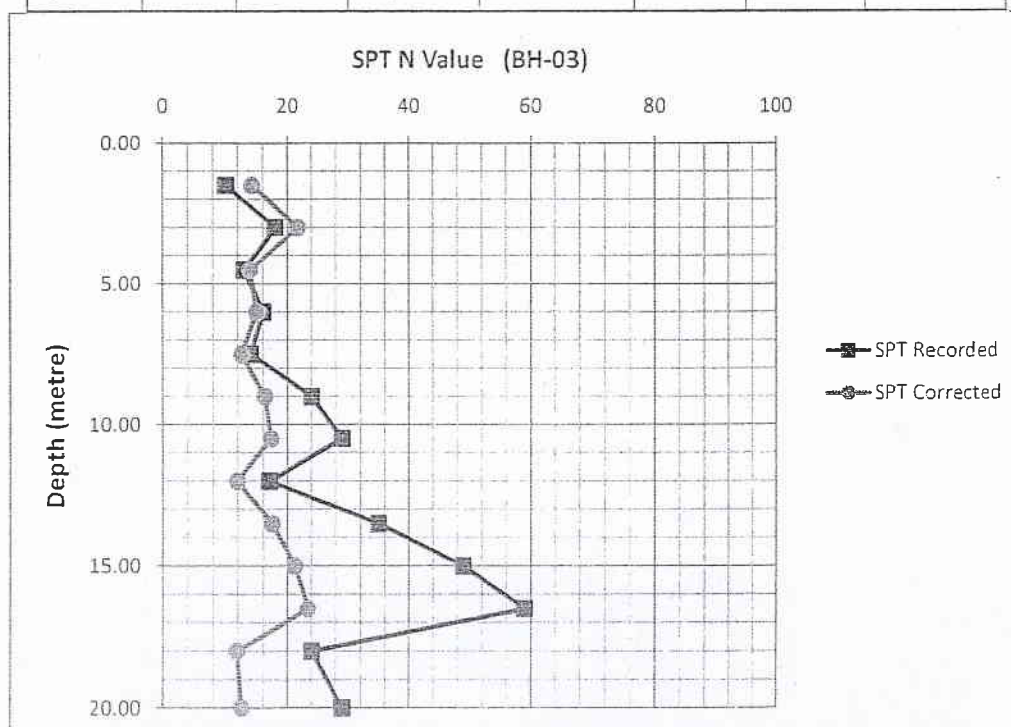
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APPENDIX -F
GRAPH-3: SPT CORRECTION & PLOT FOR BORE No. 03

Bore Hole No. : 03				Depth of water table: 4.80 m			
Depth of sample	Type of Soil	SPT Recorded	Bulk density (t/m^3)	Overburden Pressure (t/m^2)	SPT after dilatancy	Correction Factor	SPT Corrected
1.50		10	1.895	2.843	10.00	1.42	14.22
3.00		18	1.828	5.483	18.00	1.20	21.65
4.50		13	1.828	8.225	13.00	1.07	13.87
6.00		16	1.830	10.983	15.50	0.97	15.04
7.50		14	1.830	13.729	14.00	0.90	12.54
9.00		24	1.830	16.474	19.50	0.83	16.28
10.50		29	1.830	19.220	22.00	0.78	17.23
12.00		17	1.830	21.966	16.00	0.74	11.82
13.50		35	1.830	24.711	25.00	0.70	17.48
15.00		49	1.830	27.457	32.00	0.66	21.25
16.50		59	1.830	30.203	37.00	0.63	23.39
18.00		24	1.830	32.949	19.50	0.60	11.76
20.00		29	1.830	36.610	22.00	0.57	12.49





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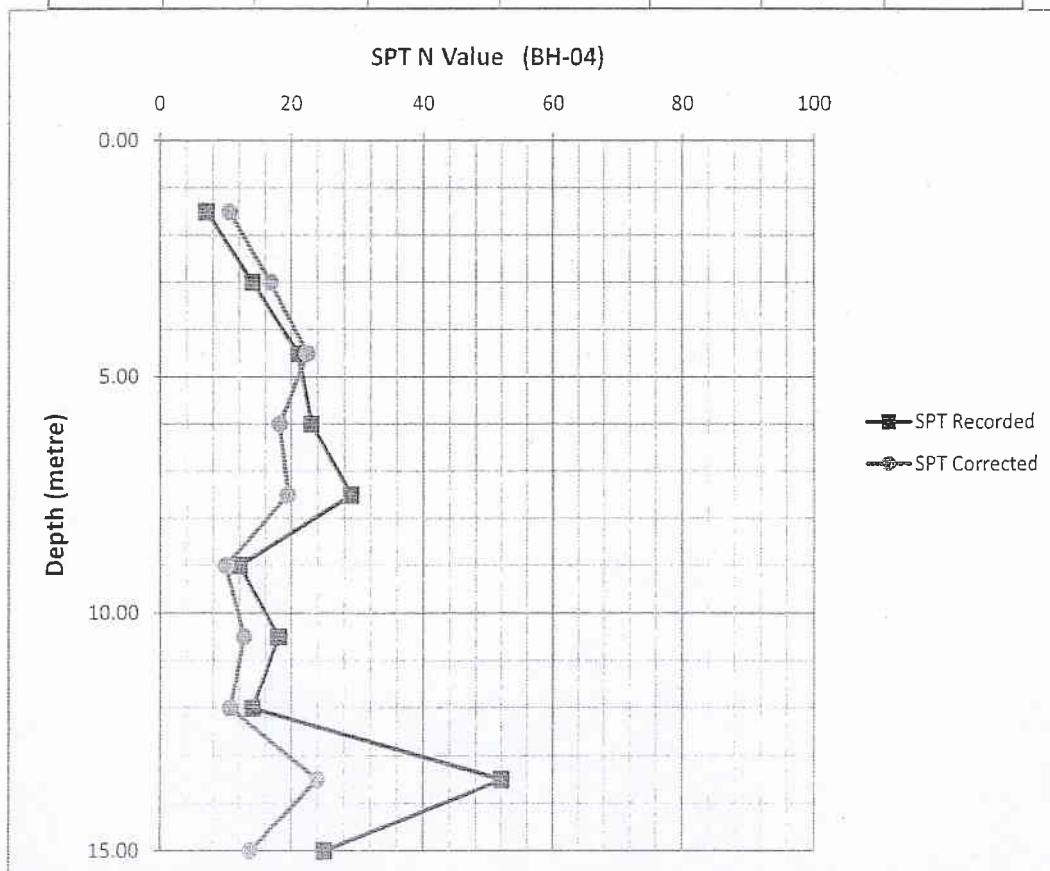
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APPENDIX -F
GRAPH-4: SPT CORRECTION & PLOT FOR BORE No. 04

