

Appendix 4

Geological & Geotechnical Survey

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOLOGICAL & GEOTECHNICAL REPORT

Dec.2012

Document Profile

Client	ORIENTAL CONSULTANTS CO. LTD. Shibuya-ku, Tokyo, 151-0071, Japan
Design	GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
Type of Document	GEOLOGICAL AND GEOTECHNICAL REPORT
Revision	00
Total Nº of Pages	29 pages
External Contributions	ECM, Geosarea, Tecnasol, Geocontrole and Infotop
Project Manager	F. Gomes Pinto
Geological & Geotechnical Manager	Luis Lopes
Date	December, 2012

Revised	Eurico Teixeira / Luis Lopes
Verified	Luis Lopes
Approved	Fernando Ferreira

TEXT INDEX

1 Introduction.....	4
2 Site Conditions.....	5
2.1 General.....	5
2.2 Geomorphology	6
2.3 Geological Settings.....	7
2.3.1 Lithostratigraphy.....	7
2.3.2 Hydrogeology.....	9
3 Ground Investigation Works.....	10
3.1 General.....	10
3.2 Rotary Boring.....	11
3.3 Laboratory testing	18
4 Geotechnical Interpretation	23
4.1 General.....	23
4.2 Geotechnical Zones.....	23
4.3 Geotechnical Design Parameters.....	24
4.4 Foundations	27
4.5 Excavations	27
4.6 Reuse of soils	28

FIGURE INDEX

Figure 1 – Location of studied area.....	5
Figure 2 – General view of site conditions.....	6
Figure 3 – Extract of Maputo geological map, 1:50 000 (published scale).....	8
Figure 4 – Samples recovered from borehole S1 (above) and S2 (below)	9
Figure 5 – Borehole locations	10
Figure 6 – A - Rotary drilling at S1. B - Terzaghi’s sample for the SPT. C – Recovered sample on drilling.....	11
Figure 7 – Graphical view of SPT results	16
Figure 8 – Moran sampler used for undisturbed sampling.....	18
Figure 9 – Grading curves of particle size distribution	21
Figure 10 – Plasticity chart.....	22
Figure 11 – Moisture content within Atterberg limits.....	22

TABLE INDEX

Table 1– Geographic features of ground investigation works	12
Table 2 – Summarize features of boreholes.....	12
Table 3 – Summarize of SPT field result values.....	15
Table 4 – Correction factors for rod length	16
Table 5 – Summarize of SPT corrected result values (NSPT _C)	17
Table 6 – Executed laboratory tests.....	19
Table 7 – Summarized results of laboratory testing	20
Table 8 – Geotechnical zoning criterion	23
Table 9 – Geotechnical design parameters.....	25
Table 10 - Engineering use chart for compacted soil	28

1 Introduction

At the request of **ORIENTAL CONSULTANTS CO. Ltd**, Shibuya-ku, Tokyo, 151-0071, Japan and with the scope of determining the geological and geotechnical model of the **Gas Fired Power Plant Development in Southern Mozambique** site, Ingérop Moçambique, with the collaboration of Geoarea supervised the ground investigation works and developed the geological and geotechnical design of the referred area.

Ground investigations were carried out between the 24th of October and the 8th of November and were undertaken by Tecnasol, consisting of rotary drill holes with core recovering.

Soil samples recovered from executed boreholes were laboratory tested including index and classification tests, specific gravity, moisture content, shear strength tests (unconfined compression test and direct shear test) and consolidation tests. Laboratory activity took place between the 28th of October and the 5th of December.

The current report is structured in 4 main chapters, including this one. A brief description is given bellow.

- **Introduction**
- **Site conditions**, where the geomorphology and geological setting is described including local hydrogeology and structural geology conditions.
- **Ground investigation works**, where a summary of executed ground investigation works is presented
- **Geotechnical interpretation**, presenting a discussion of various geotechnical aspects such as soil properties, terrain excavation ability and required foundation.

It is also presented, as an appendix to this report, the ensuing documents, bound as a separate volume.

- Ground investigation location plan
- Interpreted geotechnical cross-sections.
- Ground investigation data records and laboratory testing results

2 Site Conditions

2.1 General

The Study area is located at Maputo's Electricity of Mozambique old thermal power plant area, lying to the west of the city between the national road EN4 and the shoreline of Maputo Bay.

Figure 1 presents site location highlighted on a detailed aerial view framed up on a general aerial perspective of Maputo city.



Figure 1 – Location of studied area

Present site conditions include industrial ruins from the old thermal power plant and other accessory infrastructures.

2.2 Geomorphology

On geomorphologic unit terms, the studied location integrates the vast quaternary sedimentary deposits that dominate most of Mozambican south region and overlie the Sedimentary Mozambican Basin resulted after Gondwana dispersal

This area is situated downstream the confluence of Infulene River with Maputo Bay shoreline, where delta margins are dominated by flood plains that have been progressively intervened with earthworks throughout recent times.

The entire zone is integrated on a relatively flat area with elevation ranging from 3 to 5 meters, outlining a terrain morphology that was man modulated using landfill materials to raise the original levels.

Although preserved from the flood plains that characterize shorelines, all of the area might be periodically submitted to flood episodes due to heavy rains when combined with high sea waters or spring tides. In fairness, such scenario has not been reported happening since present site conditions were concluded for the previous thermal power plant.

Figure 3 presents a perspective of local terrain morphology and conditions.



Figure 2 – General view of site conditions

2.3 Geological Settings

2.3.1 Lithostratigraphy

Stratigraphic sequence occurring at the site location consists on Holocene superficial deposits that overlie Pleistocene (Congolote and Machava formation) and Pliocene (Ponta Vermelha formation) geological units described on the following paragraphs.

Holocene deposits compose all of the surface soils of the studied area, comprising landfill materials used to modulate terrain morphology at previous interventions. These materials are mainly constituted by silty-sandy soils with coal fragments and vegetal residues.

By this description one assume that most of it is of alluvium nature which might also occur in depth beneath the landfill deposits. Given these circumstances, it will be extremely difficult to differentiate one from the other and should all be treated as one unit.

Pleistocene unit known as Congolote formation (Qco) is mainly described as a coarse to fine grained sandy soil, poorly consolidated, of white, yellow or orange colouration. It represents aeolian materials of continental dunes, constituting a sandy stratum that overlies succeeding geological units.

Underlying the Congolote formation is the Machava formation (Qmc), mainly described as an interbedded sedimentary deposit of clayey sands with carbonated, salty and ferruginous formations and with a basal conglomerate.

Although its lateral limits are generally well defined, this geological unit may not be represented throughout all of the lower Pleistocene, enabling Congolote formation to settle directly on the Pliocene unit Ponta Vermelha through a stratigraphic unconformity.

Ponta Vermelha formation (TPv) comprises sand, siltstones and sandstones of reddish to yellowish colouration, occasionally with a ferruginous hard cover.

The Mozambican National Department of Geology published a geological map of Maputo on a scale of 1:50 000 (map 2532D3) of which an extract it is presented on the next figure with the approximate location of the new thermal power plant.

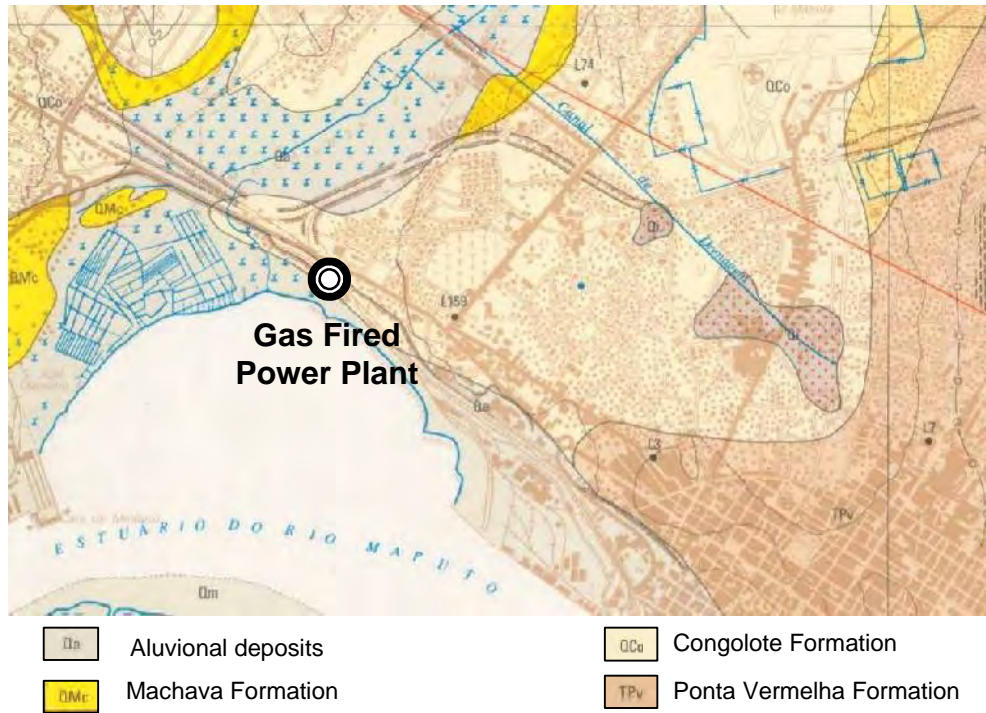


Figure 3 – Extract of Maputo geological map, 1:50 000 (published scale)

A few samples recovered from executed boreholes illustrate the described geology.





Figure 4 – Samples recovered from borehole S1 (above) and S2 (below)

Given the presented geological conditions there are no structural evidences of tectonic nature on the referred geomorphologic unit, as the deposited sediments overlie any bedrock that may exhibit any type of fragmentation.

For this reason there are no geological structural constraints at the purposed site.

2.3.2 Hydrogeology

Hydrogeological aptitude of a sedimentary deposit with the described features suggest the existence of a multi-layered aquifer system with alternating pervious to impervious stratum, depending on its grading characteristics.

Therefore, on a general approach, it may be assumed that this is a complex system where possibly confined and unconfined aquifers coexist and the existence of aquitards and aquifuges plays an essential role on the confinement of hydrogeological units and their own drainage.

Although, very little hydrogeological information is known regarding this area, soils are expected to be saturated a couple of meters below ground level as groundwater was identified on all boreholes at very superficial depths ranging from 0 to 2 meters.

3 Ground Investigation Works

3.1 General

Works started with a site visit to the future location of the new Maputo Thermal Power Plant on the 18th of October. At the time, a Client's representative was present (Mr Mitsuro Miyashita) as well as the general coordinator for the present study (Mr F. Gomes Pinto) and the geology and geotechnics consultant (Mr Luis Lopes). A topographical field team was also made available so that ground investigation locations would be promptly marked.

Ground investigation fieldworks comprised on 11 rotary drill holes. Final location was later adjusted by the geology and geotechnics consultant so that ground investigation data could be optimized for the design purpose. After fieldworks were completed these locations were surveyed by the topographic team.

The following image shows the final borehole locations.

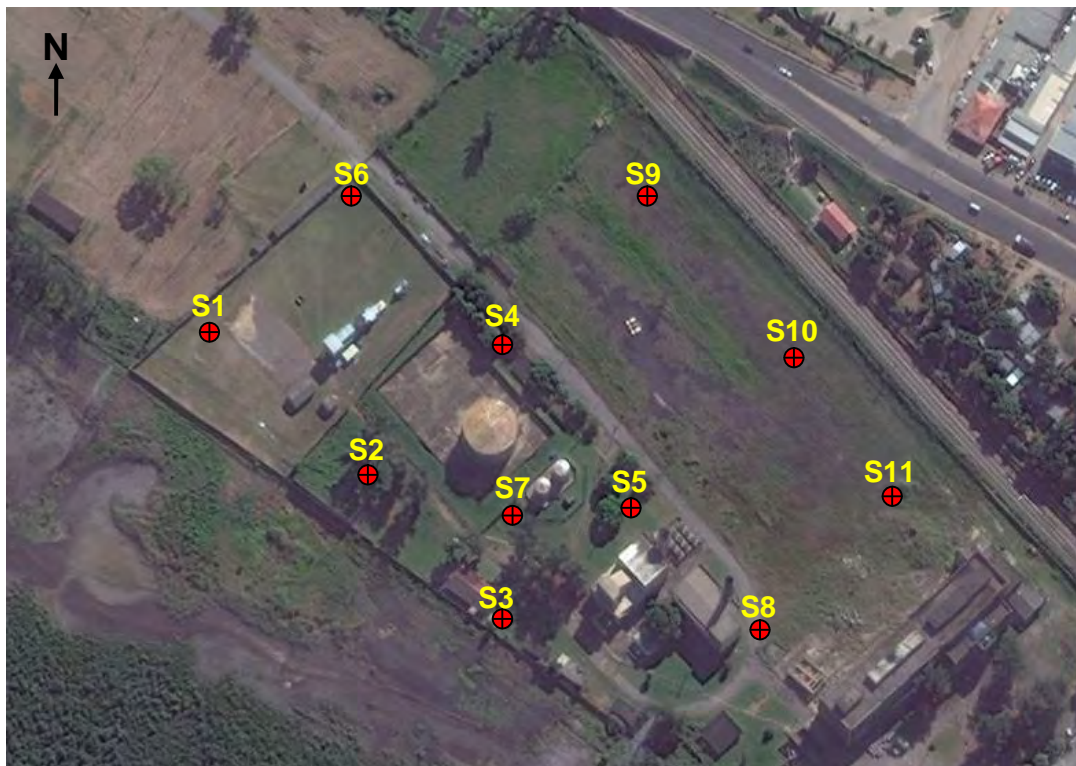


Figure 5 – Borehole locations

3.2 Rotary Boring

Using standard rotary coring methods, 11 boreholes of 86mm internal diameter were drilled with Delta Base 520 equipment. In order to prevent soil to collapse, boreholes were lined with casing, particularly when sandy soil was intersected.

In situ field testing such as SPTs were carried out along the drilling process, between 1.0m intervals constituting, in fact, the main criterion for drilling stoppage, occurring when N_{SPT} hits a minimum of 50 blows on 5 consecutive times ($N_{SPT} > 50$).

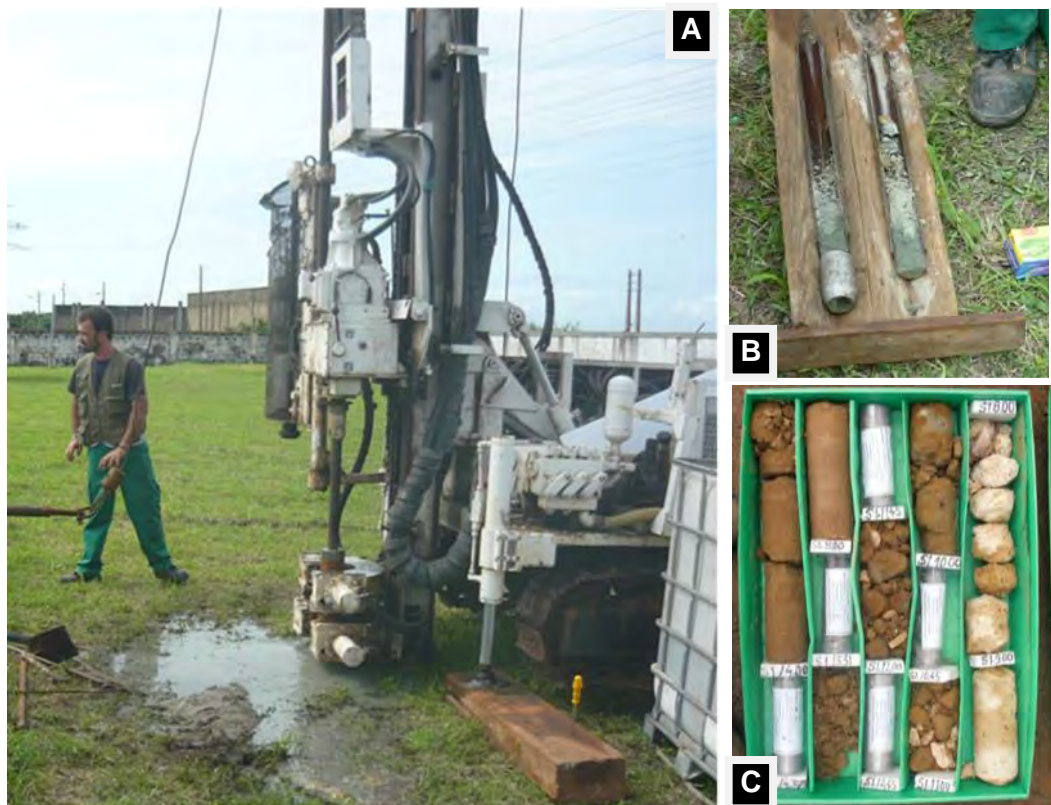


Figure 6 – A - Rotary drilling at S1. B - Terzaghi's sample for the SPT. C – Recovered sample on drilling

The following table summarizes the geographic features of executed boreholes through their respective x, y and z coordinates considering UTM format and WGS84 datum.

Table 1– Geographic features of ground investigation works

Reference	Coordinates			Remarks	
	X	Y	Z		
rotary drill hole	S1	7130964.5 7	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.9 9	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.0 2	452891.05	3.20	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.9 0	452888.10	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.8 3	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.0 4	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.2 9	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.7 4	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.3 6	452943.24	3.40	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.0 3	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.7 9	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)

The main geological and geotechnical features of all boreholes are summarized in the following table.

Table 2 – Summarize features of boreholes

Ref.	GW level (m)	Depth (m)	Geology		Total core recovery (%)		
			Depth (m)	Lithology	50	50 - 75	75
S1	1.8	20.0	0.0 – 2.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 5.2 - 14 15 - 16	14 - 15 18 – 20	4,0 - 5,2 16 - 18
			2.45 - 3	Medium grained, clean sand, poorly graded			
			3 – 6.45	Fine to coarse grained clayey sand, on a loose density state, occasionally with gravel			
			6.45 – 8.0	Medium to coarse grained clayey sand with thin marly and calcarenite interbeds			
			8.0 – 10.0	Medium to fine grained sandstone			
			10.0 – 20.0	Fine to medium grained clayey sand, generally on a very dense state			
S2	1.3	15.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4,0 5,2 - 8,0 12 - 13	8,0 - 11,0 14,0 -15,0	4,0 - 5,2 11,0 - 12,0 13,0 - 14,0
			2.0 – 3.0	Fine grained clean sand, poorly graded.			
			3.0 – 4.0	Fine grained clayey sand with calcarenite gravel			

Ref.	GW level (m)	Depth (m)	Geology		Total core recovery (%)		
			Depth (m)	Lithology	50	50 - 75	75
			4.0 – 5.5	Gravel of variable dimension with sandy silt matrix			
			5.5 – 6.45	Fine to medium clayey sand, on a loose density state.			
			6.45 – 9.0	Coarse grained calcarenite with fossiles			
			9.0 -11.0	Fine to medium grained clayey sand with interbedded sandstone gravel, on a loose density state.			
			11.0 – 12.0	Fine to medium grained sandstone			
			12.0 – 15.0	Fine to medium grained clayey sand with sandstone gravel, on a very dense state.			
S3	1.05	12.0	0.0 – 3.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 1.0 2.0 - 4.0 4.6 - 6.0 7.0 - 11	1.0 - 2.0 6.0 - 7.0 11 - 12	4.0 - 4.6
			3.45 – 4.0	Medium grained clean sand, poorly graded.			
			4.0 – 12	Fine to medium grained clayey sand with gravel, on a dense to very dense state, with highly weathered sandstone interbeds (5-7.5m)			
S4	1.0	10.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 3.5 4.7 - 8.0	8.0 - 10.0	3.5 - 4.7
			2.0 – 3.0	Medium grained clean sand, poorly graded.			
			3.0 – 5.45	Fine grained clayey sand, with gravel, on a loose density state			
			5.45 – 10.0	Fine to medium grained clayey sand, on a very dense state, with interbeds of highly weathered sandstone (5.45 – 7.0)			
S5	1.0	9.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 5.0 - 7.0	7.0 - 9.0	4.0 - 5.0
			2.0 – 3.45	Medium grained clean sand, poorly graded.			
			3.45 – 7.0	Weathered sandstone with occasionally highly weathered interbeds recovered as a clayey sand with gravel.			
			7.0 – 9.0	Fine to medium grained clayey sand, on a very dense state.			
S6	1.0	15.0	0 - 1.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 4.6 - 8.5 9.0 - 11 10 - 11 12 - 13	11.0 - 12.0 11 - 12 13 - 15	4.0 - 4.6 8.5 - 9.0
			1.45 – 4.0	Medium grained clean sand, poorly graded.			
			4.0 – 7.0	Fine to medium grained clayey sand, with gravel			
			7.0 – 8.0	Coarse grained calcarenite, weathered			
			8.0 – 12.0	Fine grained clayey sand, on a dense to very dense state			
			12.0 – 14.0	Medium grained weathered sandstone, with a fresh interbed between 13.6 and 14.0			
S7	-	10.0	0.0 – 3.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 4.4 - 4.9	5.5 - 7.0 8.0 - 9.0	4.0 - 4.4 4.9 - 5.5

Ref.	GW level (m)	Depth (m)	Geology		Total core recovery (%)		
			Depth (m)	Lithology	50	50 - 75	75
			3.0 – 4.0	Medium grained clean sand, poorly graded.	7.0 - 8.0		9.0 - 10.0
			4.0 – 4.4	Coarse gravel with clayey to sandy matrix, poorly graded			
			4.4 – 5.45	Fine grained clayey sand, with gravel.			
			5.45 – 7.2	Medium grained sandstone with occasionally interbedded calcarenite			
			7.2 – 10.0	Fine to medium grained clayey sand, on a very dense state.			
S8	1.0	11.1	0.0 – 2.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 5.0 5.6 - 6.0	6.0 - 9.0	5.0 - 5.6 9.0 - 11.0
			2.45 – 3.0	Medium grained clean sand, poorly graded.			
			3.0 – 9.35	Fine grained clayey sand, with gravel, on a medium to very dense state.			
			9.35 – 11	Medium grained weathered sandstone with interbedded marls			
			11 – 11.1	Fine grained clayey sand, on a very dense state.			
S9	0.5	14.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.5 5.1 - 12	-	4.5 - 5.1 12.0 - 14.0
			2.0 – 4.0	Medium grained clean sand, poorly graded.			
			4.0 – 5.1	Fine to medium grained clayey sand, with gravel on a very loose density state			
			5.1 – 7.0	Medium grained weathered sandstone.			
			7.0 – 9.45	Fine grained clayey sand, with gravel, on a medium density state			
			9.45 – 10.4	Fine grained weathered sandstone.			
			10.4 – 14.0	Fine grained clayey sand, on a very dense state.			
S10	0.0	14.0	0.0 – 3.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 5.0 6.2 – 9.0 11 - 13	9.0 - 11 13 - 14	5.0 - 6.2
			3.0 – 4.0	Fine grained weathered sandstone			
			4.0 – 5.0	Sandy clay, of hard consistency			
			5.0 – 6.2	Clayey sand with gravel			
			6.2 – 7.4	Coarse grained weathered sandstone with interbedded marls			
			7.4 – 14	Fine grained clayey sand, with gravel, on a very dense state, with interbedded weathered sandstone between 13-13.38m.			
S11	1.0	19.0	0.0 – 3.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 5.1 - 8.0 10 - 11 16 - 17	8.0 - 10.0 11.0 - 16.0 17.0 - 18.0	4.0 - 5.1 18.0 - 19.0
			3.0 – 10.3	Fine to medium grained clayey sand, with gravel, on a medium to very dense state			
			10.3 – 11	Sandy clay, of hard consistency			
			11 - 18	Fine to medium grained clayey sand, with gravel, on a very dense state			

Standard Penetration Test (SPT)

This dynamic penetration test was undertaken at the bottom of the boreholes along with the drilling process at intervals of 1 m, allowing for the estimation of strength and deformation properties of intersected soils as well as obtainment of disturbed samples for identification purposes.