Bore Hole No. : 04				Depth of water table: 4.80 m			
Depth of sample	Type of Soil	SPT Recorded	Bulk density (t/m^3)	Overburden Pressure (t/m^3)	SPT after dilatancy	Correction Factor	SPT Corrected
1.50		7	0.000	0.000	7.00	1.50	10.50
3.00		14	1.830	5.489	14.00	1.20	16.83
4.50		21	1.830	8.234	21.00	1.07	22.40
6.00		23	1.902	11.411	19.00	0.96	18.20
7.50		29	1.902	14.264	22.00	0.88	19.43
9.00		12	1.902	17.117	12.00	0.82	9.86
10.50		18	1.902	19.969	16.50	0.77	12.71
12.00		14	1.745	20.936	14.00	0.75	10.57
13.50		52	1.745	23.554	33.50	0.72	23.96
15.00		25	1.745	26.171	20.00	0.68	13.60





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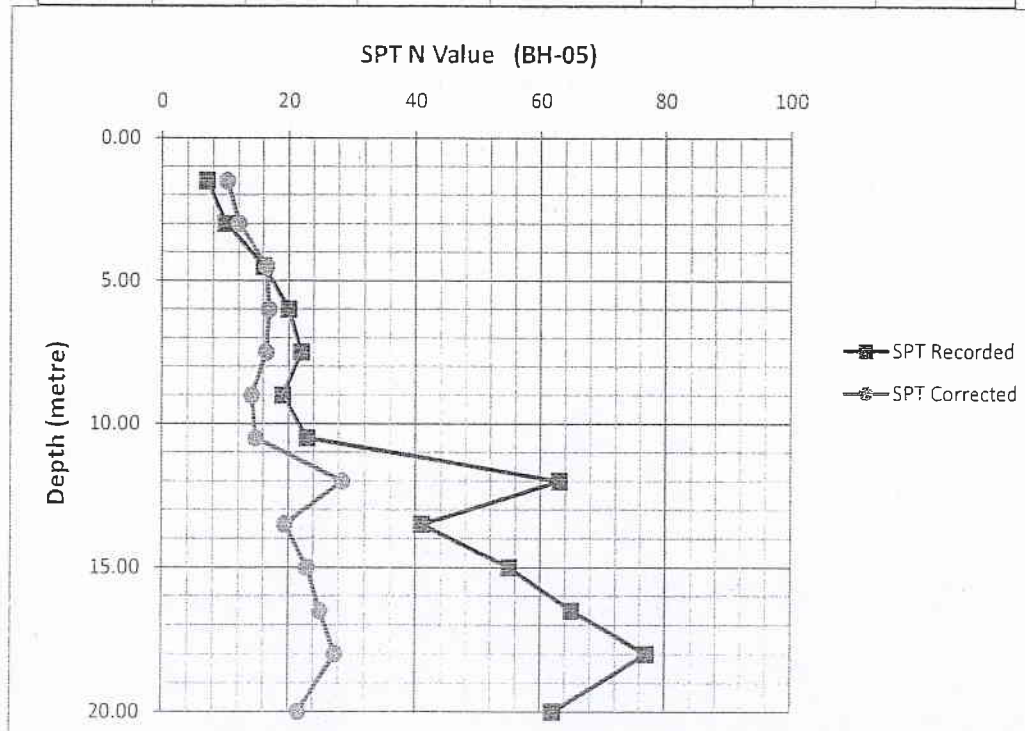
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APPENDIX -F
GRAPH-5: SPT CORRECTION & PLOT FOR BORE No. 05

Bore Hole No. : 05				Depth of water table: 4.00 m			
Depth of sample	Type of Soil	SPT Recorded	Bulk density (t/m ³)	Overburden Pressure (t/m ³)	SPT after dilatancy	Correction Factor	SPT Corrected
1.50		7	1.725	2.588	7.00	1.45	10.18
3.00		10	1.856	5.567	10.00	1.20	11.98
4.50		16	1.856	8.350	15.50	1.06	16.46
6.00		20	1.867	11.205	17.50	0.96	16.87
7.50		22	1.867	14.006	18.50	0.89	16.45
9.00		19	1.867	16.807	17.00	0.83	14.08
10.50		23	1.867	19.609	19.00	0.78	14.76
12.00		63	1.867	22.410	39.00	0.73	28.55
13.50		41	1.867	25.211	28.00	0.69	19.39
15.00		55	1.867	28.012	35.00	0.66	23.01
16.50		65	1.867	30.814	40.00	0.63	25.02
18.00		77	1.867	33.615	46.00	0.60	27.43
20.00		62	1.867	37.350	38.50	0.56	21.60