Its procedure consisted on driving a split spoon sampler of standard dimensions into the bottom of the borehole, at a given depth, by an automatic trip hammer that allowed a weight of 63,5 kg to fall on to a drive head from a height of 0,76m.

SPT field results are summarized in the following table and chart.

Table 3 – Summarize of SPT field result values

Depth Ref.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
S1	14	15	-	-	11	8	8	60	-	30	22	60	60	60	31	60	60	60	60	60
S2	-	-	-	-	60	10	54	60	10	16	60	60	60	60	60	-	-	-	-	-
S3	3	4	6	-	35 ⁽¹⁾	30	39	50	60	60	60	60	-	-	-	-	-	-	-	-
S4	14	13	15	-	22	60	60	60	60	60	-	-	-	-	-	-	-	-	-	-
S5	7	8	2	-	60	60	60	60	60	-	-	-	-	-	-	-	-	-	-	-
S6	7	5	10	-	10 ⁽¹⁾	40	44	28	38	60	60	60	60	60	60	-	-	-	-	-
S7	2	3	3	6 ⁽¹⁾	60 ⁽²⁾	60	60	60	60	60	-	-	-	-	-	-	-	-	-	-
S8	10	13	11	15	-	11 ⁽²⁾	60	60	60	60	60	-	-	-	-	-	-	-	-	-
S9	16	19	3	2	-	58	32	25	11	60	60	60	60	60	-	-	-	-	-	-
S10	18	17	60	45	-	60	60	41	31	60	60	60	60	60	-	-	-	-	-	-
S11	3	8	19	-	19	22	25	47	60	60	60	39	48	42	60	60	60	60	60	-

(1) – True SPT depth is 4.5m

(2) – True SPT depth is 5.5m

SPT refusal

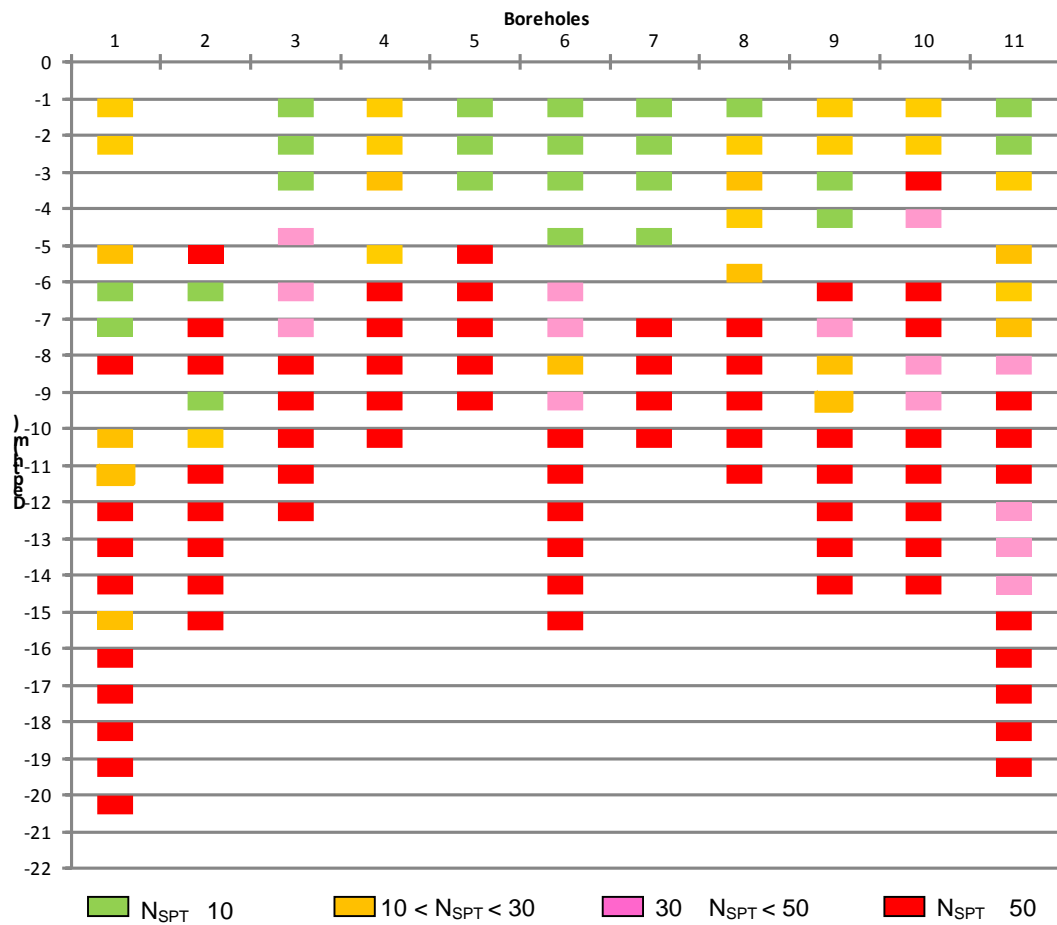


Figure 7 – Graphical view of SPT results

In order to obtain more reliable SPT results, the application of the appropriate correction factors was considered, in particular, energy delivered to the drive rods and energy loss due to the length of rods. Taking into account the moderated cohesive nature of the soils the effect of overburden pressure was not regarded.

Energy delivered to the drive rods was standardized to N_{60} so that $N_{60} = N \cdot (ER_r/60)$, where N are the SPT field results and ER_r is the energy ratio of the test equipment (60%). That being said, this correction factor assumes a proportion of 1 on this particular case.

Correction for energy losses due to the length of rods considers the following correction factors.

Table 4 – Correction factors for rod length

Rod length below the anvil (m)	Correction factor
> 10	1,0
6 – 10	0,95
4 – 6	0,85
3 - 4	0,75

SPT corrected results are summarized in the following table.

Table 5 – Summarize of SPT corrected result values (NSPT_C)

Depth Ref.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
S1	11	11	-	-	9	7	8	57	-	29	22	60	60	60	31	60	60	60	60	60
S2	-	-	-	-	51	9	51	57	10	15	60	60	60	60	60	-	-	-	-	-
S3	2	3	5	-	30 ⁽¹⁾	26	37	57	57	57	60	60	-	-	-	-	-	-	-	-
S4	11	10	11	-	19	51	57	57	57	57	-	-	-	-	-	-	-	-	-	-
S5	5	6	2	-	51	51	57	57	57	-	-	-	-	-	-	-	-	-	-	-
S6	5	4	8	-	9 ⁽¹⁾	34	42	27	36	57	60	60	60	60	60	-	-	-	-	-
S7	2	2	2	5 ⁽¹⁾	51 ⁽²⁾	51	57	57	57	57	-	-	-	-	-	-	-	-	-	-
S8	8	10	8	13	-	9 ⁽²⁾	57	57	57	57	60	-	-	-	-	-	-	-	-	-
S9	12	14	2	2	-	49	30	24	10	57	60	60	60	60	-	-	-	-	-	-
S10	14	13	45	34	-	51	57	39	29	57	60	60	60	60	-	-	-	-	-	-
S11	2	6	14	-	16	19	24	45	57	57	60	39	48	42	60	60	60	60	60	60

(1) - True SPT depth is 4.5m

(2) - True SPT depth is 5.5m

The following points highlight the obtained results.

- The geological model is generally represented by superficial landfill deposits on a loose density state, with a generalized thickness of 2-3m that overlies Pleistocene sandy soils with occasionally interbedded weathered sandstone and calcarenite.
- Core recovery is mostly below 50% - 60%, with the occasionally 75-100% recovery particularly when the special sampler was used for the laboratory tests samples.
- On general terms soil resistance estimated by the SPT increases with depth, with the occasional breaks, particularly when intersected clayey interbeds.
- All boreholes feature a minimum of 4 consecutive SPT refusals, starting at depths ranging between 5m and 15m
- Groundwater level was identified in every borehole with the exception of S7. Water level depths range between 0 and 1.8m which, in terms of elevation, translates on 1.5 to 4.8m. These water level values should be carefully analysed as most likely these readings do not match with stabilized groundwater levels.

3.3 Laboratory testing

Laboratory testing was carried out using available undisturbed and disturbed soil samples recovered throughout rotary drilling, although one must admit that in geotechnical work there is no such thing as undisturbed soil sample. In reality undisturbed means a sample where care has been taken to minimize damage.

Undisturbed samples were collected using the Moran sampler when a geotechnical stratum of $N_{SPT} < 15$ was intersected, as in these conditions a scenario of cohesive soils was expected; and also, when partially consolidated stratum were cut across by the T2 sampler.

Disturbed samples were obtained throughout drilling using either the T2 sampler or the Terzaghi sampler of the SPT surveys.



Figure 8 – Moran sampler used for undisturbed sampling

The following table resumes all sample locations and submitted laboratory testing.

Table 6 – Executed laboratory tests

Drill hole ref.	Sample ref. / Type of sample	Sample depth (m)	Soil laboratory tests						
			Grain size analysis	Atterberg limits	Moisture content	Specific gravity	Unconf. Compres. Strength	Direct Shear Strength (C.U.)	Consolid. test
S1	56727 / DS	2.4-3.0	✓	✓	✓	✓	-	-	-
	56724 / US	4.0-4.6	✓	✓	✓	✓	-	✓	-
	56725 / US	4.6-5.2	✓	✓	✓	✓	-	-	-
	56728 / DS	14.0-15.0	✓	✓	✓	✓	-	-	-
	56726 / ST2	17.6-18.0	✓	✓	✓	✓	-	✓	-
S2	56736 / US	4.0-5.2	✓	✓	✓	✓	-	-	-
	56740 / DS	9.4-10.0	✓	✓	✓	✓	-	-	-
	56737 / ST2	14.4-15.0	✓	✓	✓	✓	-	✓	-
S3	56741 / DS	1.4-2.0	✓	✓	✓	✓	-	-	-
	56738 / US	4.0-4.6	✓	✓	✓	✓	-	-	✓
	56742 / DS	6.7-7.0	✓	✓	✓	✓	-	-	-
	56739 / ST2	9.4-10.0	✓	✓	✓	✓	-	✓	-
S4	56764 / DS	2.4-3.0	✓	✓	✓	✓	-	-	-
	56753 / US	3.5-4.7	✓	✓	✓	✓	-	✓	-
	56754 / ST2	8.4-9.0	✓	✓	✓	✓	✓	✓	-
S5	56765 / DS	3.6-4.0	✓	✓	✓	✓	-	-	-
	56755 / US	4.0-4.2	✓	✓	✓	✓	-	-	-
	56756 / ST2	7.0-8.0	✓	✓	✓	✓	-	✓	-
S6	56730 / US	4.0-4.6	✓	✓	✓	✓	-	✓	✓
	56732 / DS	5.0-6.0	✓	✓	✓	✓	-	-	-
	56731 / ST2	8.4-9.0	✓	✓	✓	✓	✓	✓	-
	56733 / DS	11.5-12.0	✓	✓	✓	✓	-	-	-
S7	56757 / US	4.0-4.2	✓	✓	✓	✓	-	-	-
	56758 / US	4.8-5.4	✓	✓	✓	✓	-	✓	✓
	56766 / DS	7.7-8.0	✓	✓	✓	✓	-	-	-
	56759 / ST2	9.5-10.0	✓	✓	✓	✓	-	✓	-
S8	56767 / DS	3.6-3.9	✓	✓	✓	✓	-	-	-
	56760 / US	5.0-5.6	✓	✓	✓	✓	✓	-	✓
	56761 / ST2	8.4-9.0	✓	✓	✓	✓	-	✓	-
S9	56777 / US	4.5-5.1	✓	✓	✓	✓	-	-	✓
	56778 / ST2	7.5-8.5	✓	✓	✓	✓	-	✓	-
	56781 / DS	13.5-14.0	✓	✓	✓	✓	-	-	-
S10	56779 / US	5.0-6.2	✓	✓	✓	✓	✓	-	-
	56780 / ST2	8.5-9.0	✓	✓	✓	✓	-	✓	-
	56782 / DS	11.5-12.0	✓	✓	✓	✓	-	-	-
S11	56762 / US	4.0-5.1	✓	✓	✓	✓	-	✓	-
	56768 / DS	3.5-4.0	✓	✓	✓	✓	-	-	-
	56763 / ST2	9.5-10.0	✓	✓	✓	✓	✓	✓	-
	56769 / DS	17.4-17.8	✓	✓	✓	✓	-	-	-

Soil laboratory testing results are summarized in the following table. The complete laboratory data records are available in the appendix volume attached to this report.

Table 7 – Summarized results of laboratory testing

Sample reference / investigation point	Particle size distribution (% passing)			Atterberg limits		Classification		W _{nat} (%)	G _s (g/cm ³)	Shear Strength parameters		qu (kPa)	Consolidation	
	0.074 mm	0.42 mm	2.0 mm	WL (%)	PI (%)	ASTM	AASHTO			c (kPa)	Φ (°)		E (kPa)	C _c e ₀
56727 / S1	3	80	100	NP	NP	SP	A-3 (0)	22.8	2.67	-	-	-	-	-
56724 / S1	21	71	83	35	17	SC	A-2-6 (0)	24.0	2.74	42	22	-	-	-
56725 / S1	23	50	77	35	19	SC	A-2-6 (1)	20.0	2.75	-	-	-	-	-
56728 / S1	21	95	97	54	32	SC	A-2-7 (1)	23.4	2.72	-	-	-	-	-
56726 / S1	25	97	100	37	13	SC	A-2-6 (0)	26.6	2.75	52	37	-	-	-
56736 / S2	10	25	38	26	11	GP-GC	A-2-6 (0)	12.5	2.70	-	-	-	-	-
56740 / S2	26	83	92	44	19	SC	A-2-1 (1)	20.9	2.70	-	-	-	-	-
56737 / S2	16	96	100	41	18	SC	A-2-6 (0)	23.0	2.72	65	23	-	-	-
56741 / S3	28	44	63	NP	NP	SM	A-2-4 (0)	33.6	2.42	-	-	-	-	-
56738 / S3	21	79	86	27	12	SC	A-2-6 (0)	25.3	2.72	-	-	-	0.16	1.8E-3
													0.81	5.9E-8
56742 / S3	26	44	58	26	13	SM	A-2-6 (0)	11.6	2.74	-	-	-	-	-
56739 / S3	22	90	96	42	18	SC	A-2-7 (1)	25.7	2.75	34	30	-	-	-
56764 / S4	1	72	98	NP	NP	SP	A-3 (0)	19.3	2.65	-	-	-	-	-
56753 / S4	22	56	65	35	14	SC	A-2-6 (0)	20.1	2.76	0	41	-	-	-
56754 / S4	21	93	97	39	17	SC	A-2-6 (0)	17.7	2.75	32	26	156	-	-
												10968	-	-
56765 / S5	36	80	88	43	22	SC	A-7-6 (3)	26.1	2.72	-	-	-	-	-
56755 / S5	15	30	36	37	19	GC	A-2-6 (0)	14.0	2.73	-	-	-	-	-
56756 / S5	16	92	97	44	23	SC	A-2-7 (0)	25.2	2.76	13	33	-	-	-
56730 / S6	31	84	89	40	21	SC	A-2-6 (2)	27.0	2.74	20	35	-	0.17	7.8E-3
													0.9	2.1E-7
56732 / S6	17	53	68	34	20	SC	A-2-6 (0)	23.4	2.73	-	-	-	-	-
56731 / S6	16	86	94	48	25	SC	A-2-7 (0)	24.3	2.75	37	22	51	-	-
												9167	-	-
56733 / S6	19	96	99	38	16	SC	A-2-6 (0)	22.3	2.75	-	-	-	-	-
56757 / S7	12	28	37	37	18	GP-GC	A-2-6 (0)	14.4	2.72	-	-	-	-	-
56758 / S7	34	66	72	42	25	SC	A-2-7 (3)	24.0	2.74	17	36	-	0.15	8.5E-3
													0.77	2.0E-7
56766 / S7	18	95	99	41	18	SC	A-2-7 (0)	20.8	2.72	-	-	-	-	-

56759 / S7	21	95	98	39	18	SC	A-2-6 (0)	24.7	2.71	23	36	-	-	-
56767 / S8	29	65	74	28	12	SC	A-2-6 (0)	18.3	2.72	-	-	-	-	-
56760 / S8	29	69	80	46	27	SC	A-2-7 (2)	23.5	2.74	-	-	45	0.14	4.4E-3
												7692	0.79	8.2E-8
56761 / S8	19	96	100	40	20	SC	A-2-6 (0)	21.2	2.72	24	34	-	-	-
56777 / S9	21	53	67	49	26	SC	A-2-7 (1)	21.2	2.70	-	-	-	0.19	4.1E-3
												-	0.90	1.9E-7
56778 / S9	18	97	98	44	21	SC	A-2-7 (0)	23.3	2.70	40	28	-	-	-
56781 / S9	24	90	98	42	21	SC	A-2-7 (1)	25.0	2.72	-	-	-	-	-
56779 / S10	20	40	60	46	26	SC	A-2-7 (1)	15.1	2.72	-	-	22	-	-
												2667	-	-
56780 / S10	17	56	82	44	25	SC	A-2-7 (0)	15.5	2.71	38	34	-	-	-
56782 / S10	21	94	98	48	22	SC	A-2-7 (1)	23.2	2.72	-	-	-	-	-
56762 / S11	21	78	94	44	25	SC	A-2-7 (1)	29.0	2.73	15	34	-	-	-
56768 / S11	31	68	83	45	25	SC	A-2-7 (2)	18.3	2.74	-	-	-	-	-
56763 / S11	19	87	99	36	17	SC	A-2-6 (0)	18.4	2.70	25	34	120	-	-
												13684	-	-
56769 / S11	25	95	97	43	19	SC	A-2-7 (1)	23.8	2.71	-	-	-	-	-

The next figures present the grading curves of particle size distribution and the plasticity chart for the fine fraction of soils.

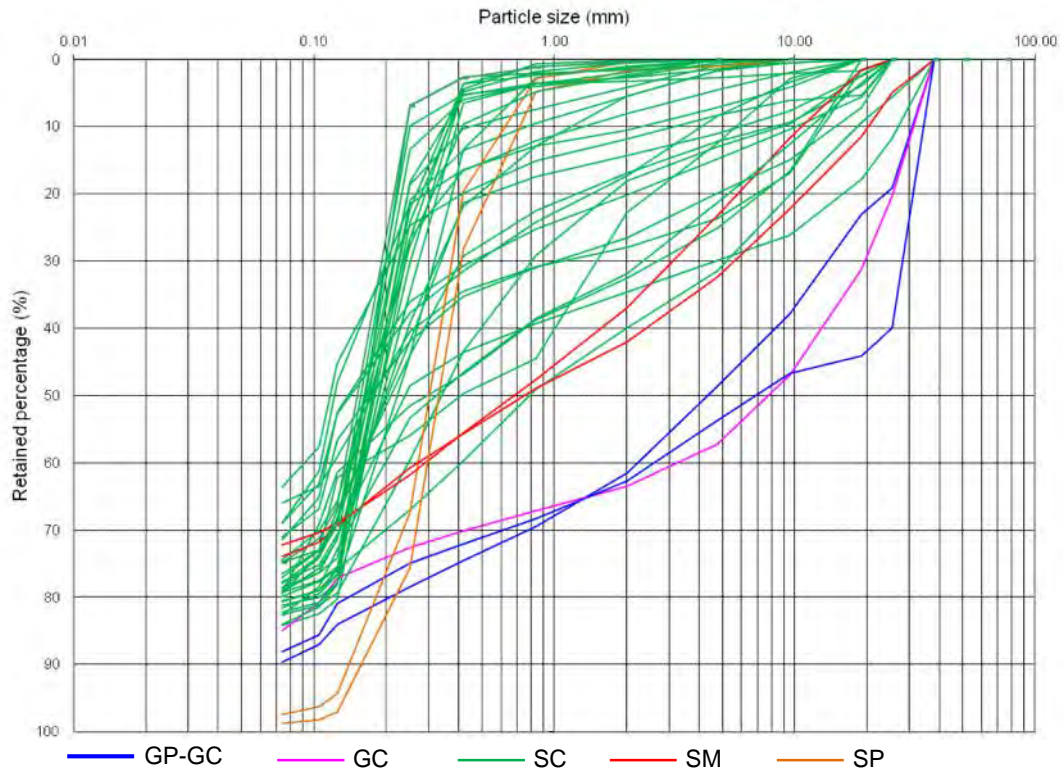


Figure 9 – Grading curves of particle size distribution

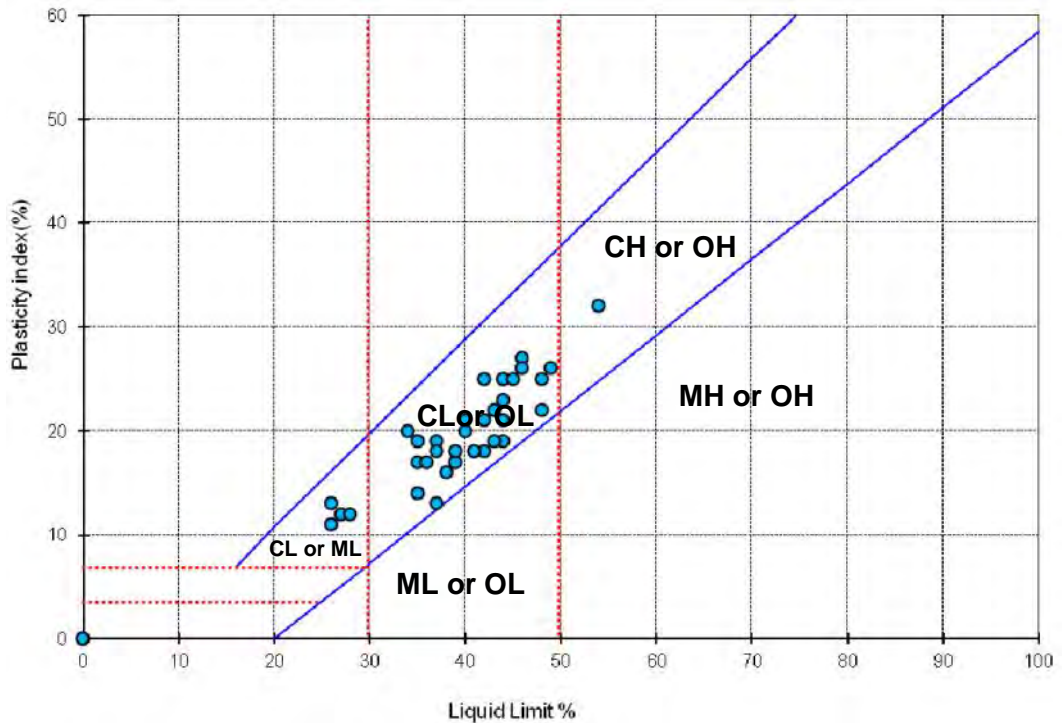


Figure 10 – Plasticity chart

Following figure exhibits the distribution of natural moisture content (in blue colour) within the computed Atterberg limits: liquid limit on the upper extreme and plastic limit on the lower extreme

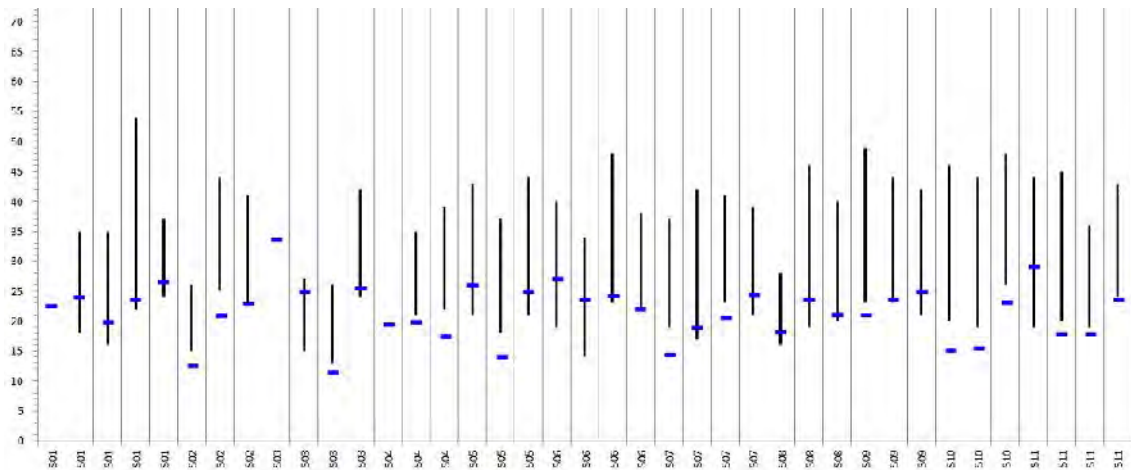


Figure 11 – Moisture content within Atterberg limits

4 Geotechnical Interpretation

4.1 General

The geotechnical deliberations set out in the following sub-chapters are based on the obtained data from the ground investigation works and laboratory testing specifically planned for this design.

It was also taken into consideration previous experience on similar geological settings by the geological team.

4.2 Geotechnical Zones

Local geotechnical conditions dictated a model comprising 5 geotechnical zones (GZ) outlined by its geology features and SPT results.

Table 8 exhibits the applied criterion when establishing these geotechnical zones.

Table 8 – Geotechnical zoning criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

[...] registered only once

These geotechnical zones are outlined in cross-sections A-A' to H-H' which can be consulted on the appended drawings referenced 02412.D01 and 02412.D02.

On a general note it's evident that the transition between geotechnical zones is not sequential, reflecting a high heterogeneity of geological materials and thus implying a wide range of soil shear strength parameters.

Geotechnical zone GZ5 represents the superficial soft soil horizon and includes materials such as topsoil and organic soil layers, landfill and earthwork debris. It was clearly identified in all of the surveyed area at depths that range from 1.5 to 3.5 m.

Geotechnical zone GZ4 represents a medium grained sandy soil that occurs on a loose to medium density state below GZ5, being identified throughout all of the surveyed area with the exception of the north-eastern sector, which comprises boreholes S10 and S11. Thickness varies between 0.5 and 2.5m and soil samples collected at matching depths mainly identified poorly graded sands (SP, on the Unified Soil Classification System (USC system))

Geotechnical zones GZ1 to GZ3 are mainly differentiated through SPT results as the sedimentary deposits exhibit an alternating sequence that tends to be repetitive in depth. It's expected that soil resistance improves from GZ3 to GZ1.

Soil identification on these geotechnical zones mainly comprise clayey sands (SC, on the USC system) with occasional gravel resulted out of the disaggregation of consolidated or partially consolidated sedimentary formations such as sandstones and calcarenites resulting in GP-GC and GC soils (USC system).

Geotechnical zone GZ1 constitutes the most capable geotechnical horizon and occurs at depths ranging from 5 to 15 metres, coinciding with the final surveyed segment. On occasion GZ1 was identified on upper levels of the geotechnical model, usually associated with interbeds of sandstones and calcarenites or very dense sandy stratum, with limited lateral continuity.

4.3 Geotechnical Design Parameters

To the greatest extent possible, geotechnical design parameters resulted of the analysis of N_{SPTc} corrected values, laboratory tests and published analytical procedures.

The geological and geotechnical design team also incurred on previous design experienced acquired on identical terrain conditions.

Table 9 presents the design values for the most relevant geotechnical parameters.

Table 9 – Geotechnical design parameters

GZ	γ_{wet} (kN/m ³)	Shear Strength parameters <i>Mohr-Coulomb</i>			Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN)		
		Dominantly granular soils		Dominantly cohesive soils		Based on an analytical approach 1	Based on N_{SPTc} results 1	
		c (KPa)	w (°)	c_u (kPa)				
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered		
GZ4			26 – 32	-				
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700			Not considered
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000	
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500	850 - 2600	2100 - 2500	

Wet unit weight was estimated through relative density evaluated from N_{SPTc} results and represents the soil in situ unit weight.

Shear strength parameters are presented for either drained and undrained conditions because geological survey data indicates a wide variety of lithological materials with an extensive range of fine percentages. This means that for Geotechnical Zone GZ3, 2 and 1 both conditions should be taken into account, depending on the intersected geology.

For dominantly granular soils these parameters were evaluated out of the laboratory test results. For cohesive soils, laboratory test results were considered as well as the correlation proposed by Bowles of $C_u = 5.74 \cdot N_{SPTc}$.

For the assessment of the stress-strain modulus the relationship for saturated sands proposed by Bowles of $E_s = 250(N_{SPTc} + 15)$ was used for GZ1 and GZ2. Other geotechnical horizons required laboratory test results (GZ3) and normalized correlations for superficial soils (GZ4 and 5) for the estimation of such property.

Ultimate static point capacity (P_{pu}) was computed through 2 different approaches. One based on the Mohr-Coulomb failure stress parameters and using Hansen's bearing capacity factors incurs on the following equation:

$$P_{pu} = A_p \cdot (c \cdot N_c \cdot d_c + q \cdot N_q \cdot d_q + 0.5 \cdot \gamma \cdot B_p \cdot N_\gamma)$$

Where:

A_p – is the area of pile tip effective in bearing

N_c , N_q and N_γ – are bearing capacity factors

d_c and d_q – are depth factors

B_p – is the width of pile tip

q – is the vertical effective pressure at pile toe

When making this point resistance computations it was assumed the following conditions:

- Groundwater level was 2 metres below ground surface
- Considered pile depth was 10 metres
- Considered pile width was 0.6 metres
- Considered pile shape was with a round cross-section.

The other approach considers N_{SPTC} values and uses the following equation (JICA Study team):

$$P_{pu} = 150 \cdot N_{SPTC} \cdot A_p$$

Where:

N_{SPTC} – are the corrected SPT values for a given geotechnical zone

A_p – is the area of pile point effective in bearing

Pile skin resistance capacity (kPa) may be estimated using N_{SPTC} results through Meyerhof's suggestion for sandy soils:

$$f_s = X_m N_{55}$$

Where

X_m – a factor of 2.0 for piles with large-volume displacement; and 1.0 for small volume piles

N_{55} – statistical average of the blow count in the upper stratum, corrected for 55% SPT energy efficiency

Considering this a pile skin resistance of 20 to 30 kPa should be accounted for depths of 10 metres.

4.4 Foundations

Given the geological and geotechnical design model it is recommended that deep foundations are taken into consideration in order to guarantee the ultimate support for any considered structure, although subjected to the following conditions:

- Geotechnical zones GZ5, GZ4 and GZ3 are not suitable as a foundation soil and do not provide a suitable loading support.
- Geotechnical zones GZ2 or GZ1 are required to be intersected by the pile toe by at least 3 to 5 times the pile diameter.
- Minimum pile diameter shall be of 0.6m

The allowable pile capacity (P_a) may be estimated using the following equation:

$$P_a = 1/3.P_{pu} + 1/3.P_s$$

On the presented geotechnical and geological scenario the following allowable pile capacity may be considered.

- Geotechnical zone ZG2: 650 – 1800 kPa
- Geotechnical zone ZG1: 1000 – 3000 kPa

Awareness of Mozambique equipment availability suggests that the most indicated pile type is the cast in place concrete pile. Nevertheless a few cautions should be taken into consideration involving site location, namely expected high groundwater levels.

4.5 Excavations

Obtaining the recommended foundation depths will require terrain excavation. Considering the known geological model, excavations are expected to be done through direct mechanical digging using an excavator with a blade or a bucket.

Cut slopes are to assume minimum geometries of 1V:1.5H and provisions should be made to minimize rainwater and surface water flows. Vertical faces of excavations will unconditionally require support solutions.

Excavations should be kept dry during the construction period. If by chance groundwater level rises up to the bottom of the footing or surface water inflows

into the excavation, dewatering must be assured either by impervious water barriers, drainage wells such as sump pits or any other efficient methods.

4.6 Reuse of soils

In case a reuse of excavated soils is intended, Table 10 presents an engineering use chart for compacted soils in relation with the Unified Soil Classification (ASTM), adapted from Lambe & Whitman, 1979.

Table 10 - Engineering use chart for compacted soil

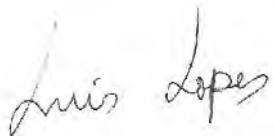
Engineering Properties of Compacted Soil					
Soil group name	Group symbol	Permeability	Shear strength (saturated)	Compressibility (saturated)	Workability as a construction material
Well-graded gravel	GW	Pervious	Excellent	Negligible	Excellent
Poorly graded gravel	GP	Pervious	Good	Negligible	Good
Silty gravel	GM	Semipervious to impervious	Good	Negligible	Good
Clayey gravel	GC	Impervious	Good to fair	Very low	Good
Well-graded sands	SW	Pervious	Excellent	Negligible	Excellent
Poorly graded sands	SP	Pervious	Good	Very low	Fair
Silty sands	SM	Semipervious to impervious	Good	Low	Fair
Clayey sands	SC	Impervious	Good to fair	Low to medium	Good
Silt	ML	Semipervious to impervious	Fair	Medium	Fair
Lean clay	CL	Impervious	Fair	Medium	Good to fair
Organic silt and organic clay	OL	Semipervious to impervious	Poor	Medium to high	Fair
Elastic silt	MH	Semipervious to impervious	Fair to poor	High	Poor
Fat clay	CH	Impervious	Poor	High	Poor
Organic silt and organic clay	OH	Impervious	Poor	High	Poor
Peat and other highly organic soils	PT	-	-	-	-

Granular soils comprising well graded gravels (GW) down to clayey sands (SC) should be given priority when soil reuse is considered on embankments, even

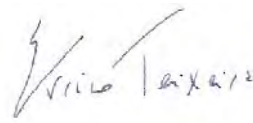
though soils such as ML and CL will still provide acceptable geotechnical properties, depending on its particular use.

High plastic and organic soils should be regarded as unsuitable for any construction work as they settle unduly even under their own weight and not be considered reusable.

Maputo, December, 2012



Geological Engineer



Engineering Geologist



Project Manager

F. Gomes Pinto



Cell: +258-82 310 5260

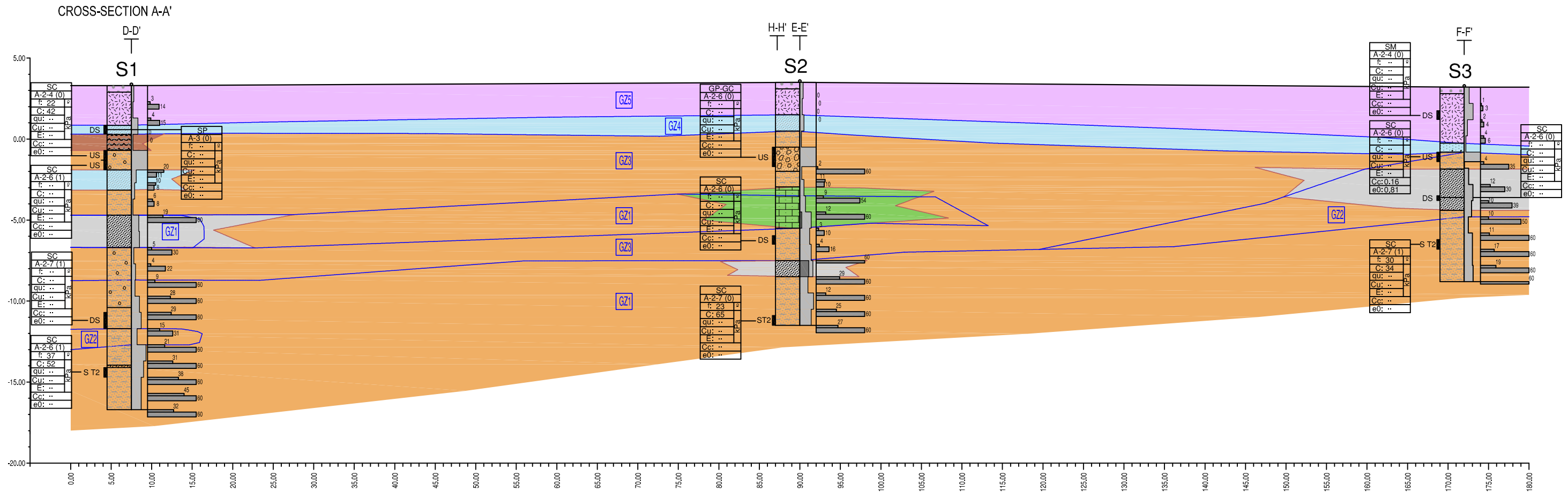
Tel: +258-21 496 650

Fax: +258-21 498 816

Email: fgpinto@ingerop.co.mz

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-4.8m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ3		[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ2	Fine grained clayey sand with sandstone and calcarenite interbeds.	30 - 48	26 - 48
GZ1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{sat} (kN/m ³)	Shear Strength parameters Mohr-Coulomb			Ultimate static tip capacity - P _{tu} (kN)		
		Dominantly granular soils		Dominantly cohesive soils	Based on an analytical approach		
		c (kPa)	ϕ (°)	c _u (kPa)	Based on analytical approach	Based on N _{SPTc} results	
GZ5	14-18	0	26 - 30	-	2000 - 6000	Not considered	
GZ4	17 - 19	0 - 20	22 - 34	11 - 22	2600 - 7700		
GZ3	19 - 20	20 - 40	23 - 37	60 - 360	12000 - 17500	850 - 2600	2100 - 2500
GZ2	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500	850 - 2600	2100 - 2500
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

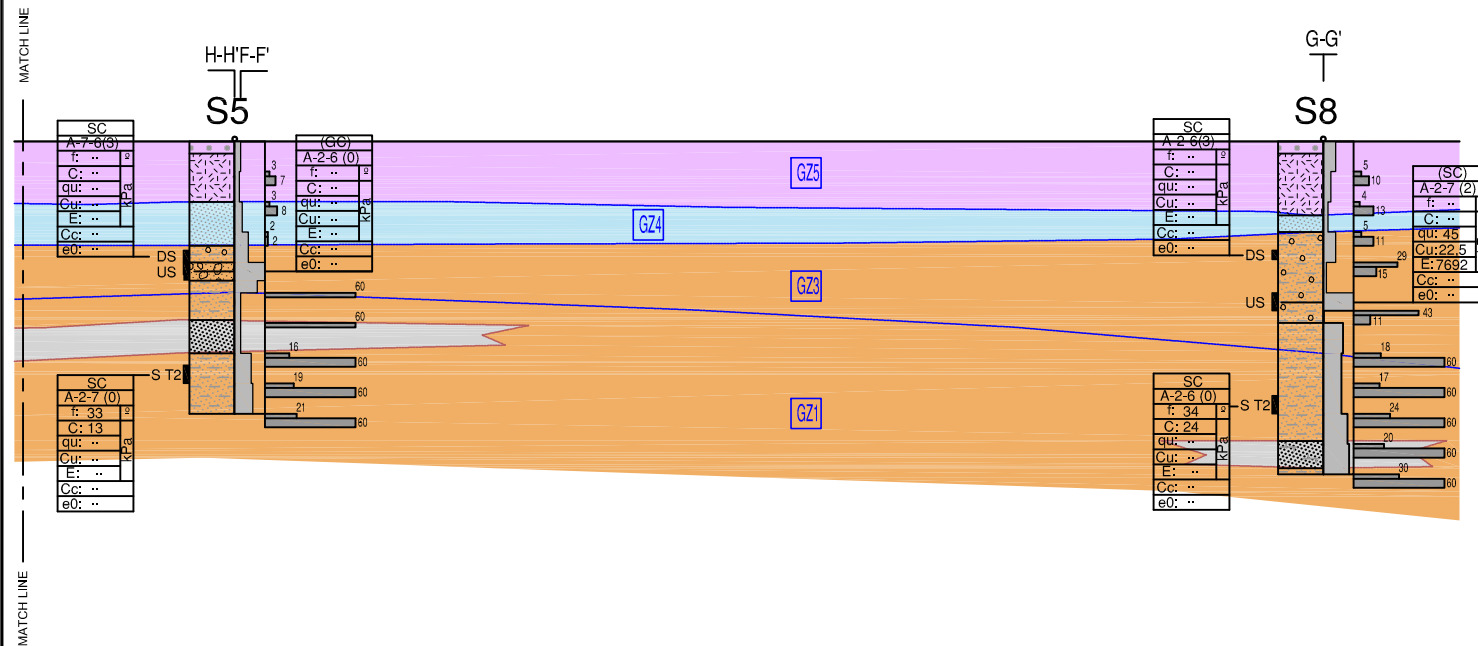
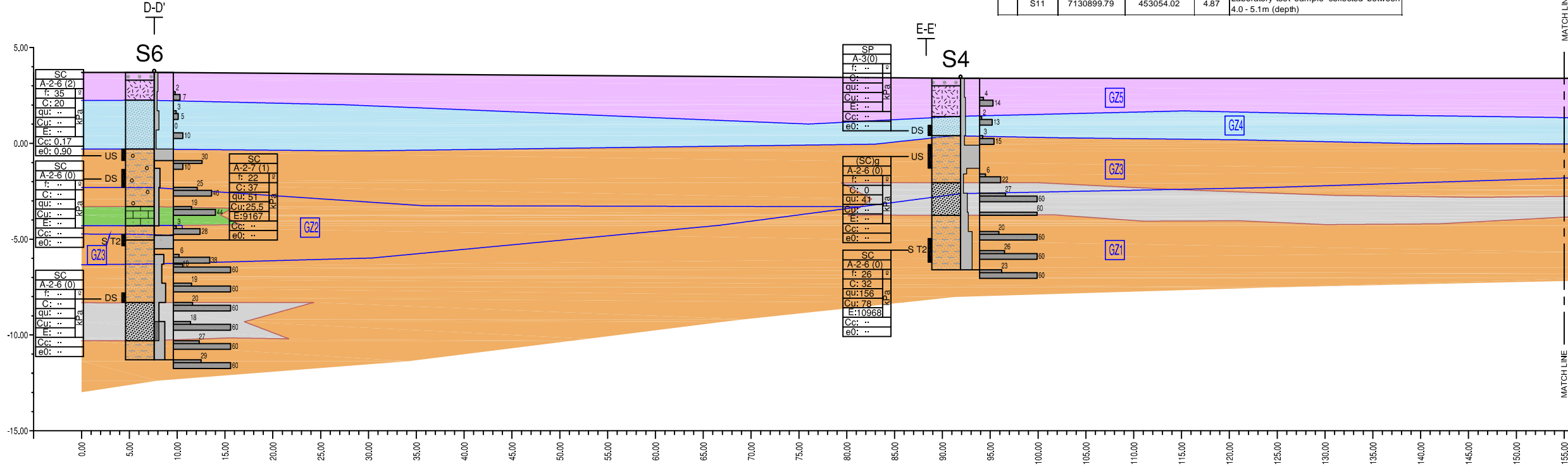
			PROJECT GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE		REVISION 0
			DRAWING TITLE INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTION A-A'		DRAWING NO. —
NO.	REV.	DESCRIPTIONS	SCALE H=1:250 V=1:125 1:2000		

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-4.5m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION B-B'



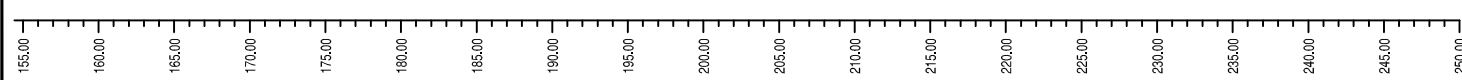
Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ3		[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ2	Fine grained clayey sand with sandstone and calcarenite interbeds.	30 - 48	26 - 48
GZ1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ _{sat} (kN/m ³)	Shear Strength parameters Mohr-Coulomb		Stress-strain modulus E _s (kPa)	Ultimate static tip capacity - P _{tu} (kN)	
		Dominantly granular soils			Based on an analytical approach	Based on N _{SPTc} results
		c (kPa)	φ (°)			
GZ5	14-18	0	26 - 30	-	2000 - 6000	-
GZ4	17 - 19	0 - 20	22 - 34	11 - 22	2600 - 7700	-
GZ3	19 - 20	20 - 40	40 - 175	9100 - 15000	520 - 1540	1100 - 2000
GZ2	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500	850 - 2600
GZ1					2100 - 2500	

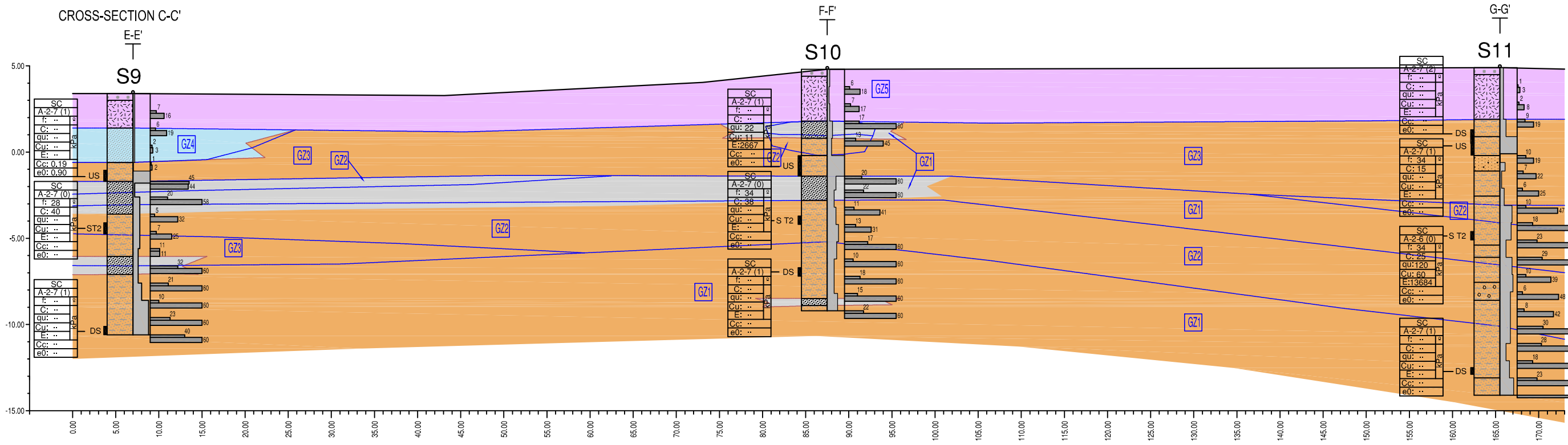
GEO REFERENCE: WGS 84
PAPER SIZE: A1



PROJECT		GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE		REVISION	0
DRAWING TITLE		INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS B-B'		SCALE	H=1:250 V=1:125 1:2000
NO.	REV.	DESCRIPTIONS		DRAWING NO.	