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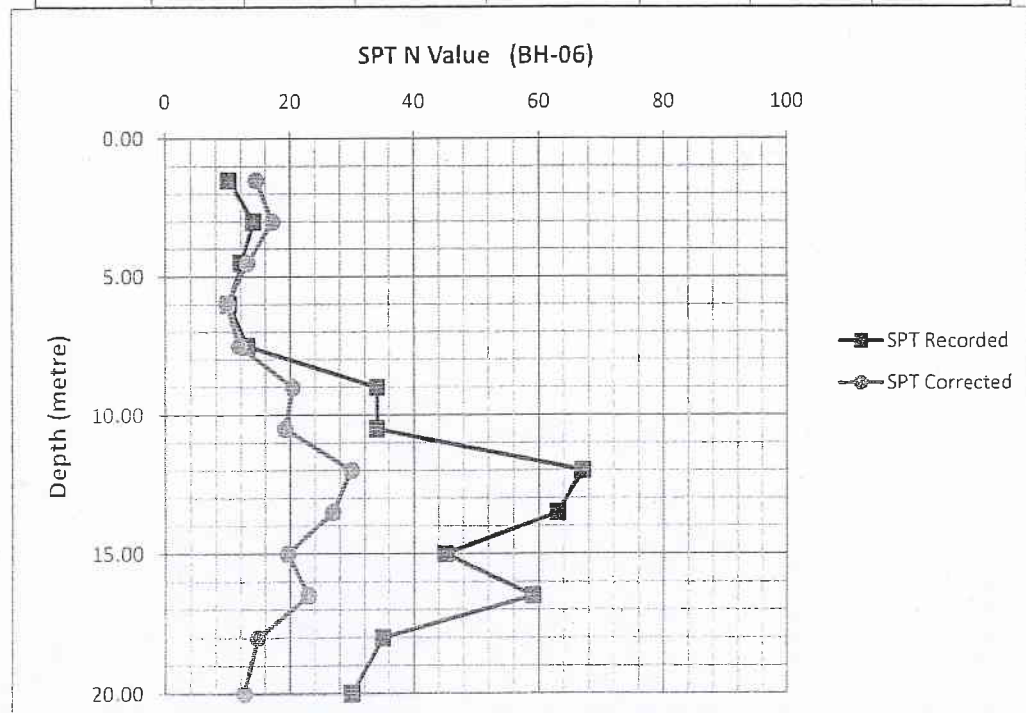
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APPENDIX -F
GRAPH-6: SPT CORRECTION & PLOT FOR BORE No. 06

Bore Hole No. : 06				Depth of water table: 5.10 m			
Depth of sample	Type of Soil	SPT Recorded	Bulk density (t/m^3)	Overburden Pressure (t/m^3)	SPT after dilatancy	Correction Factor	SPT Corrected
1.50		10	1.750	2.625	10.00	1.45	14.49
3.00		14	1.720	5.159	14.00	1.22	17.12
4.50		12	1.720	7.738	12.00	1.09	13.05
6.00		10	1.844	11.065	10.00	0.97	9.68
7.50		13	1.844	13.831	13.00	0.89	11.61
9.00		34	1.844	16.597	24.50	0.83	20.39
10.50		34	1.844	19.363	24.50	0.78	19.13
12.00		67	1.890	22.682	41.00	0.73	29.84
13.50		63	1.890	25.517	39.00	0.69	26.85
15.00		45	1.890	28.352	30.00	0.65	19.60
16.50		59	1.890	31.187	37.00	0.62	22.99
18.00		35	1.890	34.023	25.00	0.59	14.81
20.00		30	1.890	37.803	22.50	0.56	12.53





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ANNEXURE-G **ELECTRICAL RESISTIVITY SURVEY**

1.0 INTRODUCTION

1.1 Introduction to Resistivity Surveys:

Geophysical resistivity techniques are based on the response of the earth to the flow of electrical current. With an electrical current passed through the ground and two potential electrodes to record the resultant potential difference between them, we can obtain a direct measure of the electrical impedance of the subsurface material. The resistivity of the subsurface, a material constant, is then a function of the magnitude of the current, the recorded potential difference, and the geometry of the electrode array. Depending upon the survey geometry, the data are plotted as 1-D sounding or profiling curves or in 2-D cross-section in order to look for anomalous regions. In the shallow subsurface, the presence of water controls much of the conductivity variation. Measurement of resistivity is, in general, a measure of water saturation and connectivity of pore space. Resistivity measurements are associated with varying depths relative to the distance between the current and potential electrodes in the survey, and can be interpreted qualitatively and quantitatively in terms of a lithologic and/or geohydrologic model of the subsurface.

The ultimate objective of a VES at a locality is to obtain a true resistivity log similar to, for example, the induction log of a well at the locality, without actually drilling the well. However, because of inherent

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limitations (which will be discussed briefly), the resolution of the VES methods is not as high as that of the induction log. Nonetheless, the VES methods remain as the most inexpensive methods of subsurface exploration. On the other hand, its resistivity varies according to small changes in water salinity. This property together with the low cost makes the VES methods very suitable for groundwater exploration.

1.2 Electrical Properties of Earth Materials

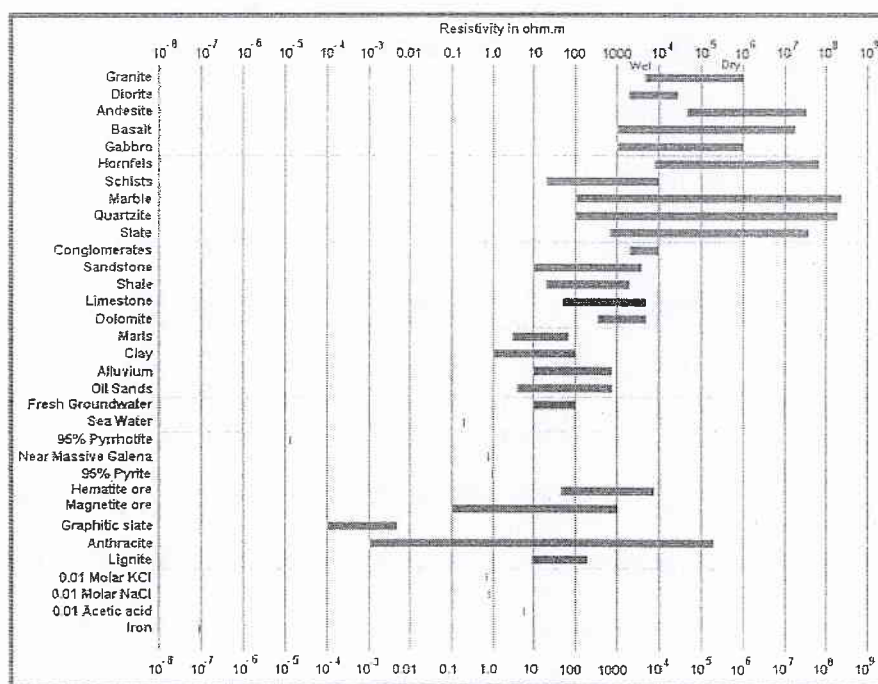




Table 1: Typical Range of Resistivities of Earth Materials

The electrical resistivity of rock is a property which depends on lithology and fluid content. The resistivity of coarse-grained, well-consolidated sands to nesaturated with fresh water is higher than that of unconsolidated silt of the same porosity, saturated with the same water. Also, the resistivities

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Identical porous rock samples vary considerably according to the salinity of the saturating water. The higher the salinity of the water, the lower the resistivity of the rock. Thus, it is quite possible for two different types of rock, such as shale and sandstone, to be of essentially the same resistivity when the sandstone is saturated with saline water and the shale with freshwater. For this reason, the number and thicknesses of the geoelectric units as determined from Vertical Electrical Sounding (VES) measurements at a locality may not necessarily be the same as the geological ones.