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-5.2m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ 3		[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ 2	Fine grained clayey sand with sandstone and calcarenite interbeds.	30 - 48	26 - 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

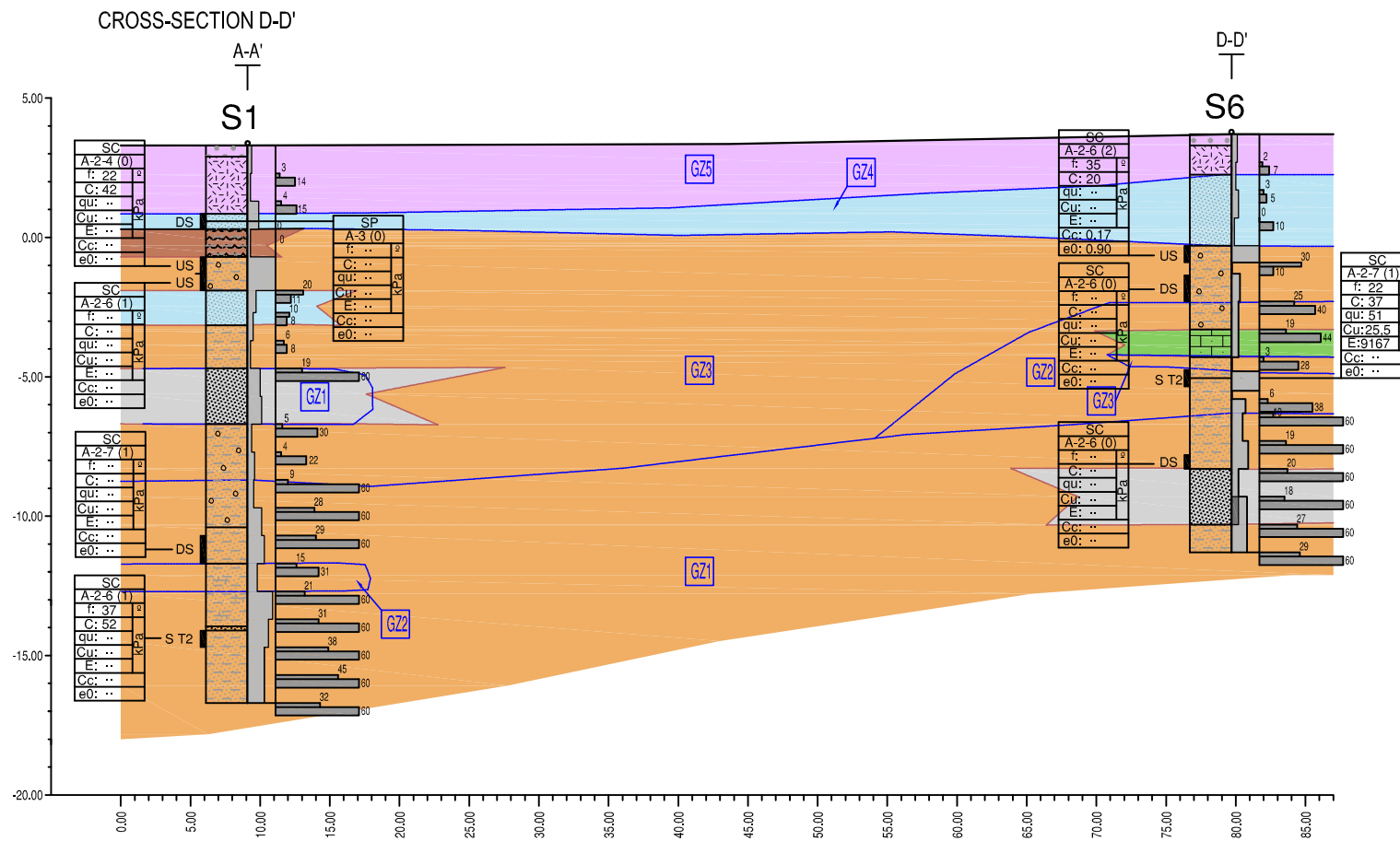
GZ	γ _{sat} (kN/m ³)	Shear Strength parameters Mohr-Coulomb		Stress-strain modulus E _s (kPa)	Ultimate static tip capacity - P _{pu} (kN)			
		Dominantly granular soils			Based on an analytical approach	Based on N _{SPTc} results		
		c (kPa)	φ (°)				c _u (kPa)	
GZ5	14-18	0	26 - 30	-	2000 - 6000	Not considered		
GZ4	17 - 19	0 - 20	22 - 34	11 - 22	2600 - 7700			
GZ3	19 - 20	20 - 40	40 - 175	9100 - 15000	520 - 1540		1100 - 2000	
GZ2	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500		850 - 2600	2100 - 2500
GZ1								

GEO REFERENCE: WGS 84
PAPER SIZE: A1

PROJECT			GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE		REVISION
DRAWING TITLE			INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS C-C'		0
SCALE			H=1:250 V=1:125		DRAWING NO.
NO. REV.			DESCRIPTIONS		—

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-4.5m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ3		[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ2	Fine grained clayey sand with sandstone and calcarenite interbeds.	30 - 48	26 - 48
GZ1		54 - 60	49 - 60

Geotechnical Design Parameters

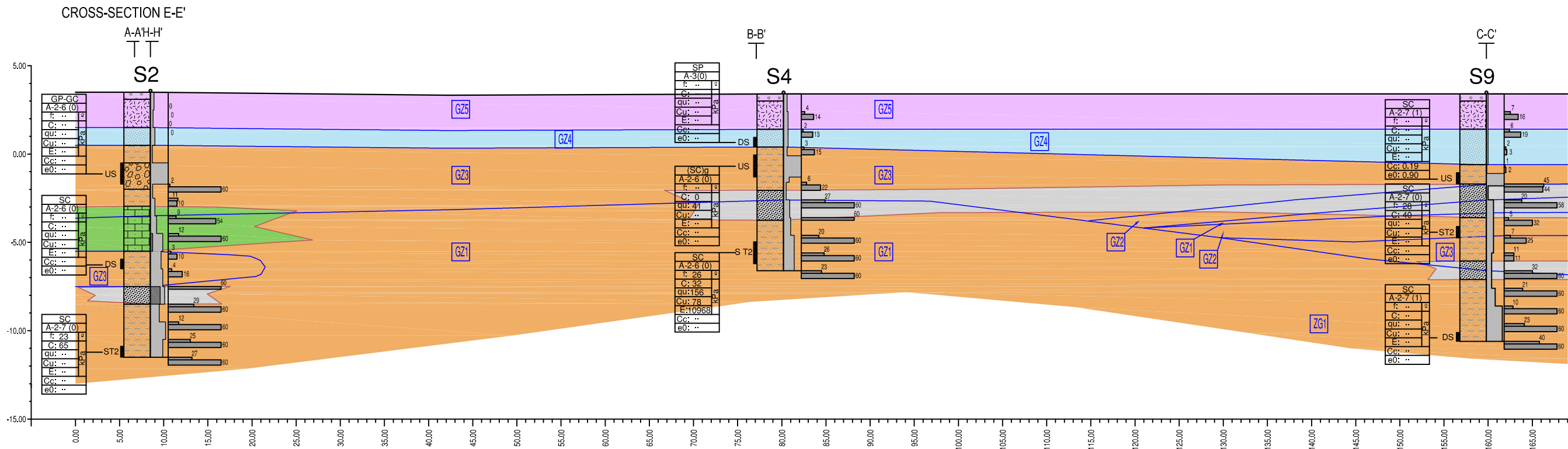
GZ	γ_{sat} (kN/m ³)	Shear Strength parameters Mohr-Coulomb			Ultimate static tip capacity - P _{tu} (kN)		
		Dominantly granular soils		Dominantly cohesive soils	Based on an analytical approach	Based on N _{SPTc} results	
		c (kPa)	ϕ (°)	c _u (kPa)			
GZ5	14-18	0	26 - 30	-	2000 - 6000	Not considered	
GZ4	17 - 19	0 - 20	22 - 34	11 - 22			
GZ3	17 - 19	0 - 20	22 - 34	11 - 22	2600 - 7700		
GZ2	19 - 20	20 - 40	23 - 37	60 - 360	9100 - 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

		PROJECT GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE		REVISION 0	
		DRAWING TITLE INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS D-D'		DRAWING NO. —	
NO.	REV.	DESCRIPTIONS		SCALE H=1:250 V=1:125	1:2000

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-4.8m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ2		30 - 48	26 - 48
GZ1		54 - 60	49 - 60

Geotechnical Design Parameters

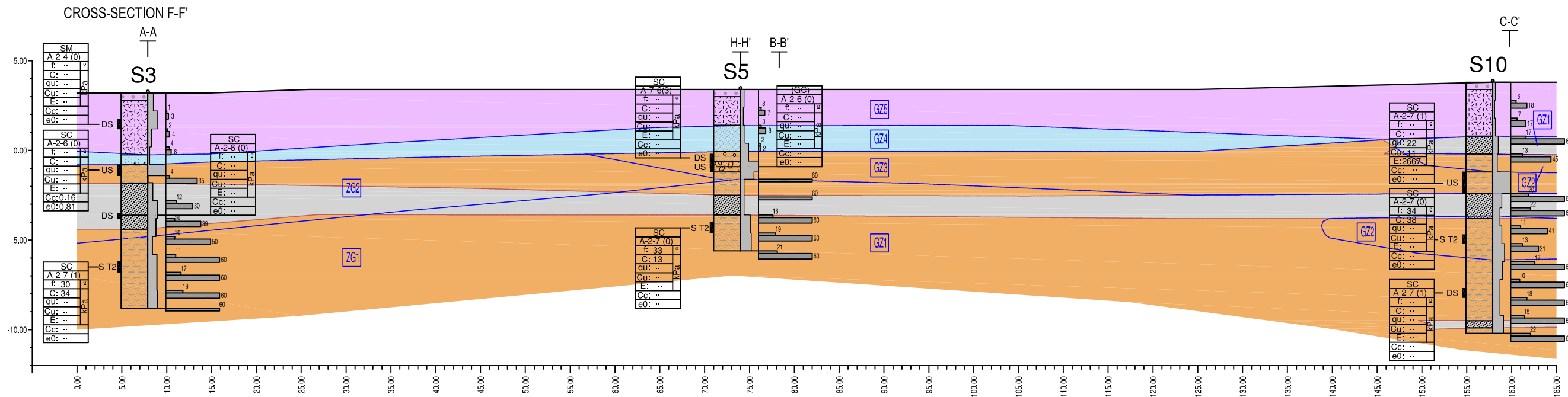
GZ	γ_{sat} (kN/m ³)	Shear Strength parameters			Ultimate static tip capacity - P _{ult} (kN)	
		Mohr-Coulomb		Stress-strain modulus E _s (kPa)	Based on an analytical approach	
		Dominantly granular soils	Dominantly cohesive soils		Based on analytical approach	Based on N _{SPTc} results
		c (kPa)	ϕ (°)	c _u (kPa)		
GZ5	14-18	0	26 - 30	-	2000 - 6000	Not considered
GZ4			26 - 32	-		
GZ3	17 - 19	0 - 20	22 - 34	11 - 22	2600 - 7700	
GZ2	19 - 20	20 - 40		40 - 175	9100 - 15000	520 - 1540
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500	850 - 2600

GEO REFERENCE: WGS 84
PAPER SIZE: A1

			PROJECT GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE		REVISION 0	
			DRAWING TITLE INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS E-E'		DRAWING NO. -	
NO.	REV.	DESCRIPTIONS	SCALE H=1:250 V=1:125		1:2000	

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-4.8m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ 3		[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ 2	Fine grained clayey sand with sandstone and calcarenite interbeds.	30 - 48	26 - 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

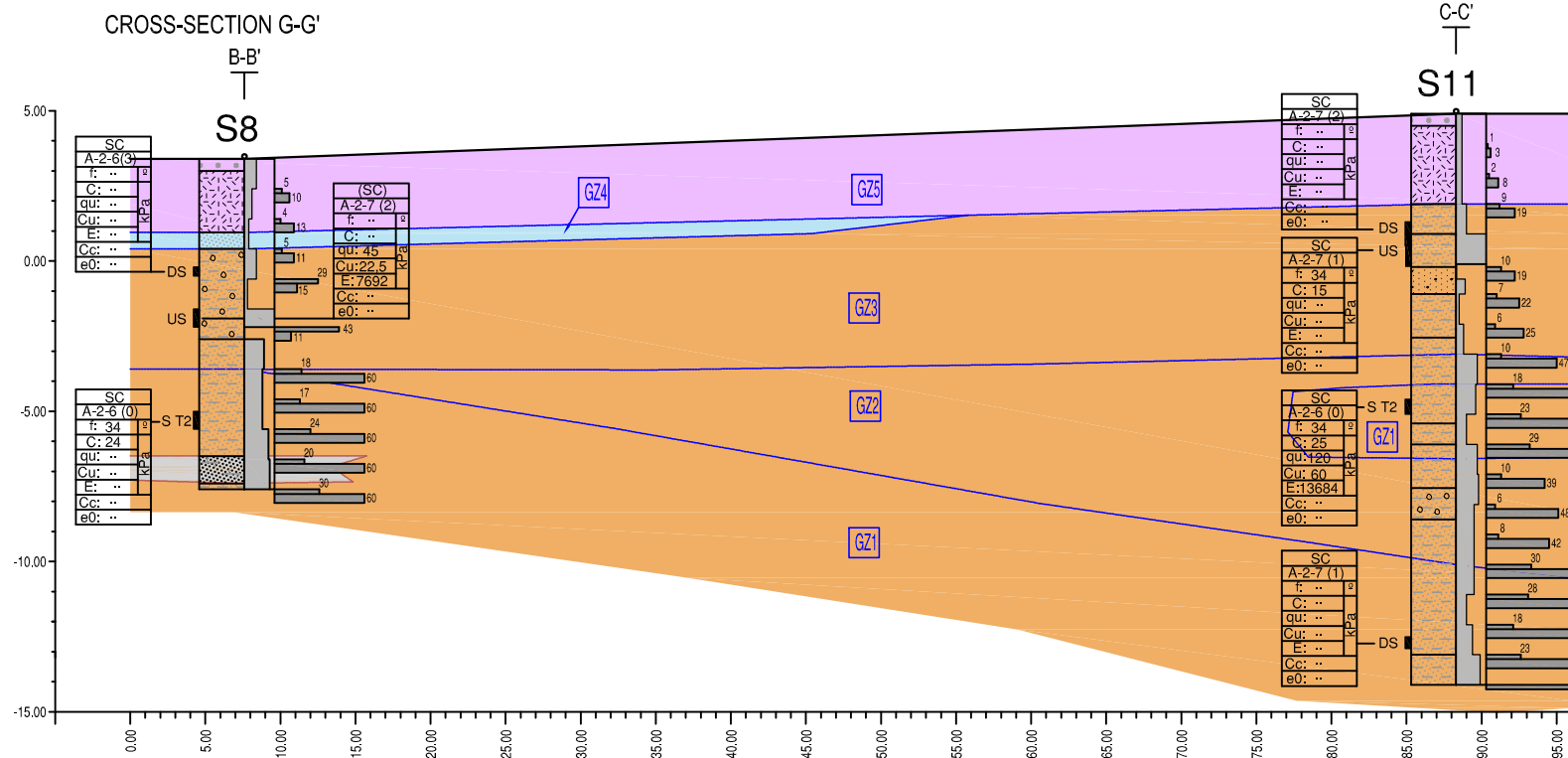
GZ	γ_{sat} (kN/m ³)	Shear Strength parameters <i>Mohr-Coulomb</i>		Stress-strain modulus E _s (kPa)	Ultimate static tip capacity - P _{tu} (kN)		
		Dominantly granular soils			Based on an analytical approach	Based on N _{SPTc} results	
		c (kPa)	ϕ (°)				c _u (kPa)
GZ5	14-18	0	26 - 30	-	2000 - 6000	Not considered	
GZ4	17 - 19	0 - 20	26 - 32	-			
GZ3	19 - 20	20 - 40	22 - 34	11 - 22	2600 - 7700		
GZ2	20 - 22	13 - 65	23 - 37	60 - 360	9100 - 15000	520 - 1540	1100 - 2000
GZ1				12000 - 17500	850 - 2600	2100 - 2500	

GEO REFERENCE: WGS 84
PAPER SIZE: A1

PROJECT GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE			REVISION 0	
DRAWING TITLE INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS F-F'			DRAWING NO. —	
NO.	REV.	DESCRIPTIONS	SCALE H=1:250 V=1:125	1:2000

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-4.8m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ 2		30 - 48	26 - 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{sat} (kN/m ³)	Shear Strength parameters <i>Mohr-Coulomb</i>			Ultimate static tip capacity - P _{tu} (kN)		
		Dominantly granular soils		Dominantly cohesive soils	Stress-strain modulus E _s (kPa)	Based on an analytical approach	Based on N _{SPTc} results
		c (kPa)	ϕ (°)				
GZ5	14-18	0	26 - 30	-	2000 - 6000	Not considered	
GZ4			26 - 32	-			
GZ3	17 - 19	0 - 20	22 - 34	11 - 22	2600 - 7700		
GZ2	19 - 20	20 - 40		40 - 175	9100 - 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

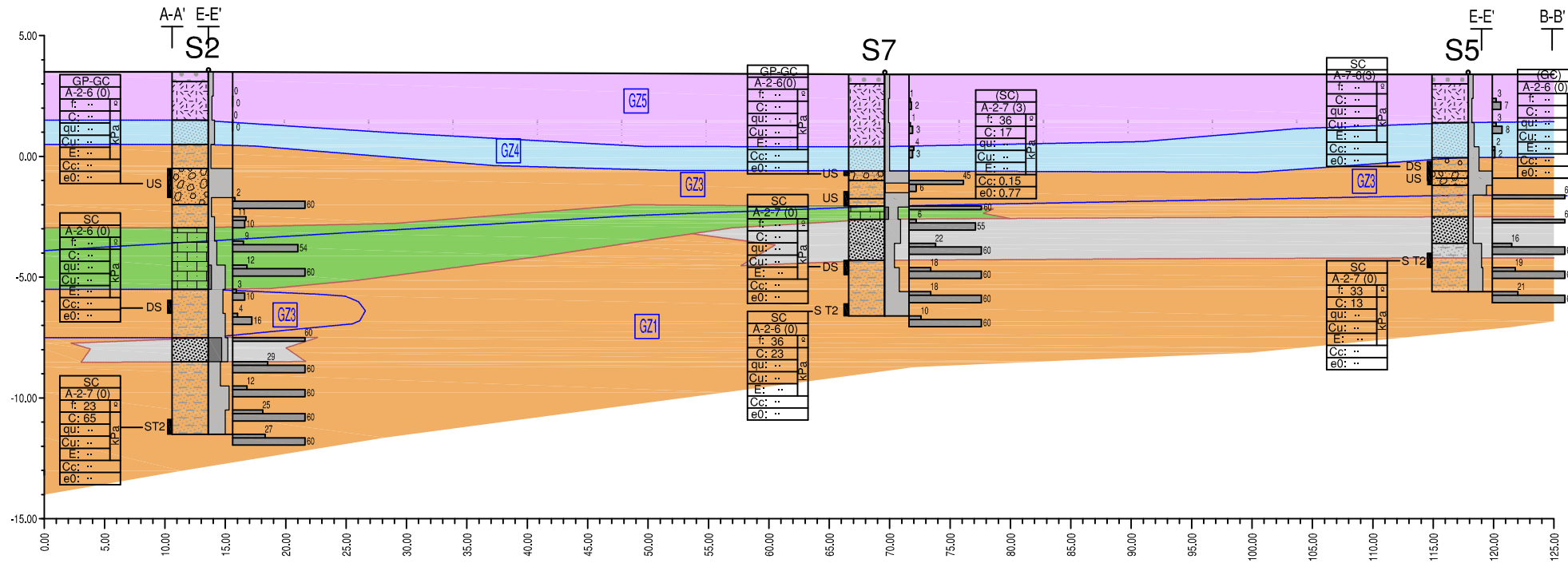
			PROJECT GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE		REVISION 0	
			DRAWING TITLE INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS G-G'		DRAWING NO. —	
NO.	REV.	DESCRIPTIONS	SCALE H=1:250 V=1:125		1:2000	

Geographic Features of Ground Investigation Works

Reference	Coordinates			Remarks
	X	Y	Z	
S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4.5-5.2m (depth)
S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4.5-5.2m (depth)
S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4.5-4.8m (depth)
S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4.6m (depth)
S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4.6m and 8.5 - 9.0 m (depth)
S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 - 5.5 m (depth)
S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4.5 - 5.1m (depth)
S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION H-H'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N _{SPT}	N _{SPTc}
GZ5	Topsoil, landfill and organic soils	0 - 16	0 - 12
GZ4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 - 14
GZ3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 - 25 [30]	[2] 5 - 24 [29]
GZ2		30 - 48	26 - 48
GZ1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{sat} (kN/m ³)	Shear Strength parameters Mohr-Coulomb			Ultimate static tip capacity - P _{tu} (kN)		
		Dominantly granular soils		Dominantly cohesive soils	Based on an analytical approach	Based on N _{SPTc} results	
		c (kPa)	ϕ (°)	c _u (kPa)			
GZ5	14-18	0	26 - 30	-	2000 - 6000	Not considered	
GZ4			26 - 32	-			
GZ3	17 - 19	0 - 20	22 - 34	11 - 22	2600 - 7700		
GZ2	19 - 20	20 - 40	-	40 - 175	9100 - 15000		520 - 1540 1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 - 17500		850 - 2600 2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

			PROJECT GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE		REVISION 0
			DRAWING TITLE INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS H-H'		DRAWING NO. —
NO.	REV.	DESCRIPTIONS	SCALE H=1:250 V=1:125 1:2000		

Sample Type : Undisturbed

Laboratory Test Results

Borehole (N°)	Sample (N°)	Depth (m)	Description	Lit. - str.	Classif. Unified RTR AASHTO	W Sr EA (%)	ρ ρd (g/cm³) Dens. Part. G	W _L I _P V _S (%)	VB (g/100g) MO (%) Ph	Particle size Characteristics			Comp. Wopt (%) γ dmax (kN/m²) Light Heavy	CBR				Consolidation		Shear Strength				Permeability Gradient I (kg/cm²) K (cm/s)	
										<2.0 mm	<0.075 mm	d _m , bigger part. Max. Min. (mm)		CR (%)	Desv. Wopt (%)	Expan sibility (%)	CBR at 95% Penet.	Cc	Cv (cm²/s)	qu (kPa)	σ ₃ (kPa)	C (kPa)	φ (°)		
										<0.42 mm	<0.002 mm						e ₀	K (cm/s)	E (kPa)	σ ₁ (kPa)	C' (kPa)	φ' (°)			
										(%)	(%)														
S 5 (CTM)	56756	7.40 8.00	Fine sand, silty-clayey, greenish yellow		(SC) A-2-7(0)	25.2		44 23		97 92	16 8	18											13 --	33 --	
S 6 (CTM)	56730	4.00 4.60	Fine sand, silty-clay, with dispersed gravel greenish gray		(SC) A-2-6(2)	27.0		40 21		89 84	31					0.17 0.90	7.8 EE-3 2.1 EE-7						20 --	35 --	
S 6 (CTM)	56731	8.45 9.05	Fine sand, silty-clay, greenish yellow		(SC) A-2-7(0)	24.3		48 25		94 86	16									51 9167			37 --	22 --	
S 7 (CTM)	56757	4.00 4.20	Coarse gravel, sandy silty-clayey, light gray		(GP-GC)s A-2-6(0)	14.4		37 18		37 28	12 11	48													
S 7 (CTM)	56758	4.80 5.45	Fine sand, silt-clayey, with gravel fine to medium greenish gray		(SC)g A-2-7(3)	24.0		42 25		72 66	34 5	40				0.15 0.77	8.1 EE-3 2.0 EE-7						17 --	36 --	
S 7 (CTM)	56759	9.50 10.00	Fine sand, silty-clayey, greenish yellow		(SC) A-2-6(0)	24.7		39 18		98 95	21												23 --	36 --	
S 8 (CTM)	56760	5.00 5.60	Fine sand, silt-clayey, with Fine to medium gravel, yellow		(SC)g A-2-7(2)	23.5		46 27		80 69	29 8	36				0.14 0.79	4.4 EE-3 8.2 EE-8	45 7692							
S 8 (CTM)	56761	8.40 9.00	Fine sand, silty-clayey, brownish yellow		(SC) A-2-6(0)	21.2		40 20		100 96	19												24 --	34 --	
S 9 (CTM)	56777	4.50 5.10	Variable grain size sand, silt-clayey, with fine to medium gravel, yellow		(SC)g A-2-7(1)	21.2		49 26		67 53	21 8	33				0.19 0.90	4.1 EE-3 1.9 EE-7								
S 9 (CTM)	56778	7.50 8.50	Fine sand, silty-clayey, greenish yellow		(SC) A-2-7(0)	23.3		44 21		98 97	18 7	18											40 --	28 --	

Sample Type : Undisturbed

Laboratory Test Results

Borehole (N°)	Sample (N°)	Depth (m)	Description	Lithology	Classif. Unified RTR AASHTO	W (%)	ρ (g/cm³) Dens. Part. G	W _L I _p V _S (%)	VB (g/100g) MO (%) Ph	Particle size Characteristics			Comp. Wopt (%) γ _{dmax} (kN/m³) Light Heavy	CBR				Consolidation		Shear Strength				Permeability Gradient I (kg/cm²) K (cm/s)					
										<2.0 mm (%)	<0.075 mm (%)	dim. bigger part. Max. (mm)		CR (%)	Desv. Wopt (%)	Expansibility (%)	CBR at 95% Penet.	C _c	C _v (cm²/s)	q _u (kPa)	σ ₃ (kPa)	C' (kPa)	φ' (°)						
										<0.425 mm (%)	<0.002 mm (%)																		
S 10 (CTM)	56779	5.00 6.20	Variable grain size sand, silt-clayey, with fine to medium gravel, light yellow.		(SC)g A-2-7(1)	15.1	2.72	46 26		60 40	20 12	43							22 2667										
S 10 (CTM)	56780	8.50 9.00	Fine to medium sand, clayey, with fine gravel, yellowish brown		(SC) A-2-7(0)	15.5	2.71	44 25		82 56	17 8	31										38 --	34 --						
S 11 (CTM)	56762	4.00 5.10	Fine to medium sand, silty-clayey, brownish yellow		(SC) A-2-7(1)	29.0	2.73	44 25		94 78	21 6	16										15 --	34 --						
S 11 (CTM)	56763	9.50 10.00	Fine sand, silty-clayey, greenish yellow		(SC) A-2-6(0)	18.4	2.70	36 17		99 87	19									120 13684			25 --	34 --					

Sample Type : Remolded

Laboratory Test Results

Borehole (N°)	Sample (N°)	Depth (m)	Description	Lithology	Classif. Unified RTR AASHTO	W Sr EA (%)	ρ ρd (g/cm³) Dens. Part. G	W _L I _p V _S (%)	VB (g/100g) MO (%) Ph	Particle size Characteristics			Comp. Wopt (%) Y _{dmax} (kN/m²) Light Heavy	CBR				Consolidation		Shear Strength				Permeability					
										<2.0 mm	<0.075 mm	dim. bigger part. Max. Min. (mm)		CR (%)	Desv. Wopt (%)	Expansibility (%)	CBR at 95% Penet.	C _c	C _v (cm²/s)	q _u	σ ₃	C	φ	Gradient I (kg/cm²)					
										<0.425 mm	<0.002 mm																		
										(%)	(%)																		
S 1 (CTM)	56727	2.45 3.00	Fine to medium sand, light gray		(SP) A-3(0)	22.8 2.67				100 80	3																		
S 1 (CTM)	56728	14.00 15.00	Fine sand, silty-clay, light yellow		(SC) A-2-7(1)	23.4 2.72				97 95	21																		
S 1 (CTM)	56729	17.60 18.00	Fine sand, silty-clay, yellow		(SC) A-2-6(0)	26.6 2.75				100 97	25																		
S 2 (CTM)	56740	9.45 10.00	Fine sand, silt-clay, with gravel scattered greyish yellow		(SC) A-2-7(1)	20.9 2.70				92 83	26 7	20																	
S 3 (CTM)	56741	1.45 2.00	Variable grain size sand, silty, with thin to medium gravel, black		(SM)g A-2-4(0)	33.6 2.42				63 44	28 11	25																	
S 3 (CTM)	56742	6.70 7.00	Variable grain size sand, silt-clay, with gravel medium to fine yellow		(SC)g A-2-6(0)	11.6 2.74				58 44	26 19	41																	
S 4 (CTM)	56764	2.45 3.00	Fine to medium sand, light gray		(SP) A-3(0)	19.3 2.65				98 72	1																		
S 5 (CTM)	56765	3.60 4.00	ay silty-sandy, with dispersed gravel, yellowish gray		(SC) A-7-6(3)	26.1 2.72				88 80	36 8	39																	
S 6 (CTM)	56732	5.05 6.00	Variable grain size sand, silty-clay, with gravel and medium grayish yellow		(SC)g A-2-6(0)	23.4 2.73				68 53	17																		
S 6 (CTM)	56733	11.50 12.00	Fine sand, silty-clay, greenish yellow		(SC) A-2-6(0)	22.3 2.75				99 96	19																		

Sample Type : Remolded

Laboratory Test Results

Borehole (N°)	Sample (N°)	Depth (m)	Description	L i t - s t r.	Classif.	W	ρ	W _L	VB	Particle size Characteristics			Comp.	CBR				Consolidation		Shear Strength				Permeability		
					Unified	Sr	ρ _d	I _p	(g/100g)	<2.0	<0.074	d _m bigger part.	Wopt (%)	CR	Desv.	Expansibility	CBR at 95%	C _c	C _v	q _u	σ ₃	C	φ	Gradient I		
					RTR	EA	(g/cm ³)	V _S	MO (%)	mm	mm	mm	Y _{dmax} (kN/m ²)	Wopt	CBR	(%)	(%)	(%)	Penet.	e _o	K (cm/s)	E (kPa)	σ ₁ (kPa)	C' (kPa)	φ' (°)	K (cm/s)
					AASHTO	(%)	Dens. Part. G	(%)	Ph	(%)	(%)	Min. (mm)	Light Heavy	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
S 7 (CTM)	56766	7.70 8.00	Fine sand, clayey, greenish yellow.		(SC)	20.8		41 18		99	18															
					A-2-7(0)		2.72			95																
S 8 (CTM)	56767	3.60 3.90	Fine sand, silt-clayey, with fine to medium gravel, gray		(SC)g	18.3		28 12		74	29	27														
					A-2-6(0)		2.72			65		6														
S 9 (CTM)	56781	13.50 14.00	Fine sand, silty-clay, dark yellow		(SC)	25.0		42 21		98	24															
					A-2-7(1)		2.72			90																
S 10 (CTM)	56782	11.50 12.00	Fine sand, silty-clay, yellowish brown.		(SC)	23.2		48 22		98	21															
					A-2-7(1)		2.72			94																
S 11 (CTM)	56768	3.50 4.00	Variable grain size sand, silt-clayey, with fine gravel, yellowish green.		(SC)	18.3		45 25		83	31	26														
					A-2-7(2)		2.74			68		7														
S 11 (CTM)	56769	17.40 17.80	Fine sand, silty-clayey, greenish yellow		(SC)	23.8		43 19		97	25															
					A-2-7(1)		2.71			95																



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S1

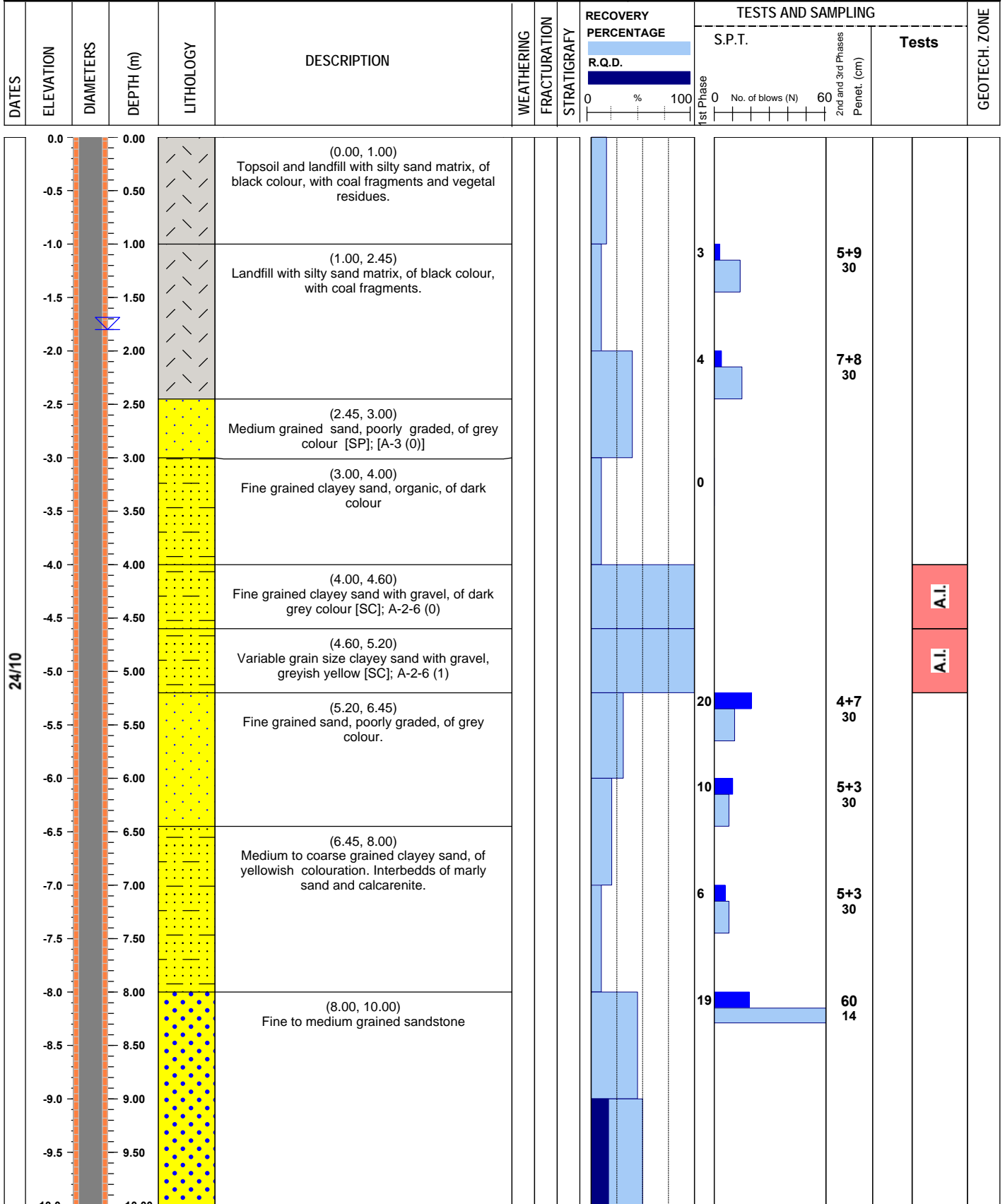
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130964.57	E: 452773.806	H: 3.32	DIRECTION:	DEPTH: 20.21 m	DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 20.00 m = 86mm						CASING 0.00 m - 20.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)						STARTED: 24/10/2012 COMPLETED: 25/10/2012	
						WATER LEVEL DETECTED 1.8 PIEZOMETRIC	
						Logger NOV/12 JRC Geolog. NOV/12 GO	

Page 1 of 3



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S1

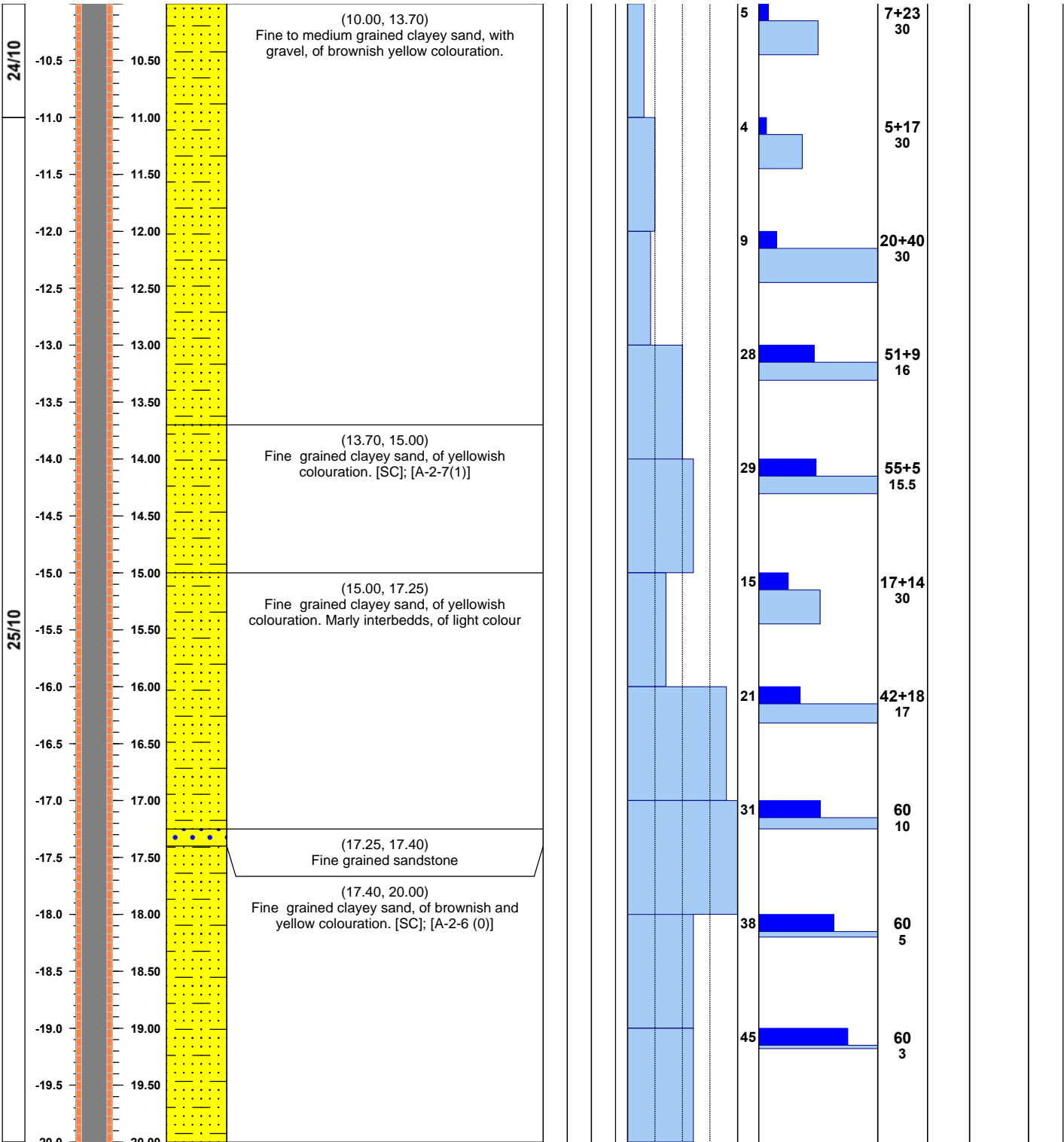
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130964.57 E: 452773.806 H: 3.32 DIRECTION:	DEPTH: 20.21 m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 20.00 m = 86mm CASING 0.00 m - 20.00 m = 113mm		WATER LEVEL DETECTED 1.8 PIEZOMETRIC	Logger NOV12 JRC Geolog. NOV12 GO
EQUIPMENT: DELTA BASE 520 (31650) STARTED: 24/10/2012 COMPLETED: 25/10/2012		Page 2 of 3	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE		TESTS AND SAMPLING		GEOTECH. ZONE
									R.Q.D.	%	S.P.T.	Tests	



CBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
CLIENT: ORIENTAL CONSULTANTS CO. Ltd
LOCATION: MATOLA - MAPUTO

BOREHOLE
S1
WORK No 19.3622

N: 7130964.57 E: 452773.806 H: 3.32	DIRECTION:	DEPTH: 20.21 m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 20.00 m = 86mm		CASING 0.00 m - 20.00 m = 113mm		WATER LEVEL
EQUIPMENT: DELTA BASE 520 (31650)		STARTED: 24/10/2012 COMPLETED: 25/10/2012		Logger: NOV12 JRC Geolog: NOV12 GO Page 3 of 3