1.3 Resistivity Surveys: Application and Limitation

Resistivity (Geo-electrical)

surveying is one of the most versatile and successful geophysical prospecting methods for mineral prospecting, ground resistance measurements, geological and geo-technical mapping, bedrock studies, certain civil engineering applications and also for ground water prospecting.



The greatest limitation of the resistivity sounding method is that it does not take into account lateral changes in the layer resistivity. Independent geophysical and geological information are necessary for a valid interpretation of resistivity data.

2.0 ELECTRICAL RESISTIVITY METHOD

2.1 A brief description

Electrical resistivity method consists of transmitting electrical current into the earth through a pair of grounded metal electrodes, and measuring the resulting potential generated across the second pair of

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grounded metal electrodes. There are a variety of electrode arrangements (arrays) that can be used.

The electric resistivity of a rock formation limits the amount of current passing through the formation when an electric potential is applied. It may be defined as the resistance in ohms between opposite faces of a unit cube of the material. If a material of resistance R has a cross-sectional area A and a length L, then its resistivity can be expressed as

$$r=RA/L$$



Units of resistivity (r) are ohm-m.

Resistivity of rock formations vary over a wide range, depending on the material, density, porosity, pore size and shape, water content and quality, and temperature. There are no fixed limits for resistivities of various rocks. In relatively porous formations, the resistivity is controlled more by water content and quality within the formation than by the rock resistivity. For aquifers composed of unconsolidated materials, the resistivity decreases with the degree of saturation and the salinity of groundwater. Clay minerals conduct electric current through their matrix, therefore clayey formations tend to display lower resistivities than do permeable alluvial aquifers. The representative resistivity values of common earth materials are displayed in Table-1 for reference.

2.2 Instrument used

Geoelectric data acquisition was carried out by using the Resistivity Meter Aquameter CRMAUTO C. The instrument is equipped with microprocessor technology which employs ingenious methods for extracting subsurface

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Therefore the heavy down pour during a limited period creates the havoc of water logging and flood and most of the water use to flow without economic use except some water which is collected in the water bodies and the depressions spread in the city.

5.0 GEOPHYSICAL INVESTIGATION

5.1 Field Methodology of VES

The most popular Schlumberger array was used for the delineation of vertical variation of resistivity in the sub-surface. In this configuration current electrodes are moved outward in steps while potential electrodes remain fixed and moved occasionally. In present VES investigations, the spread length of 400 m has been selected for the ground water prospect in the sub-surface. The center point of the spread was selected nearby the proposed location (due to existing wheat crops their and ground clearance of 400 m long straight profile). A metal electrode, made of stainless steel, was driven into the soil at each end of the spread (A & B, Figure 2). Both electrodes were then connected to the current port of the instrument with the cables, located at the center of spread. The electrodes M and N (Figure 2) were also driven into the soil and connected to the respective voltage terminal.

5.2 Layout and computation

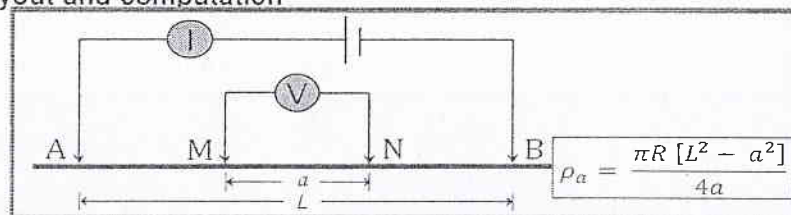




Fig 2: Schematic diagram of VES layout

where,

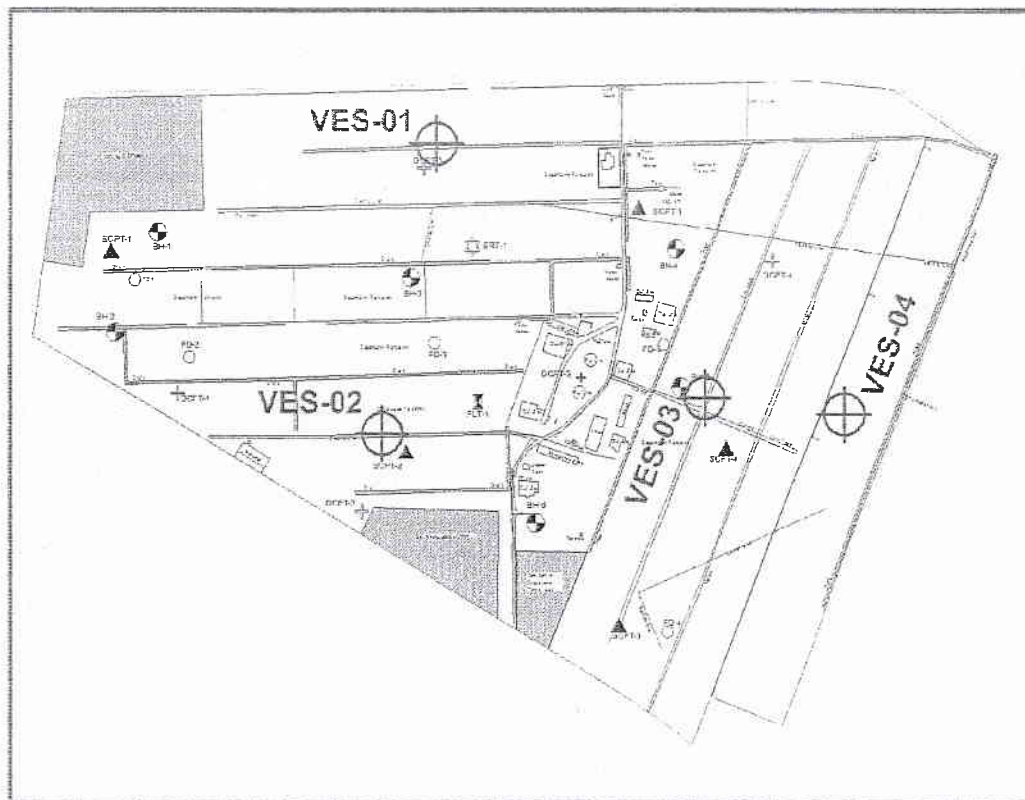
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A, B = Current Electrodes
 M, N = Potential Electrodes
 a = Separation between potential electrodes
 L = Separation between current electrodes
 ρ_a = Apparent Resistivity