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		
25/10	-20.5		20.50										

OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S1



0 – 8,0 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S1



8,0 – 17,00 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S1



17,00 – 20,21 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S2

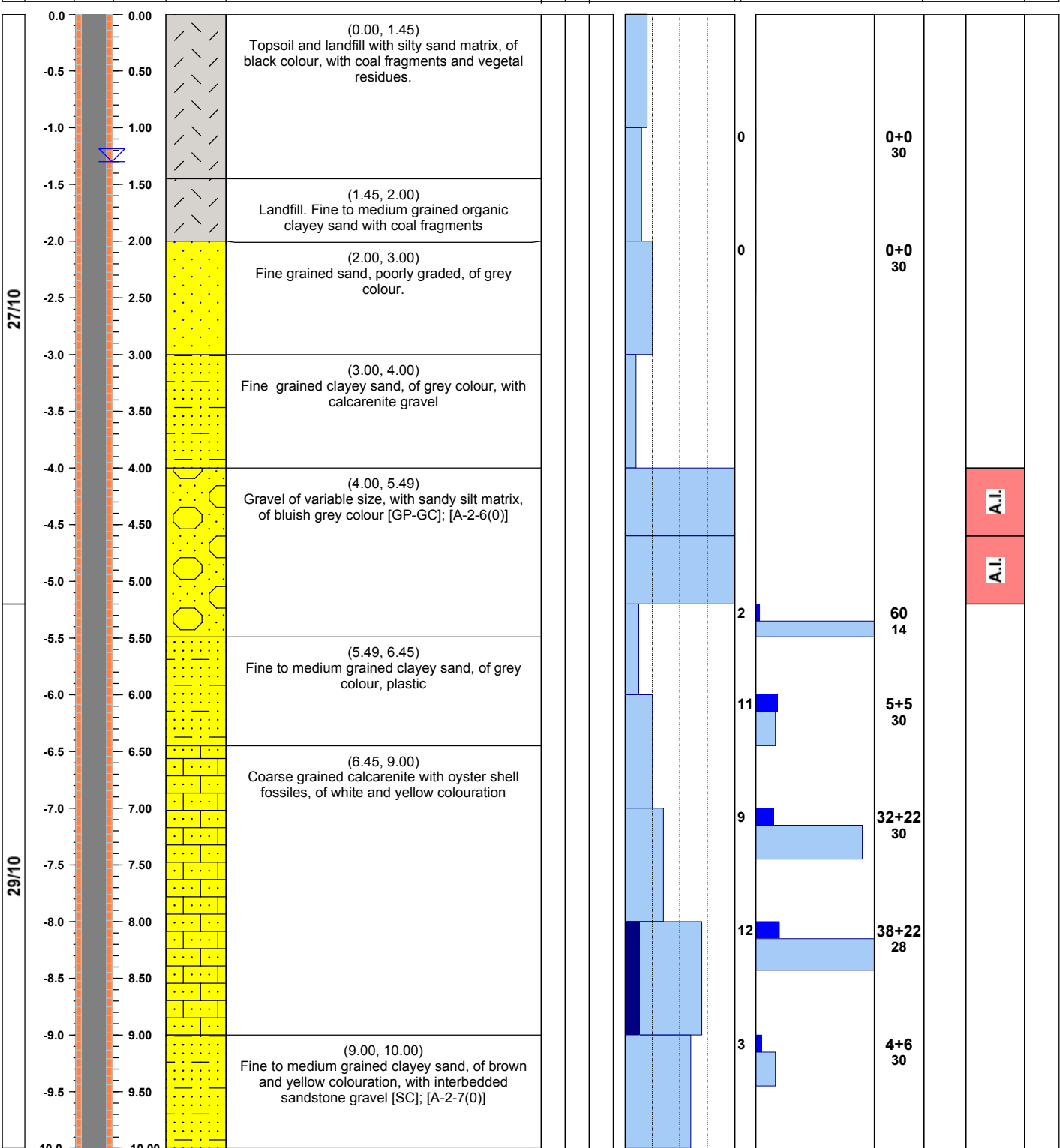
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130907.99	E: 452833.926	H: 3.547	DIRECTION:	DEPTH: 15.00m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 15.00 m = 86mm					CASING 0.00 m - 15.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)					STARTED: 27/10/2012 COMPLETED: 29/10/2012	
					WATER LEVEL DETECTED 1.3 PIEZOMETRIC	
					Logger NOV/12 JRC Geolog. NOV/12 GO Page 1 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE		TESTS AND SAMPLING			GEOTECH. ZONE
									R.Q.D.	%	S.P.T.	Tests		



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S2

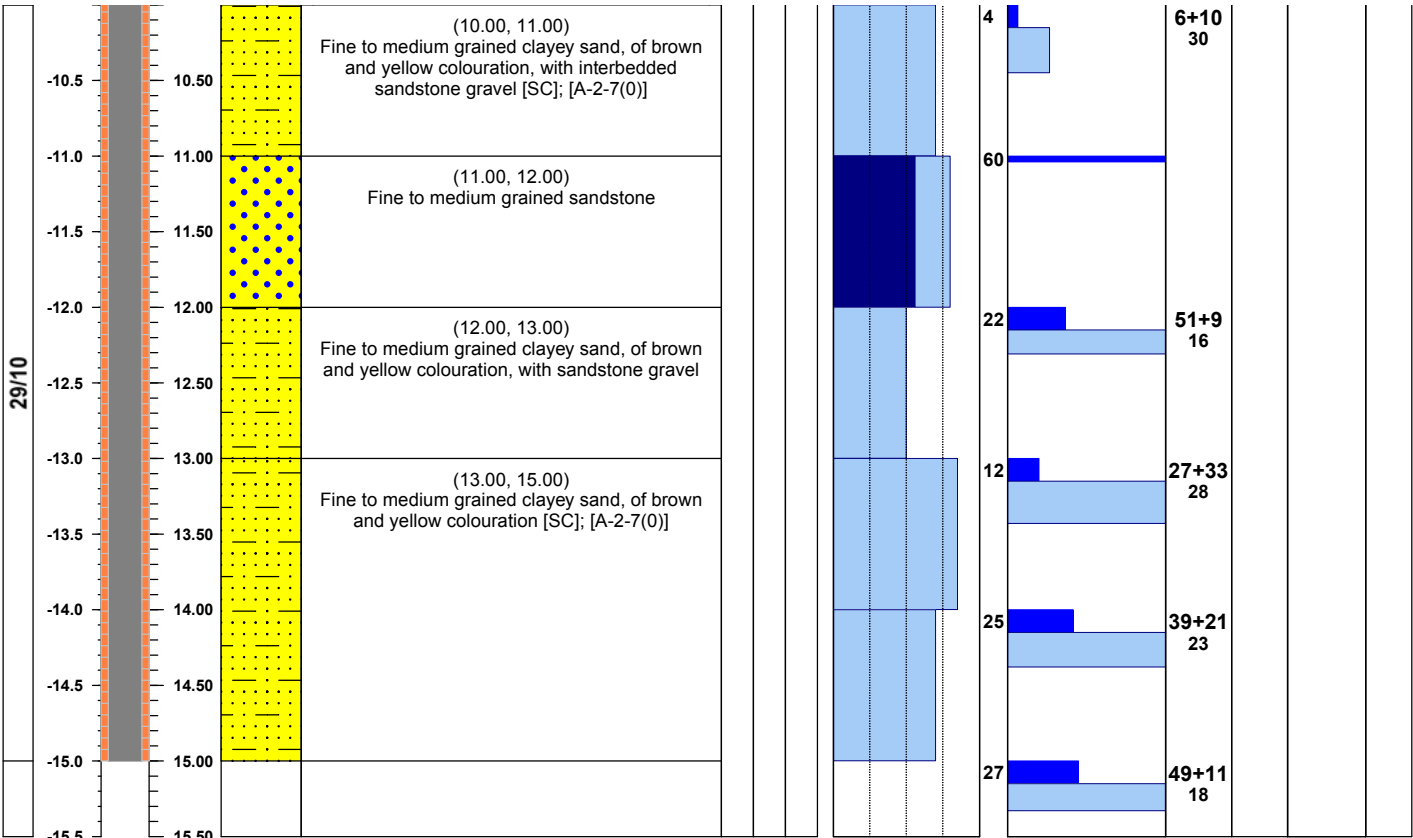
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130907.99	E: 452833.926	H: 3.547	DIRECTION:	DEPTH: 15.00m	DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 15.00 m = 86mm						CASING 0.00 m - 15.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)						STARTED: 27/10/2012 COMPLETED: 29/10/2012	
						WATER LEVEL ▽ DETECTED 1.3 ▽ PIEZOMETRIC	
						Logger NOV/12 JRC Geolog. NOV/12 GO	
						Page 2 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D.	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		



OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE GEOTECHNICAL SURVEY BOREHOLE S2



0 – 8,2 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S2



8,2 – 15,33 m



WORK: ; 5 G: F98 DCK 9F D@ BH'89J9 @ CDA9BH-B'GCI H<9FB'ACN5A6=EI 9

CLIENT: ORIENTAL CONSULTANTS CO. Ltd

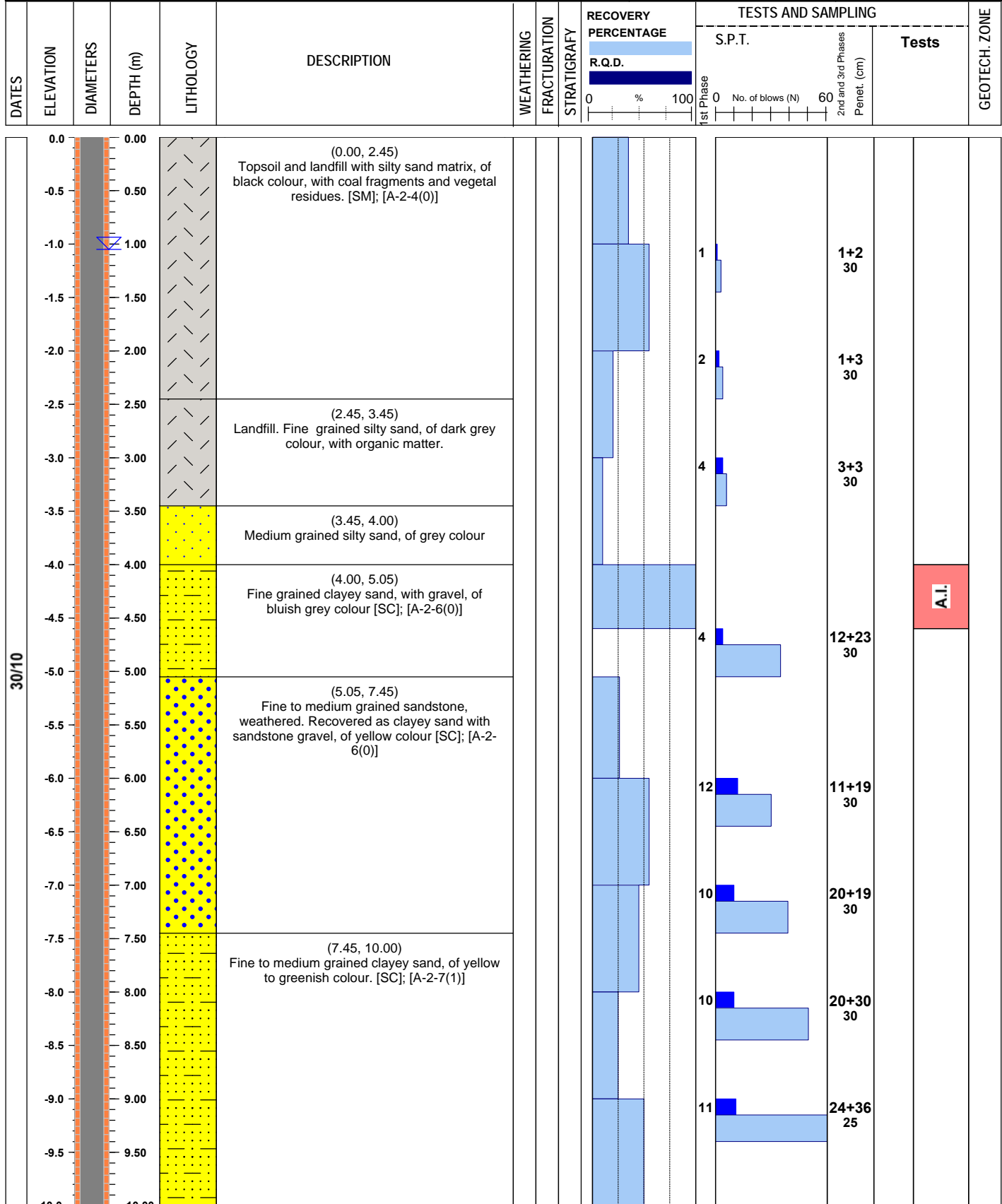
LOCATION: MATOLA - MAPUTO

BOREHOLE S3

WORK No 19.3622

N: 7130849.02	E: 452891.045	H: 3.2	DIRECTION:	DEPTH: 12.00m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 12.00 m= 86mm			CASING 0.00 m - 12.00 m= 113mm			WATER LEVEL ▽ DETECTED 1.05 ▽ PIEZOMETRIC
EQUIPMENT: DELTA BASE 520 (31650)			STARTED: 30/10/2012 COMPLETED: 30/10/2012			Logger NOV/12 JRC Geolog. NOV/12 GO

Page 1 of 2



OBSERVATIONS:



WORK: ; 5 G: F98 DCK9F D@ BH'89J9 @ CDA9BH-B'GCI H<9FB'ACN5A6=EI 9

BOREHOLE S3

CLIENT: ORIENTAL CONSULTANTS CO. Ltd

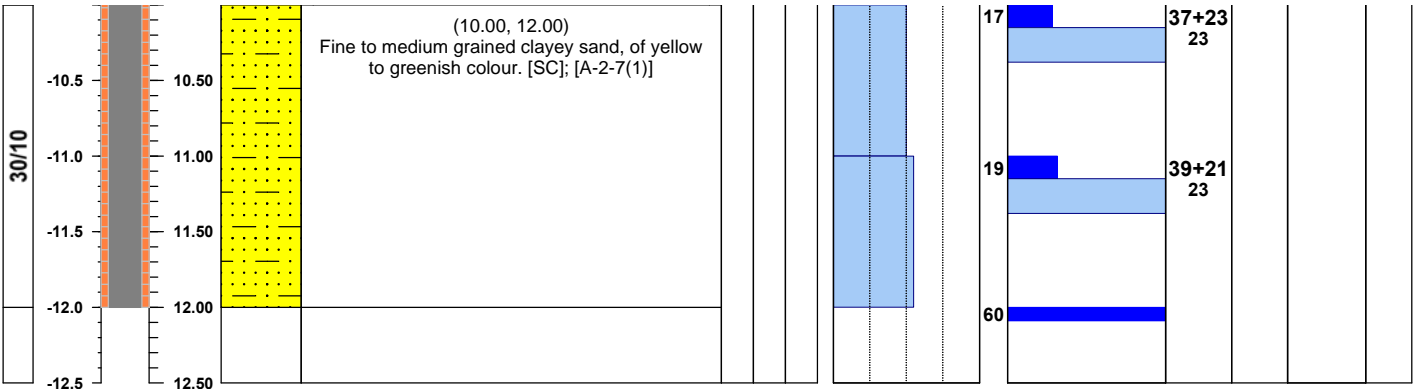
LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130849.02 **E:** 452891.045 **H:** 3.2 **DIRECTION:** **DEPTH:** 12.00m **DEG. FROM HORIZ.:** 90° **ROTARY BORING** **Proj. No.**

BORING 0.00 m - 12.00 m= 86mm **CASING** 0.00 m - 12.00 m= 113mm **WATER LEVEL** **Logger** NOV/12 JRC **Geolog.** NOV/12 GO
 DETECTED 1.05
 PIEZOMETRIC
EQUIPMENT: DELTA BASE 520 (31650) **STARTED:** 30/10/2012 **COMPLETED:** 30/10/2012 **Page 2 of 2**

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D. 0 % 100	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	1st Phase	2nd and 3rd Phases	



OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S3



0 – 6,8 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S3



6,8 – 12,9 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S4

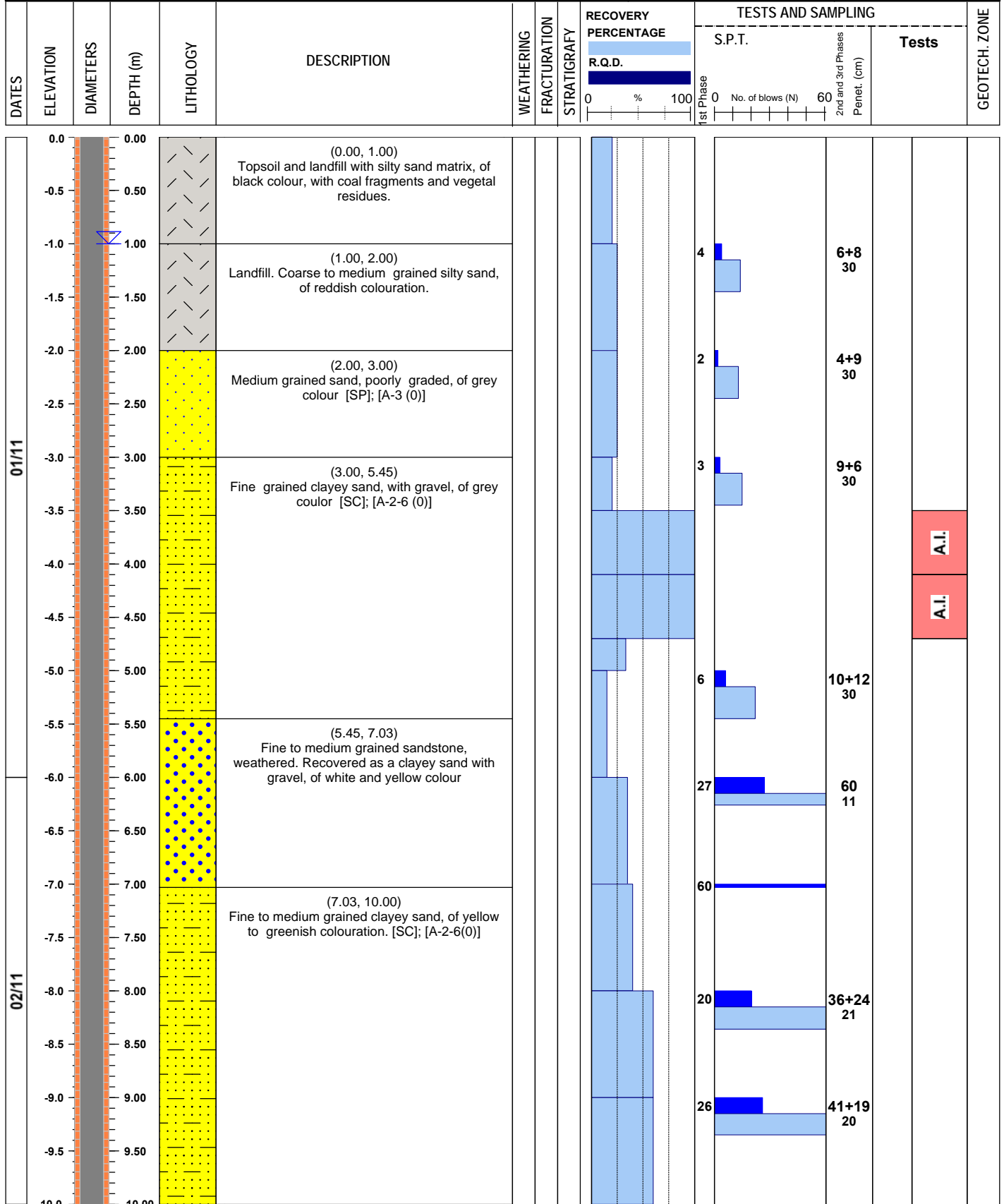
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130954.9	E: 452888.099	H: 3.352	DIRECTION:	DEPTH: 10.00 m	DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 10.00 m = 86mm						CASING 0.00 m - 10.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)						STARTED: 01/11/2012 COMPLETED: 02/11/2012	
						WATER LEVEL ▽ DETECTED 1 ▽ PIEZOMETRIC	
						Logger NOV/12 JRC Geolog. NOV/12 GO	

Page 1 of 2



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S4

CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130954.9 **E:** 452888.099 **H:** 3.352 **DIRECTION:** **DEPTH:** 10.00 m **DEG. FROM HORIZ.:** 90° **ROTARY BORING** **Proj. No.**

BORING 0.00 m - 10.00 m = 86mm **CASING** 0.00 m - 10.00 m = 113mm **WATER LEVEL**
 Logger NOV/12 JRC
 Geolog. NOV/12 GO
EQUIPMENT: DELTA BASE 520 (31650) **STARTED:** 01/11/2012 **COMPLETED:** 02/11/2012
 DETECTED 1
 PIEZOMETRIC
Page 2 of 2

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		
02/11	-10.5		10.50						0 100	0 60	0 30		

OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S4



0 – 8,0 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S4



8,0 – 10,35 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S5

CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130895.83 **E:** 452937.723 **H:** 3.422 **DIRECTION:** **DEPTH:** 9.00m **DEG. FROM HORIZ.:** 90°

ROTARY BORING

Proj. No.