5.3 FIELD DATA ACQUISITION

The Vertical Electrical Sounding (VES) investigations were conducted in the proposed area on 2nd March 2017. The vertical electrical sounding (VES) were carried out at 4 proposed points as displayed in Fig 3.



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5.4 Field Data Processing

Upon completion of a field resistivity data acquisition, a value is calculated that represents the apparent resistivity of the volume of earth that the current flows through.

$$\rho_a = \frac{\pi R [L^2 - a^2]}{4a} \quad (1)$$

Where,

ρ_a = Apparent Resistivity

a = Separation between potential electrodes

L = Separation between current electrodes



Computed apparent resistivity data vs electrode separation is plotted on log-log scale. The electrode separation is plotted on X-axis and apparent resistivity values on Y-axis. The plotted apparent resistivity values are shown as circles and black line.

5.5 VES Data Interpretation

The interpretation of each sounding curve was carried out by the use of curve matching technique and by an automatic interpretation program and curve is matched and modified by trial and error until a very close match (with the standard curve set, shown in red lines) was attained between the calculated and standard resistivity curves. The differences between the observed and calculated blocks were minimized to obtain an acceptable agreement of the fitting process (Loke & Barker, 1996). A measure of this

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difference is given by the root-mean-square error (RMS%). However, the lowest RMS error may show large and unrealistic variations in the model resistivity values and might not be the best from a geological concept. Notwithstanding this, reasonable values of RMS (3.12-7.81) were maintained for all the profiles.

While the resistivity method is used to measure the resistivity of earth materials, it is the interpreter who, based on knowledge of local geologic conditions and other data, must interpret resistivity data and arrive at a reasonable geologic and hydrologic interpretation.

In geophysical inversion, one seek to find a model that gives a response that is similar to the actual measured values. The model is an idealized mathematical representation of a section of the earth. The model has a set of model parameters that are the physical quantities we want to estimate from the observed data. The model response is the synthetic data that can be calculated from the mathematical relationships defining the model for a given set of model parameters. All inversion methods essentially try to determine a model for the subsurface whose response agrees with the measured data subject to certain restrictions and within acceptable limits.

5.6 VES Interpretation Result

The proposed project area was covered with 4 VES points in order to delineate sub-surface lithological units and occurrence of ground water and its quality. The area is covered by unconsolidated alluvial

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deposits comprising of medium to fine grained sand, clay and kankar. Ground water occurrence in the project area is primarily in the unconfined aquifer.

The interpreted result of all 4 VES is enclosed in Annexure-A from Fig 4 to Fig 7.

6.0 QHSE

We care for utmost safety of man and machinery during field operations. Provisions have been made as per industry standard to acquire highest quality of data. As a concern to the environment, the crew desisted from any littering in the surrounding.



7.0 OPERATIONAL STANDARD

We adopt ASTM (American Society for Testing and Materials) standard guidelines D6431 equipment, field procedures, and interpretation methods for the assessment of the electrical properties of subsurface materials and their pore fluids, using the direct current (DC) resistivity method.

8.0 LIMITATION

A fundamental limitation of all geophysical methods lies in the fact that a given set of data cannot be associated with a unique set of subsurface conditions. In most situations, surface geophysical measurements alone cannot resolve all ambiguities, and some additional information, such as borehole data, is required. Because of this inherent limitation in geophysical methods, a resistivity survey alone is never considered a complete assessment of subsurface conditions. Properly integrated with other information, resistivity surveying is an effective method of obtaining subsurface information. All surface geophysical methods are inherently limited by decreasing resolution with depth.

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A common feature of all electrical methods is that the models derived from the electric profiling are not unique. That is, depending on the subsurface geo-electric structure, there may be many models that will produce essentially the same apparent resistivities. This is known as the principal of equivalence. To overcome this limitation, computer software programs include routines for evaluating the equivalence of a given model relative to the observed resistivity values, resulting in a model that provides the closest fit to the observed data. In brief, the limitations of electrical resistivity technique can be summarized as:

- a) Interpretations are ambiguous; consequently, independent geophysical and geological controls are necessary to discriminate between valid alternative interpretations of the resistivity data (Principles of Suppression & Equivalence)
- b) Interpretation is limited to simple structural configurations.
- c) Topography and the effects of near surface resistivity variations can mask the effects of deeper variations.
- e) The depth of penetration of the method is limited by the maximum electrical power that can be introduced into the ground and by the practical difficulties of laying out long length of cable. The practical depth limit of most surveys is about 1 Km.
- f) Accuracy of depth determination is substantially lower than with seismic methods or with drilling.
- g) Presence of high-tension wire, fences or elongated buried conductor may affect the resistivity measurements.