BORING 0.00 m - 9.00 m = 86mm **CASING** 0.00 m - 9.00 m = 113mm

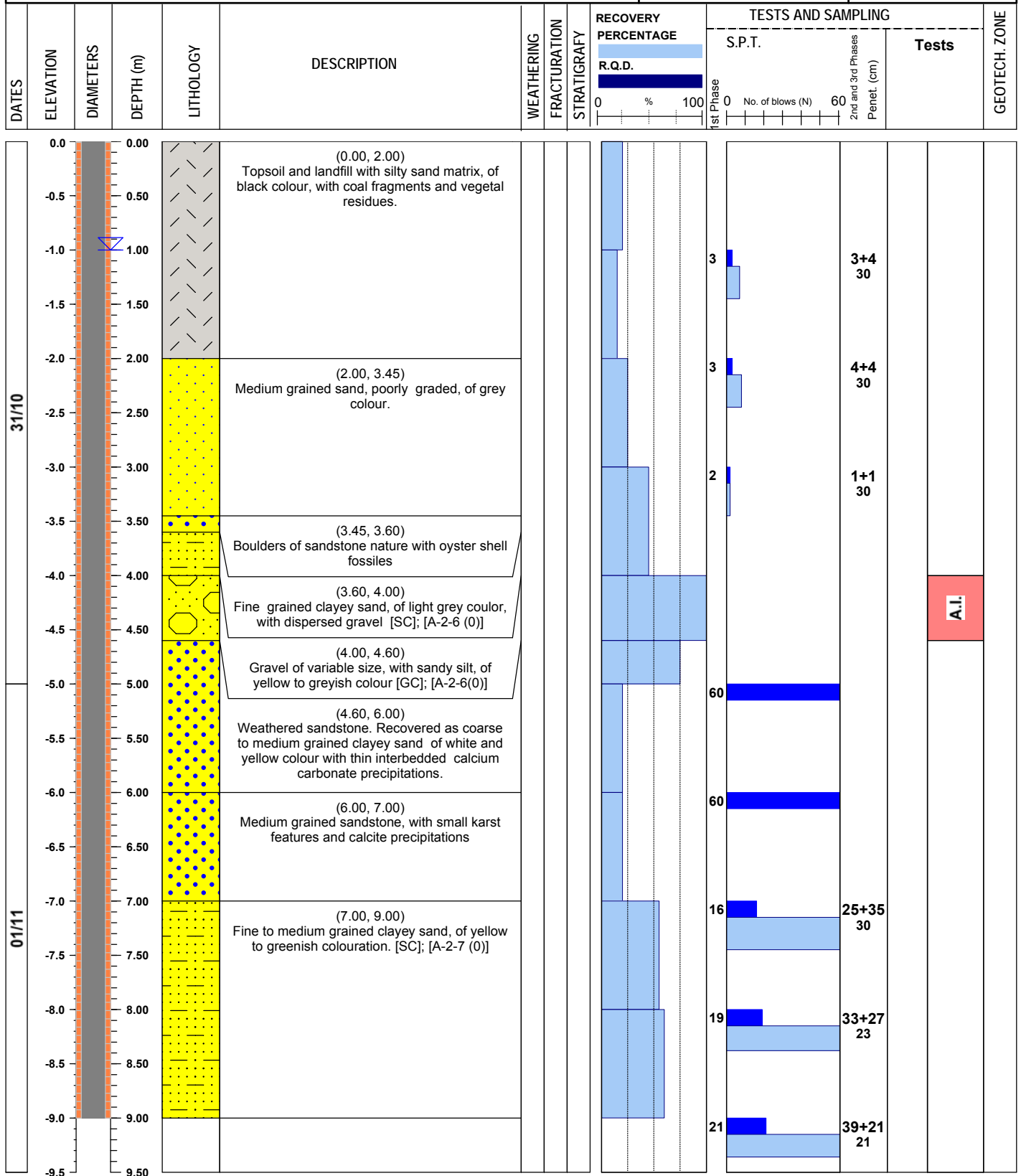
WATER LEVEL

Logger NOV/12 JRC
Geolog. NOV/12 GO

☒ **DETECTED** 1
☒ **PIEZOMETRIC**

EQUIPMENT: DELTA BASE 520 (31650) **STARTED:** 31/10/2012 **COMPLETED:** 01/11/2012

Page 1 of 1



OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S5



0 – 7,4 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S5



7,4 – 9,36 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S6

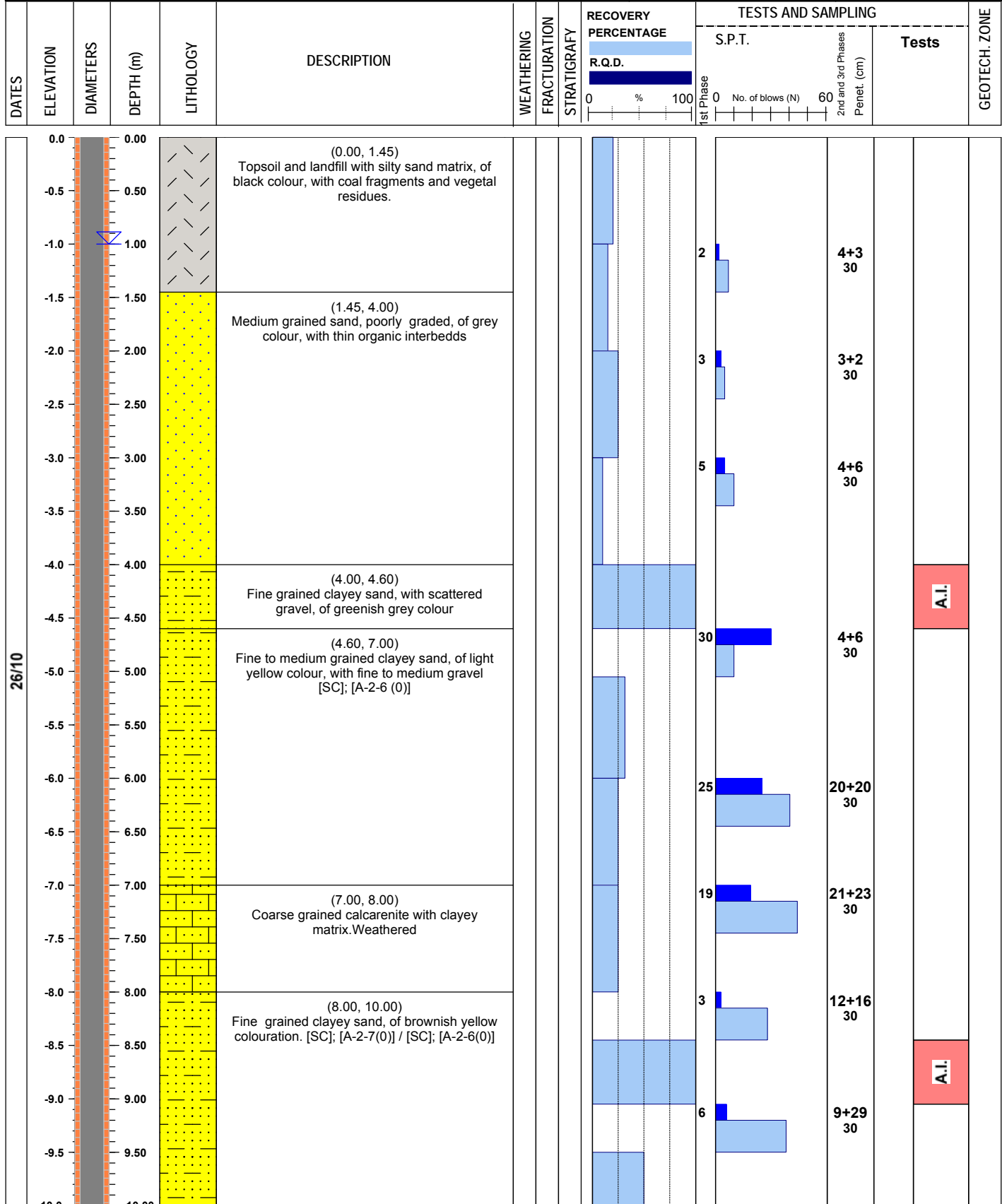
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7131012.04	E: 452826.081	H: 3.68	DIRECTION:	DEPTH: 15.00m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 15.00 m = 86mm					CASING 0.00 m - 15.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)					STARTED: 26/10/2012 COMPLETED: 27/10/2012	
					WATER LEVEL ▽ DETECTED 1 ▽ PIEZOMETRIC	
					Logger NOV/12 JRC Geolog. NOV/12 GO	

Page 1 of 2



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S6

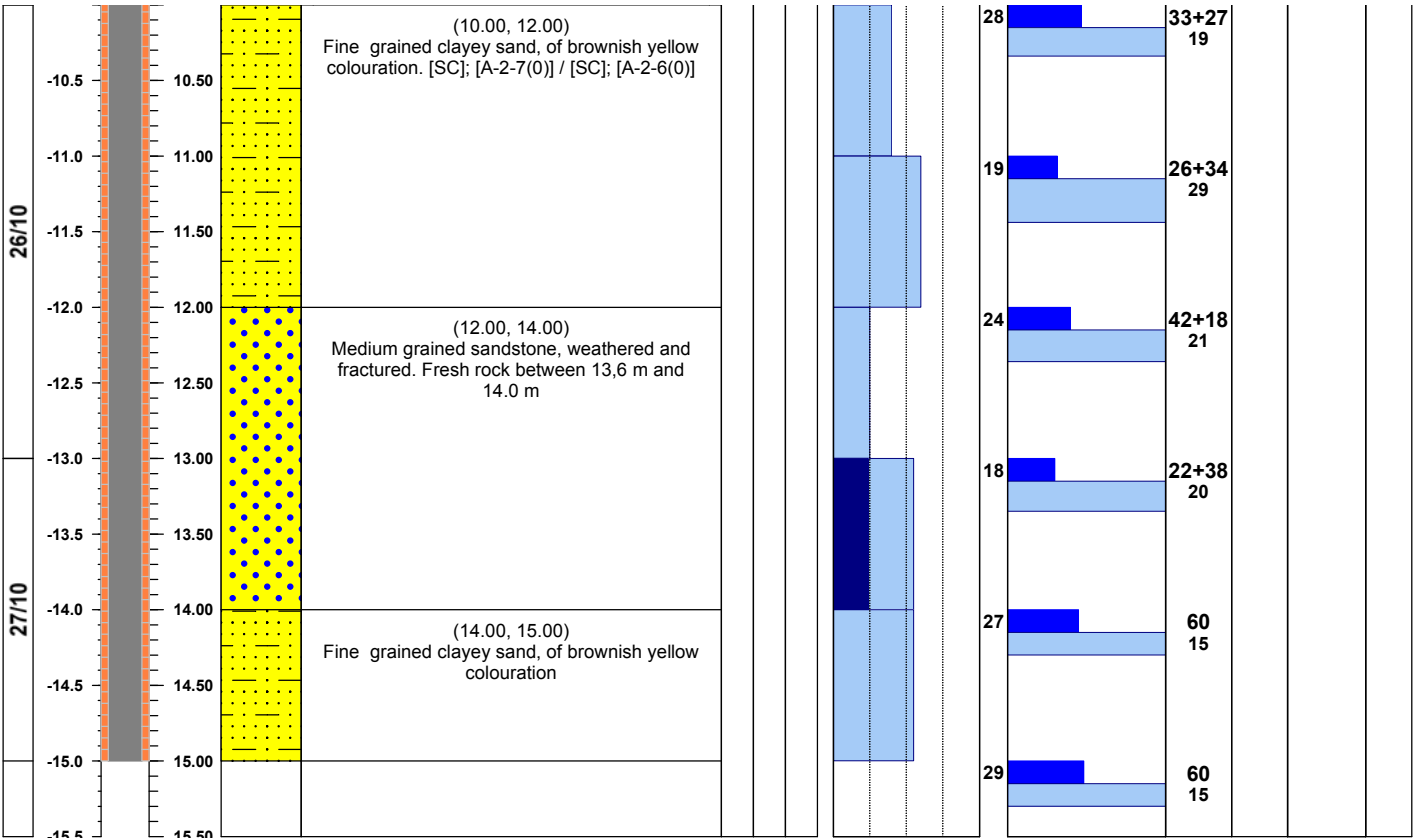
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7131012.04	E: 452826.081	H: 3.68	DIRECTION:	DEPTH: 15.00m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 15.00 m = 86mm					CASING 0.00 m - 15.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)					STARTED: 26/10/2012 COMPLETED: 27/10/2012	
					WATER LEVEL	
					▽ DETECTED 1 ▽ PIEZOMETRIC	
					Logger NOV/12 JRC Geolog. NOV/12 GO Page 2 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D.	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		



OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S6



0 – 8,0 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S6



8,0 – 15,18 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S7

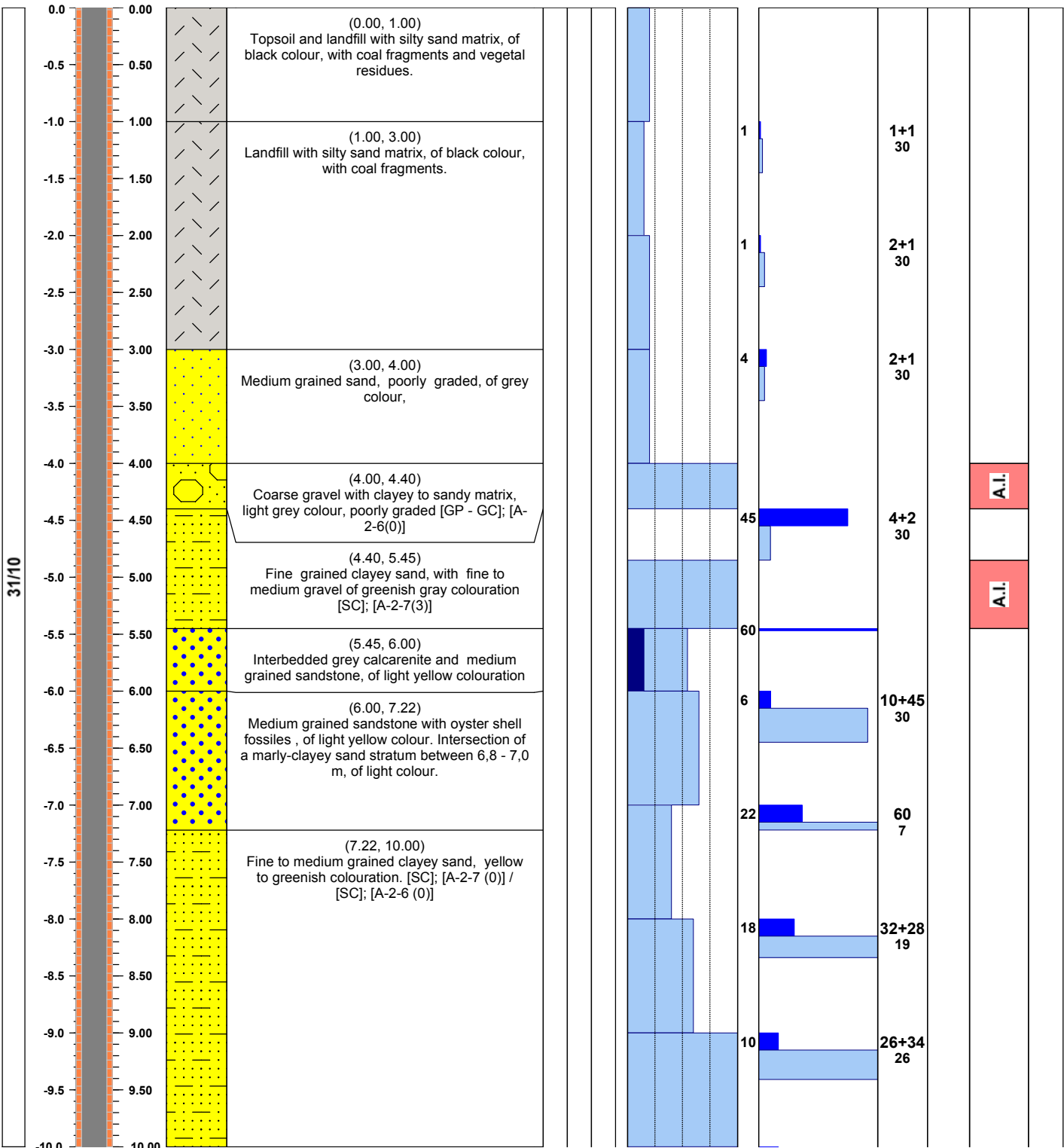
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130894.29	E: 452888.706	H: 3.438	DIRECTION:	DEPTH: 10.00 m	DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 10.00 m = 86mm						CASING 0.00 m - 10.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)						STARTED: 31/10/2012 COMPLETED: 31/10/2012	
						WATER LEVEL ▽ DETECTED ▽ PIEZOMETRIC	
						Logger NOV/12 JRC Geolog. NOV/12 GO Page 1 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE			TESTS AND SAMPLING			GEOTECH. ZONE
									R.Q.D.	%	100	S.P.T.	No. of blows (N)	Penet. (cm)	



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S7

CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130894.29 **E:** 452888.706 **H:** 3.438 **DIRECTION:** **DEPTH:** 10.00 m **DEG. FROM HORIZ.:** 90° **ROTARY BORING** **Proj. No.**

BORING 0.00 m - 10.00 m = 86mm **CASING** 0.00 m - 10.00 m = 113mm **WATER LEVEL**
 Logger NOV/12 JRC
 Geolog. NOV/12 GO
EQUIPMENT: DELTA BASE 520 (31650) **STARTED:** 31/10/2012 **COMPLETED:** 31/10/2012
DETECTED
PIEZOMETRIC
Page 2 of 2

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D. 0 % 100	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	No. of blows (N)	Penet. (cm)	
31/10	-10.5		10.50							10	29+31 24		

OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S7



0 – 7,0 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S7



6,8 – 10,39 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S8

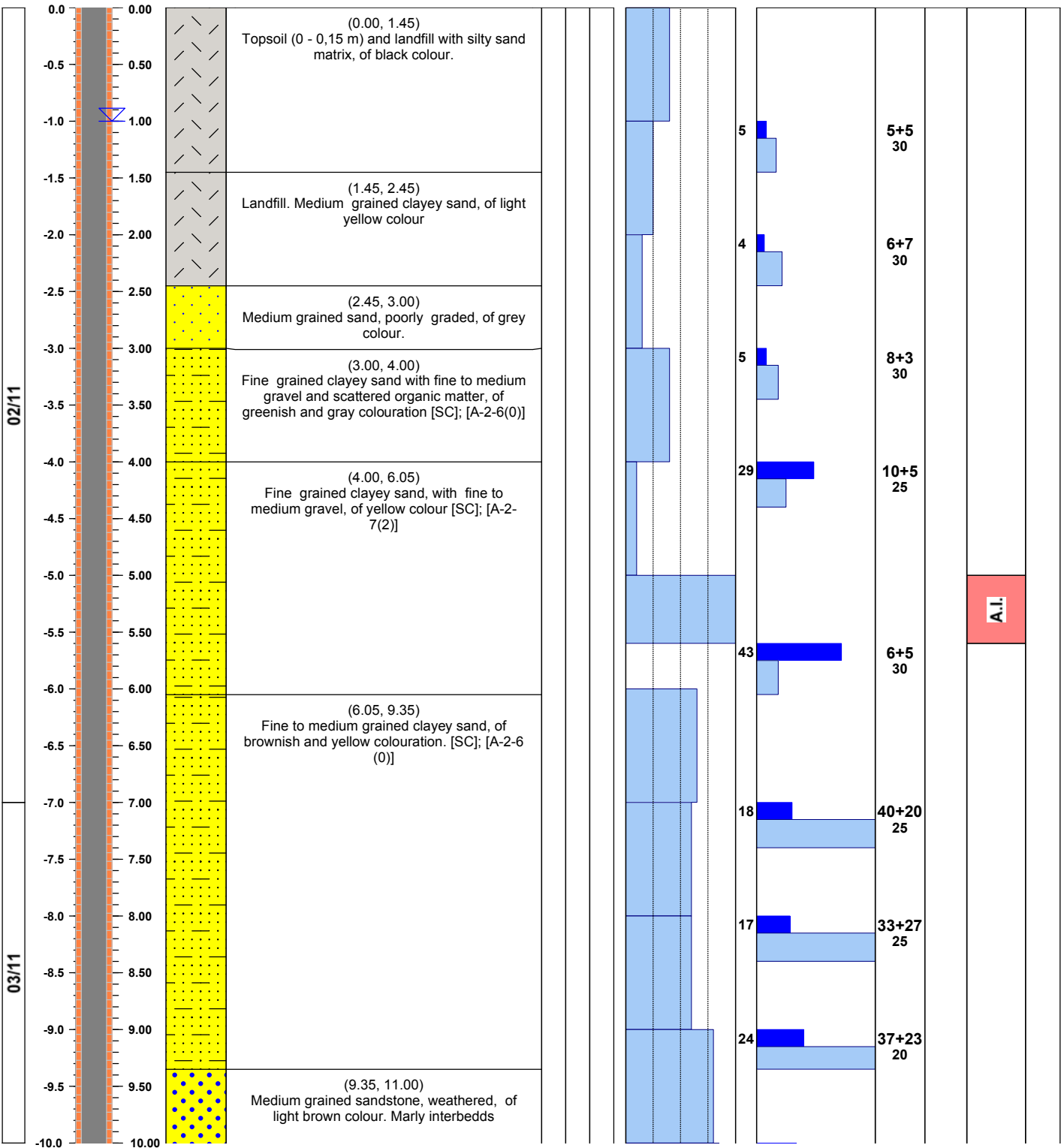
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130847.74	E: 452992.307	H: 3.346	DIRECTION:	DEPTH: 11.10m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 11.00 m = 86mm					CASING 0.00 m - 11.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)					STARTED: 02/11/2012 COMPLETED: 03/11/2012	
					WATER LEVEL ▽ DETECTED 1 ▽ PIEZOMETRIC	
					Logger NOV/12 JRC Geolog. NOV/12 GO Page 1 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D.	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S8

CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130847.74 **E:** 452992.307 **H:** 3.346 **DIRECTION:** **DEPTH:** 11.10m **DEG. FROM HORIZ.:** 90°

ROTARY BORING

Proj. No.