9.0 DATA COLLECTION FROM EXISTING BOREWELLS

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Sub-surface litho units, bore diameter, ground water discharge and its quality has been selected as parameter to obtain general information about the ground water availability and yield in the proposed area. The gathered information is tabulated below:

S.No.	Location	Bore Dia	Qty	Installed Pump Capacity	Approx. Discharge
1	Sugarcane Research Station	7.5"	1	15 HP	240 LPM
2		6"	2	15 HP	240 LPM
3		4"	3	7.5 HP	100 LPM
4		3"	4	5 HP	60 LPM

Table 3: Data from existing borewell at sugarcane research station

10.0 DRILLING RECOMMENDATION

Based on the interpreted result it is observed that the saturation exists in the depth range of 12 m to 145 m within the aquifer formed of mainly fine-medium-coarse grained sand. In terms of lithological variation and occurrence of ground water in the sub-surface, all the surveyed points are almost similar in nature. However, eastern end of surveyed area are comparatively better for borewell drilling for ground water exploration and preferences are tabulated hereunder on the basis of observed resistivity values and aquifer thickness



Preference Order	VES Location	Approx. Discharge
1	VES-03	350 LPM
2	VES-04	350 LPM
3	VES-01	300 LPM
4	VES-02	250 LPM

Table 4: Preference order for borewell drilling

The above estimated ground water yield are qualitative only based on the information from existing borewells in the surroundings

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
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11.0 CONCLUSION

From this study, several conclusions can be made. Perhaps the most important conclusion is that vertical electrical resistivity sounding (VES) do provide adequate and inexpensive means of studying the sub-surface for the ground water exploration purposes; and, notwithstanding inherent inaccuracies caused by lateral inhomogeneities and anisotropism, interpretation of VES data leads to the knowledge of the maximum depth below which it could be unlikely for groundwater aquifer to occur.

The geophysical investigation revealed that the subsurface consists of layered structure composed mainly of fine to course grained sand and silt. In general, the upper 10 m layer formation of sand with silt comes under dry to moisture accumulation and is having resistivity values in the range 68 – 211 Ω -m. Saturation occurs below this depth extending till 140 m depth in the unconfined condition. Ground water quality in this zone is mostly potable to brackish.

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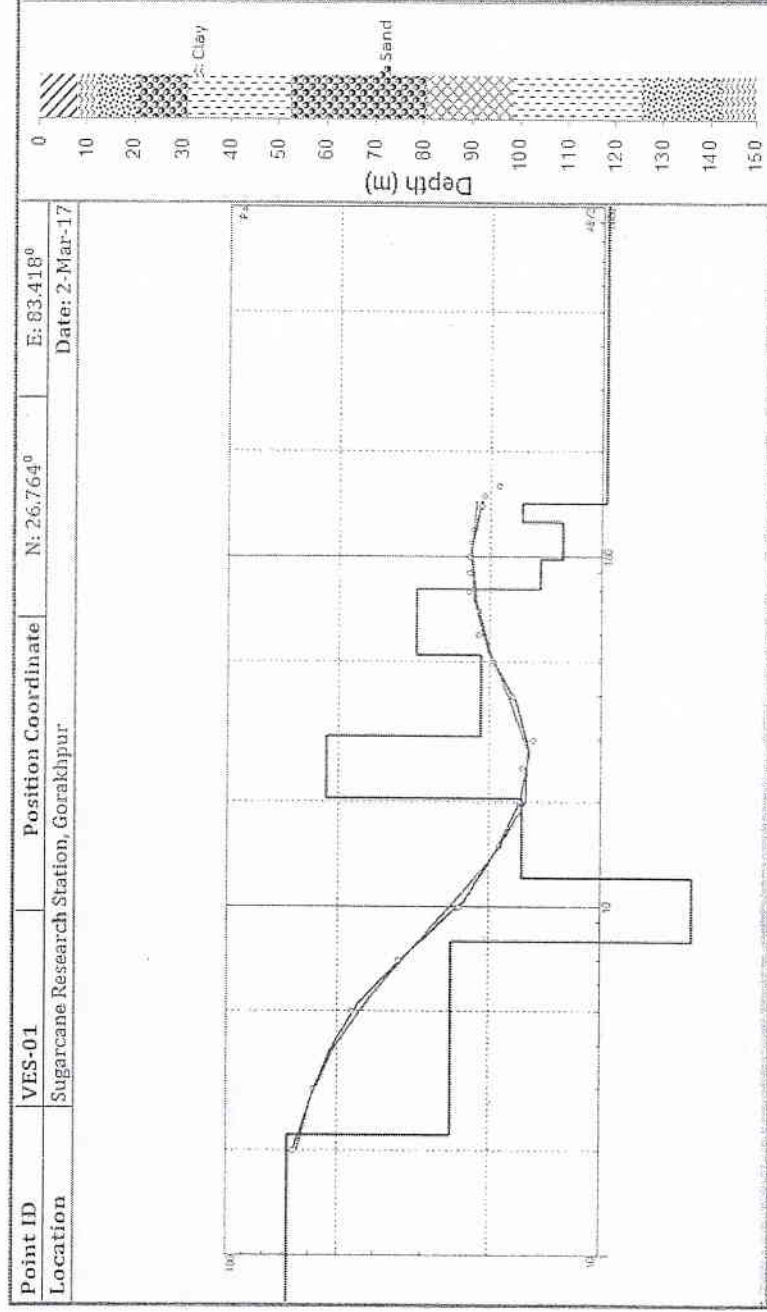







Fig 4: VES plotting and interpreted geoelectric sections

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True Resistivity (Ω -m)	Layer Thickness (m)	Depth Range (m)		Litholog	Remarks	Water Quality
		From	To			
68.5	2.21	0.00	2.21	Top soil		
25.1	5.72	2.21	7.93	Silty Sand		
5.63	4.15	7.93	12.08	Sand with silt		
16.27	8.33	12.08	20.41	Fine grained Sand		
54.4	10.43	20.41	30.84	Coarse grained sand		
12.1	21.38	30.84	52.22	Fine Sand		
31.1	28.4	52.22	80.62	Medium-to-coarse grained sand		
14.6	17.6	80.62	98.22	Fine-to-Medium Sand		
12.8	27.1	98.22	125.32	Fine Sand with clay		
16.4	16.6	125.32	141.92	Fine Sand		
9.7	Contd.	141.92	Contd.	Clay		

Table 4: Tabulation of geoelectric sections of VES-01

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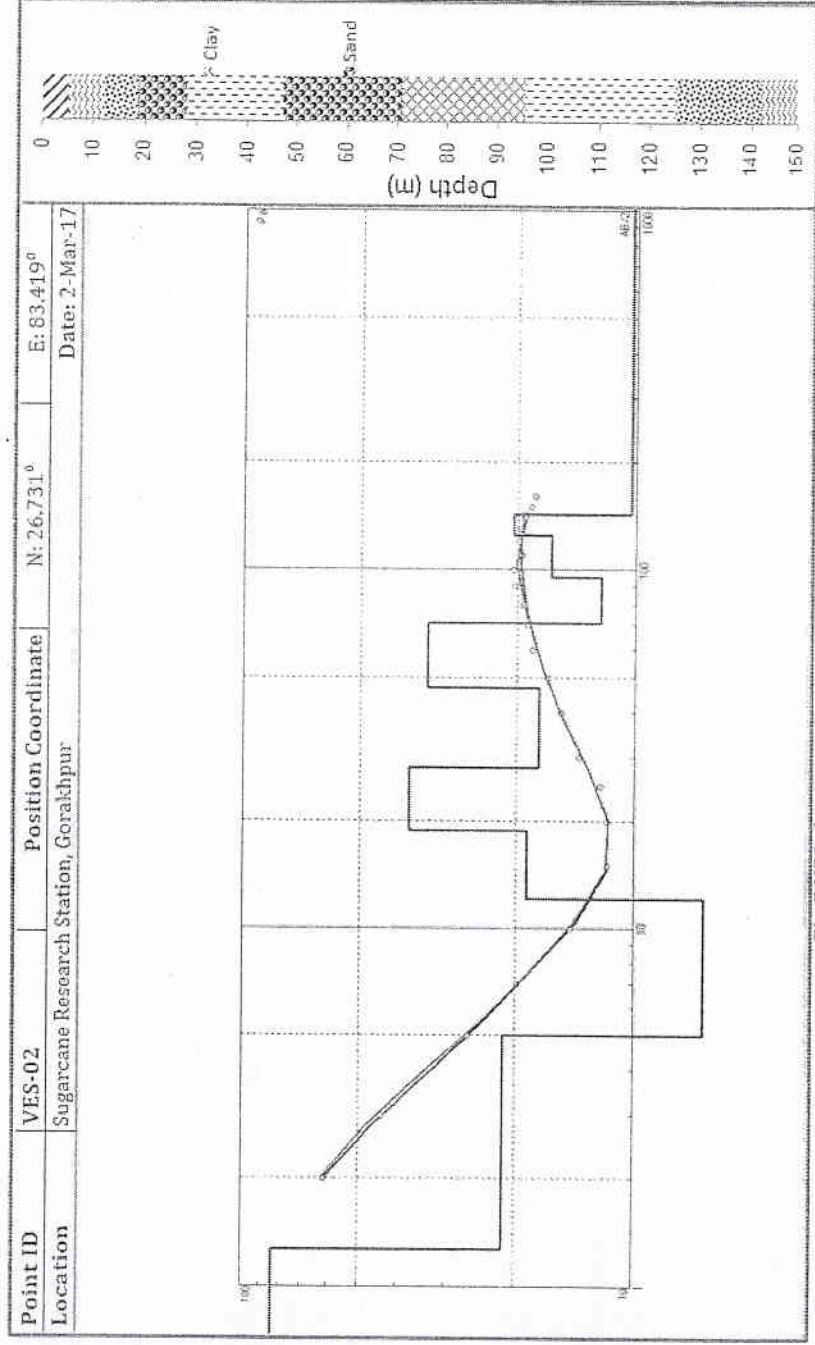




Fig 5: VES plotting and interpreted geoelectric sections



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True Resistivity (Ω -m)	Layer Thickness (m)	Depth Range (m)		Litholog	Remarks	Water Quality
		From	To			
83.2	1.27	0.00	1.27	Top soil		
21.5	3.73	1.27	5.00			
6.68	7.11	5.00	12.11	Silty Sand		
18.8	6.61	12.11	18.72	Fine grained Sand		
37.5	9.43	18.72	28.15	Coarse grained sand		
17.5	18.78	28.15	46.93	Fine Sand		
33.7	23.9	46.93	70.83	Medium-to-coarse grained sand		
12.2	24.6	70.83	95.43	Fine-to Medium Sand		
16.4	29.3	95.43	124.73	Fine Sand with clay		
20.4	17.4	124.73	142.13	Fine Sand		
10.3	Contd.	142.13	Contd.	Clay		

Table 5: Tabulation of geoelectric sections of VES-02

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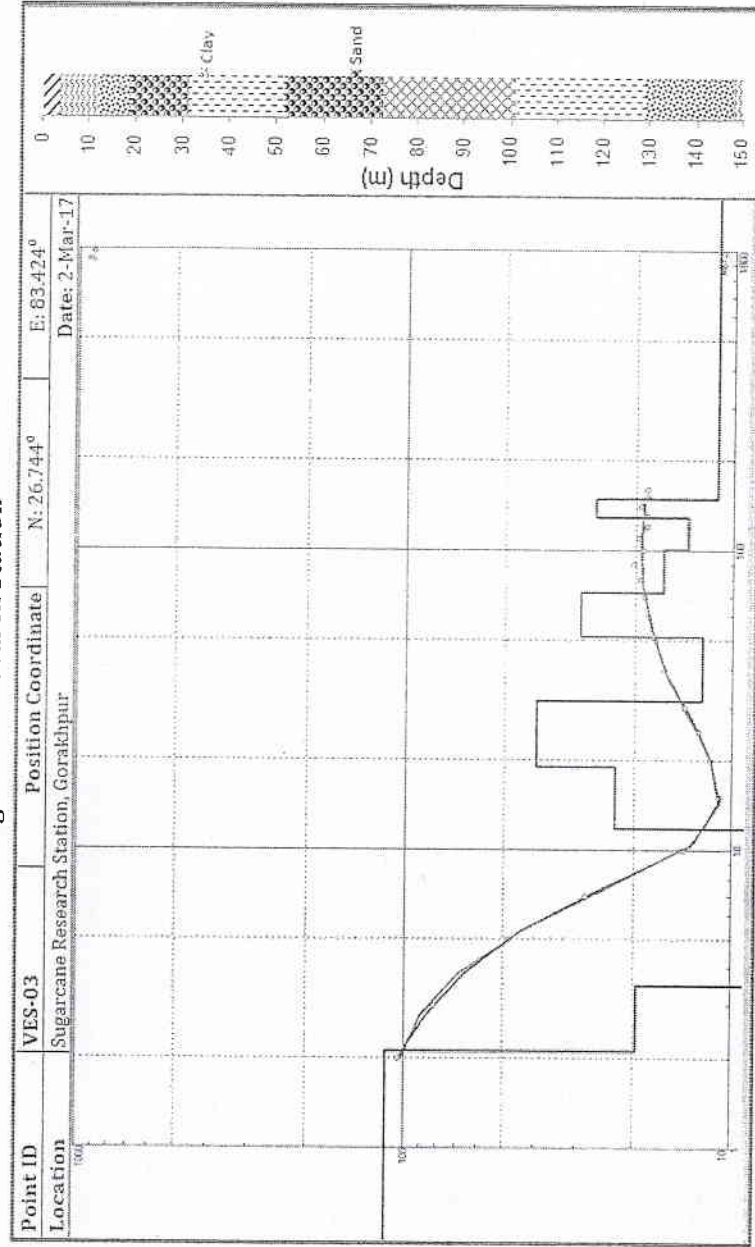




Fig 6:VES plotting and interpreted geoelectric sections

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True Resistivity (Ω -m)	Layer Thickness (m)	Depth Range (m)		Litholog	Remarks	Water Quality
		From	To			
114.6	2.11	0.00	2.11	Top soil		
19.6	1.39	2.11	3.50	Silty Sand		
7.31	8.23	3.50	11.73	Fine grained Sand		
22.9	7.13	11.73	18.86	Coarse grained sand		
39.9	12.5	18.86	31.36	Fine Sand		
12.5	20.2	31.36	51.56	Medium-to-coarse grained sand		
29.4	20.9	51.56	72.46	Fine to Medium Sand		
16.4	28.5	72.46	100.96	Fine Sand with clay		
13.8	27.8	100.96	128.76	Fine Sand		
26.5	19.3	128.76	148.06	Clay		
11.2	Contd.	148.06	Contd.			

Table 6: Tabulation of geoelectric sections of VES-03

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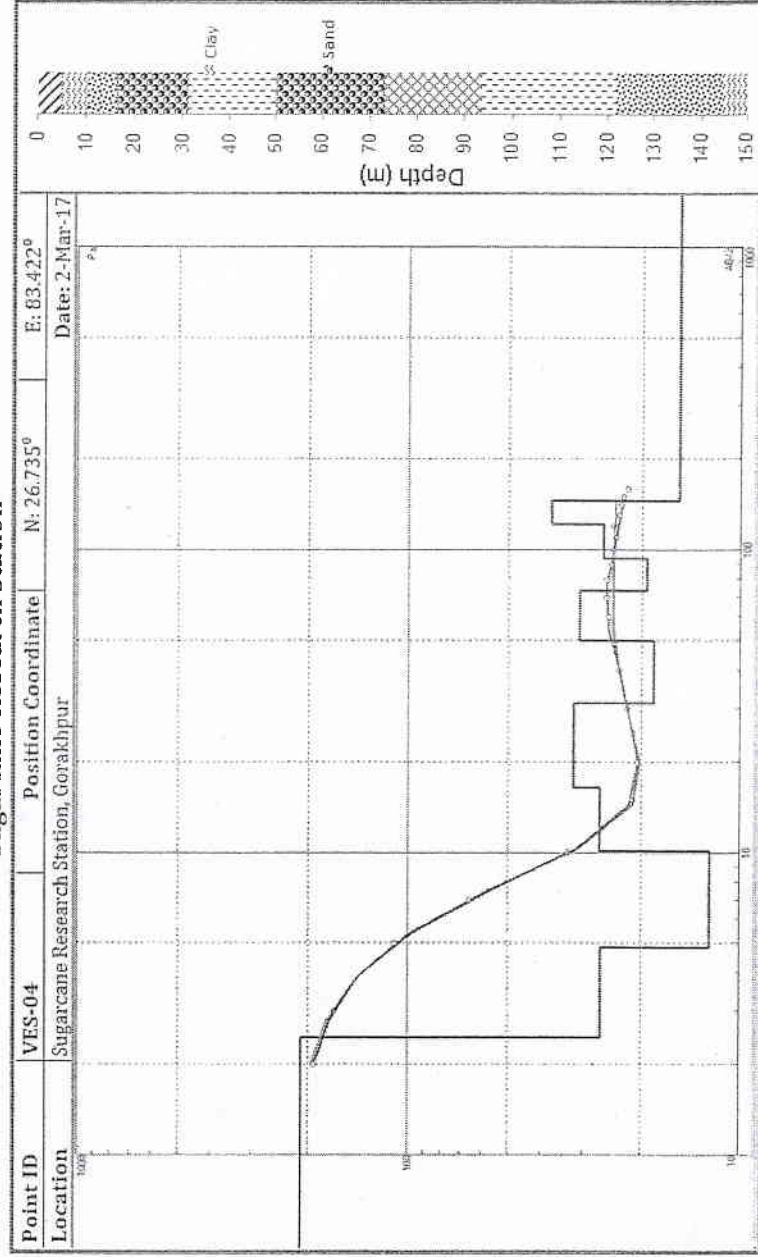


Fig 7:VES plotting and interpreted geoelectric sections

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True Resistivity (Ω -m)	Layer Thickness (m)	Depth Range (m)		Litholog	Remarks	Water Quality
		From	To			
211.3	2.45	0.00	2.45	Top soil		
26.5	2.39	2.45	4.84			
12.45	5.28	4.84	10.12	Silty Sand		
26.7	6.22	10.12	16.34	Fine grained Sand		
32.1	14.8	16.34	31.14	Coarse grained sand		
18.4	18.9	31.14	50.04	Fine Sand		
30.7	23.2	50.04	73.24	Medium-to-coarse grained sand	Saturated	Potable
19.3	20.4	73.24	93.64	Fine-to-medium Sand		
26.2	27.8	93.64	121.44	Fine Sand with clay		
37.5	23.3	121.44	144.74	Fine Sand		
15.4	Contd.	144.74	Contd.	Clay		

Table 7: Tabulation of geoelectric sections of VES-04

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