BORING 0.00 m - 11.00 m = 86mm **CASING** 0.00 m - 11.00 m = 113mm

WATER LEVEL

Logger NOV/12 JRC
Geolog. NOV/12 GO

☒ **DETECTED** 1
☑ **PIEZOMETRIC**

EQUIPMENT: DELTA BASE 520 (31650) **STARTED:** 02/11/2012 **COMPLETED:** 03/11/2012

Page 2 of 2

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D. 0 % 100	TESTS AND SAMPLING			GEOTECH. ZONE	
										S.P.T.	Tests			
03/11	-10.5		10.50							1st Phase	No. of blows (N)	2nd and 3rd Phases	Penet. (cm)	
	-11.0		11.00		(11.00, 11.10) Fine grained clayey sand, of yellow colour					20	60	15		
	-11.5		11.50							30	60	15		

OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S8



0 – 7,0 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S8



7,0 – 11,30 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S9

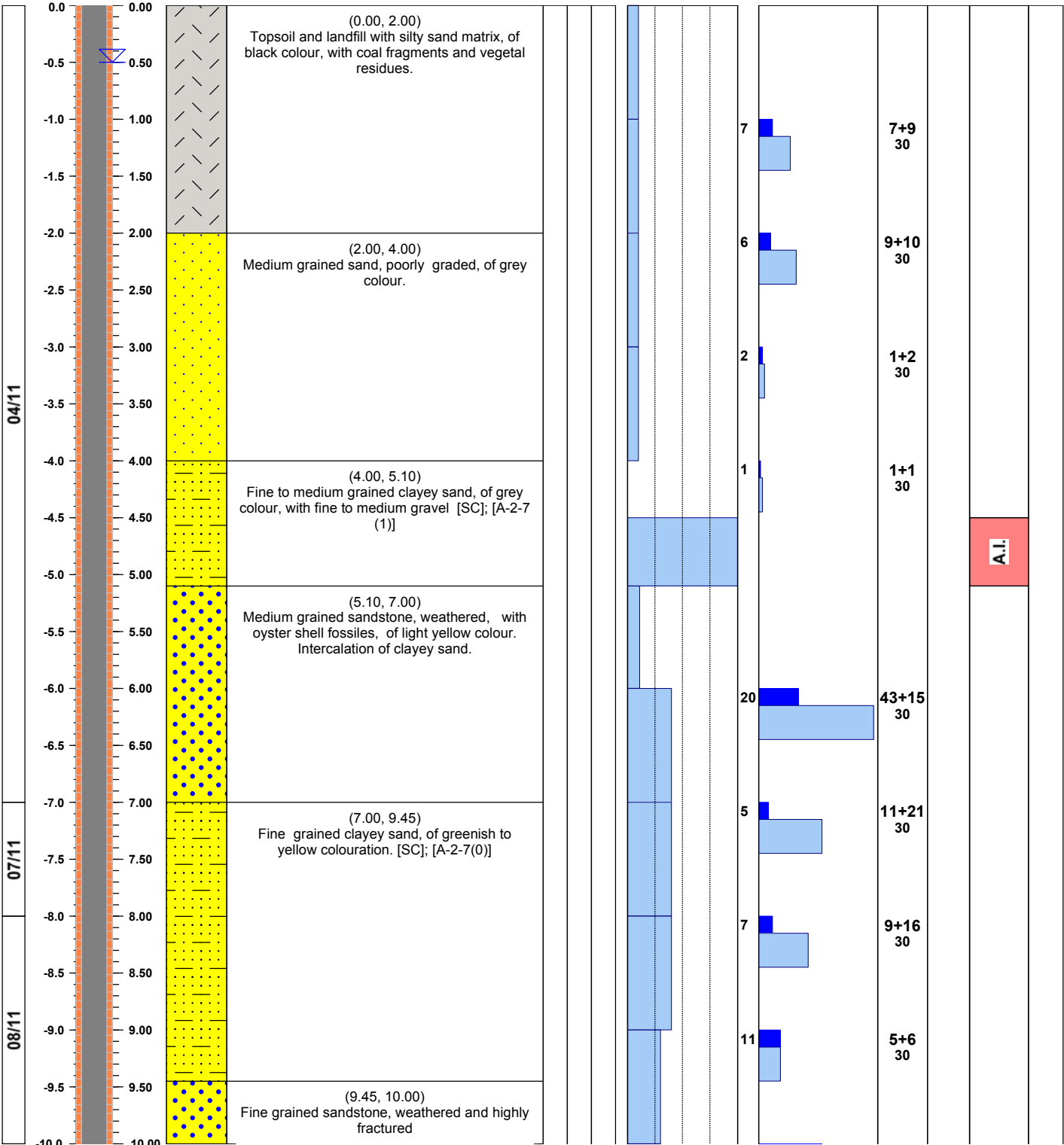
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7131012.36	E: 452943.237	H: 3.404	DIRECTION:	DEPTH: 14.00m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 14.00 m = 86mm					CASING 0.00 m - 14.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)					STARTED: 04/11/2012 COMPLETED: 08/11/2012	
					WATER LEVEL ▽ DETECTED 0.5 ▽ PIEZOMETRIC	
					Logger NOV/12 JRC Geolog. NOV/12 GO Page 1 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D.	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S9

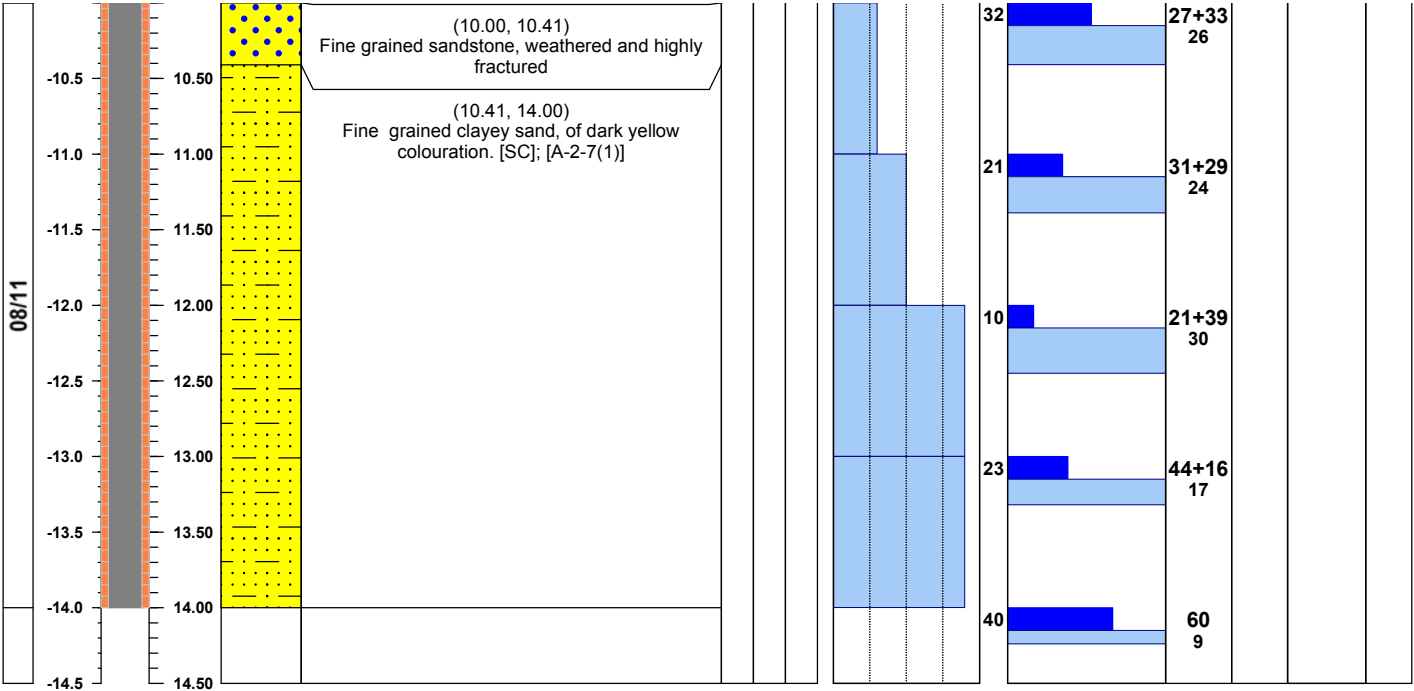
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7131012.36	E: 452943.237	H: 3.404	DIRECTION:	DEPTH: 14.00m	DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 14.00 m = 86mm						CASING 0.00 m - 14.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)						STARTED: 04/11/2012 COMPLETED: 08/11/2012	
						WATER LEVEL DETECTED 0.5 PIEZOMETRIC	
						Logger NOV/12 JRC Geolog. NOV/12 GO Page 2 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	TESTS AND SAMPLING			GEOTECH. ZONE
									RECOVERY PERCENTAGE	S.P.T.	Tests	
									R.Q.D. 0 % 100	1st Phase 0 No. of blows (N) 60 2nd and 3rd Phases Penet. (cm)		



OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S9



0 – 8,00 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S9



8,0 – 14,24 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S10

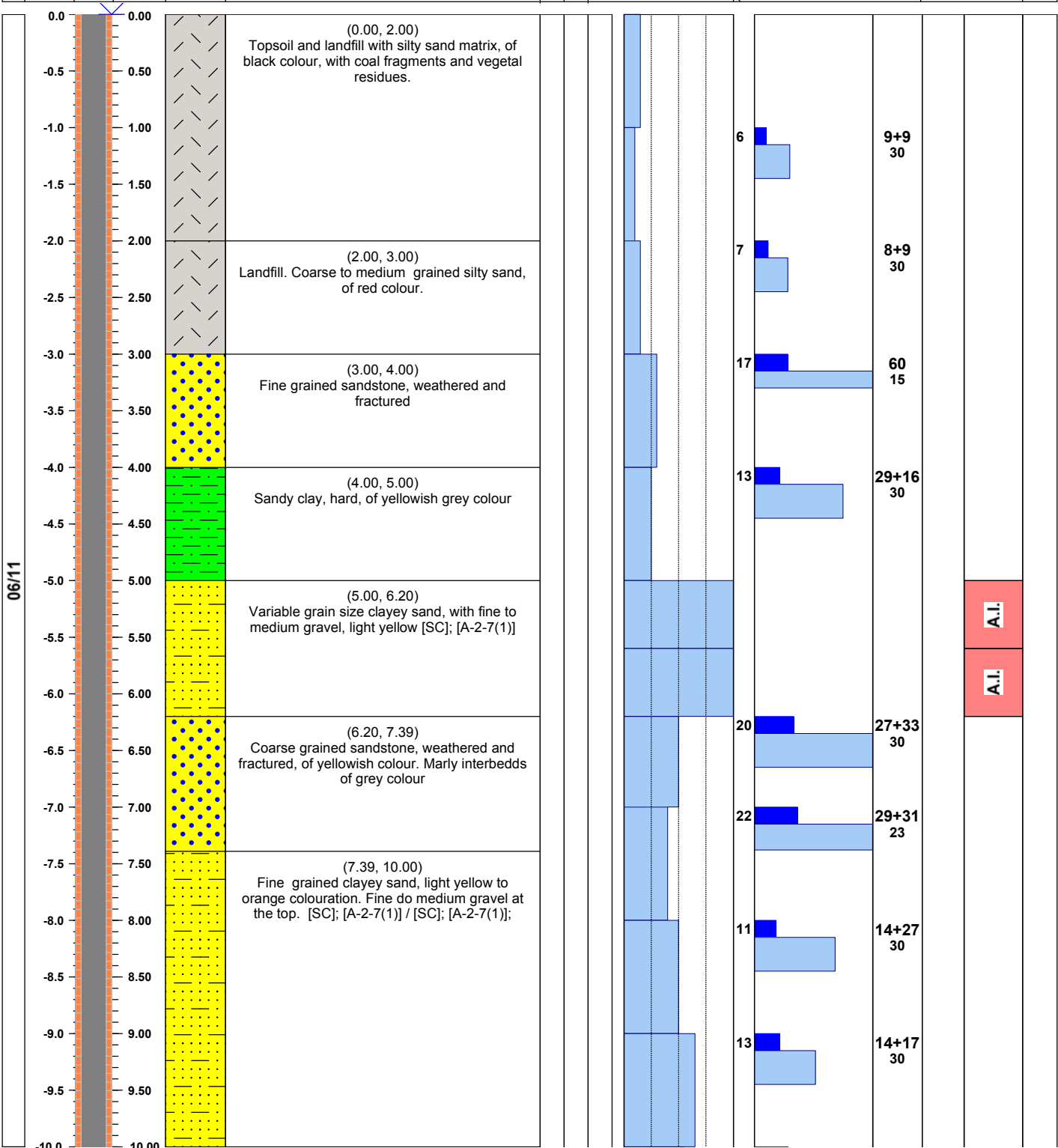
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130954.03	E: 452997.923	H: 4.812	DIRECTION:	DEPTH: 14.00m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 15.00 m = 86mm					CASING 0.00 m - 15.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)					STARTED: 06/11/2012 COMPLETED: 07/11/2012	
					WATER LEVEL ▽ DETECTED 0 ▽ PIEZOMETRIC	
					Logger NOV/12 JRC Geolog. NOV/12 GO	
					Page 1 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D.	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S10

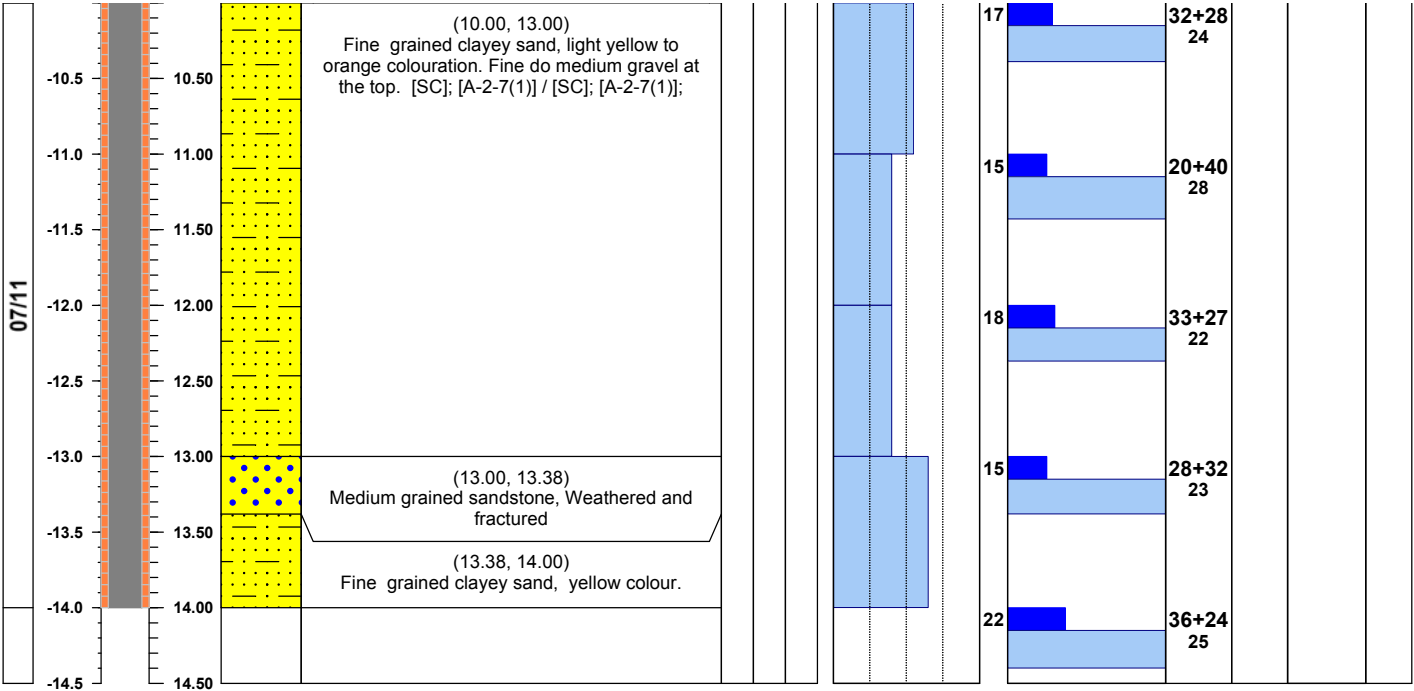
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130954.03	E: 452997.923	H: 4.812	DIRECTION:	DEPTH: 14.00m	DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 15.00 m= 86mm						WATER LEVEL	
CASING 0.00 m - 15.00 m= 113mm						DETECTED 0 PIEZOMETRIC	
EQUIPMENT: DELTA BASE 520 (31650)				STARTED: 06/11/2012		COMPLETED: 07/11/2012	
						Logger NOV/12 JRC	
						Geolog. NOV/12 GO	
						Page 2 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D.	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		



OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S10



0 – 8,00 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOTECHNICAL SURVEY

BOREHOLE S10



8,0 – 14,40 m



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S11

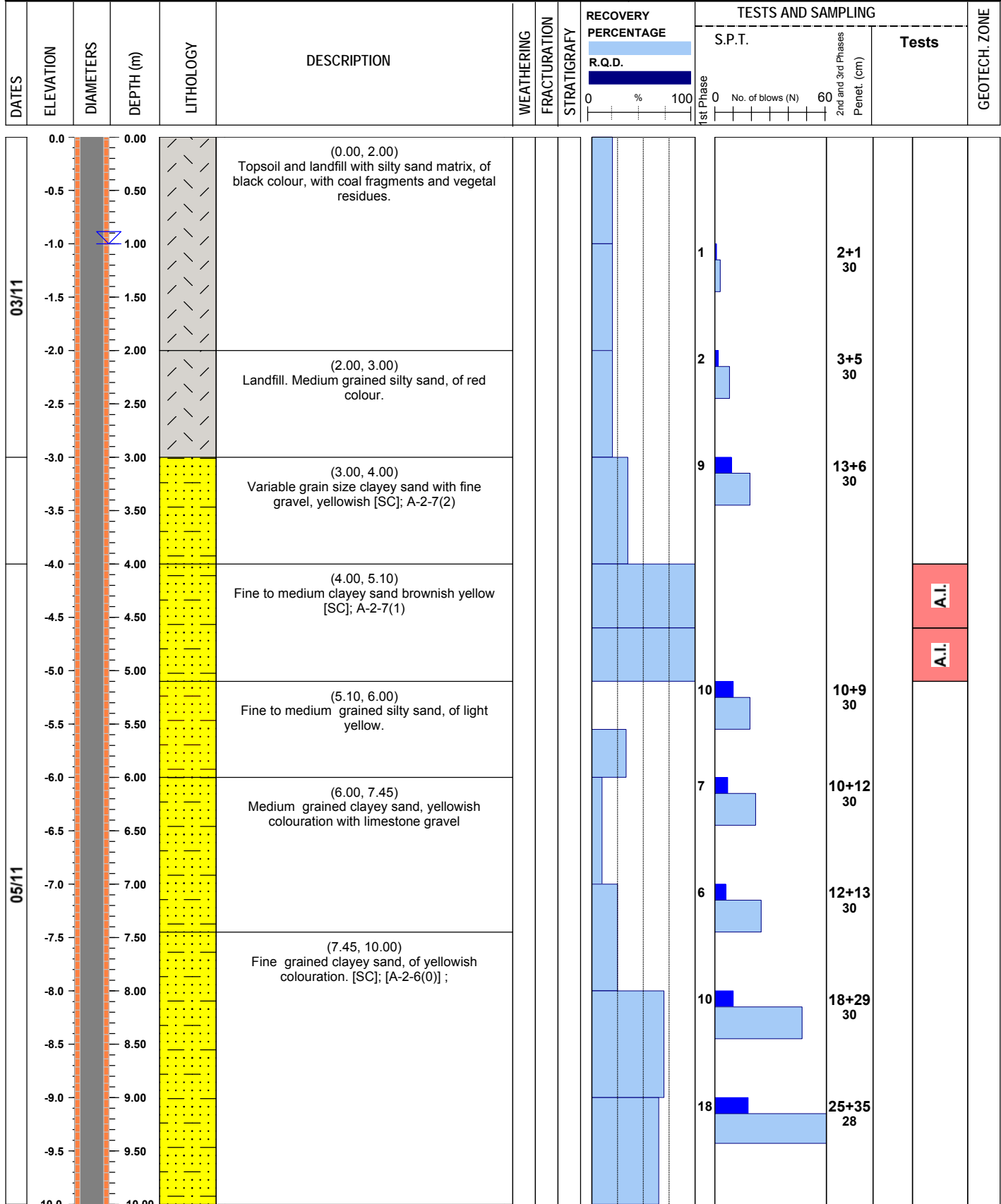
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130899.79	E: 453054.018	H: 4.872	DIRECTION:	DEPTH: 19.00m DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 19.00 m = 86mm					CASING 0.00 m - 19.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)					STARTED: 03/11/2012 COMPLETED: 06/11/2012	
					WATER LEVEL ▽ DETECTED 1 ▽ PIEZOMETRIC	
					Logger NOV/12 JRC Geolog. NOV/12 GO	

Page 1 of 2



OBSERVATIONS:



WORK: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

BOREHOLE S11

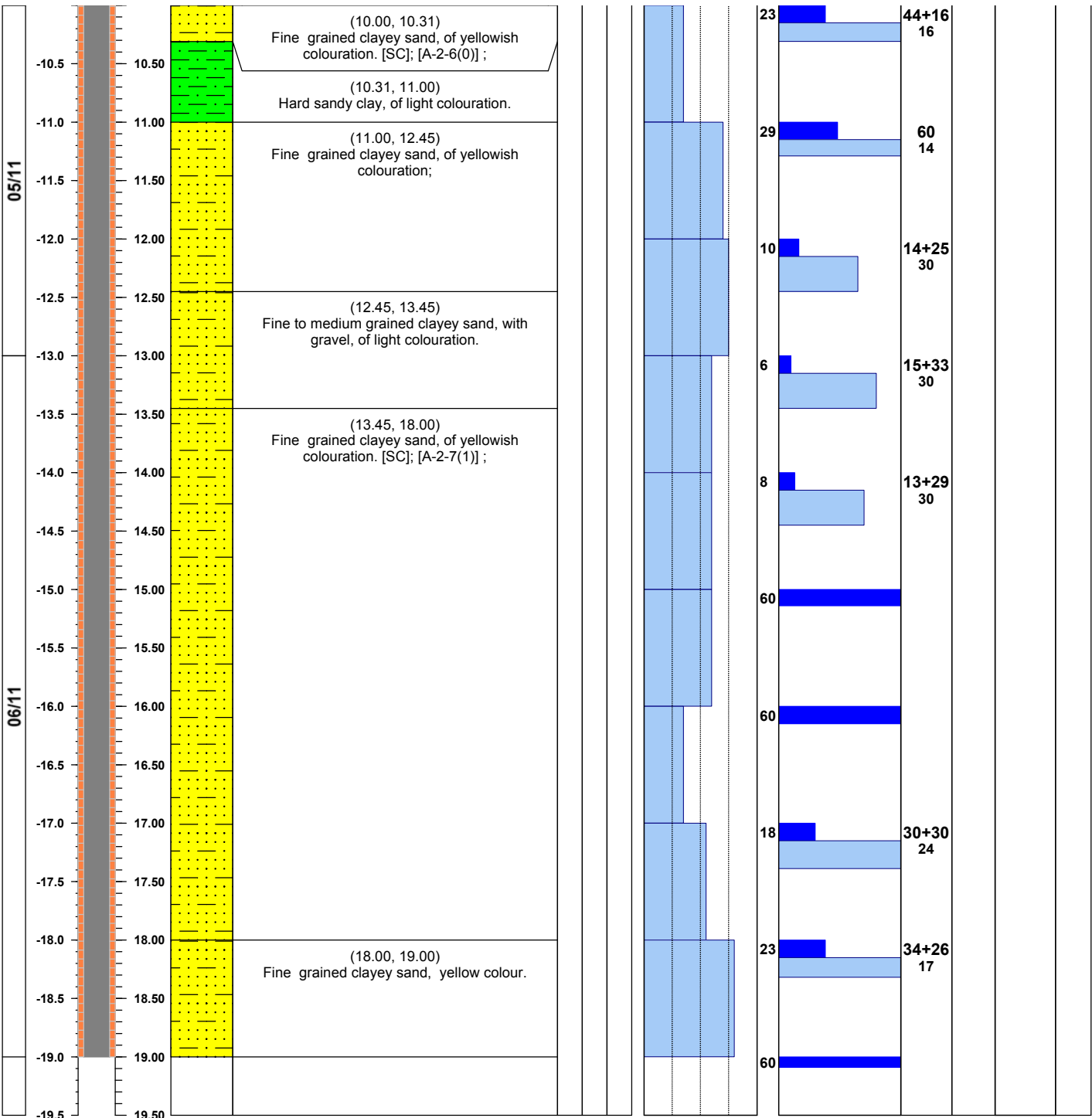
CLIENT: ORIENTAL CONSULTANTS CO. Ltd

LOCATION: MATOLA - MAPUTO

WORK No 19.3622

N: 7130899.79	E: 453054.018	H: 4.872	DIRECTION:	DEPTH: 19.00m	DEG. FROM HORIZ.: 90°	ROTARY BORING	Proj. No.
BORING 0.00 m - 19.00 m = 86mm						CASING 0.00 m - 19.00 m = 113mm	
EQUIPMENT: DELTA BASE 520 (31650)						STARTED: 03/11/2012 COMPLETED: 06/11/2012	
						WATER LEVEL ▲ DETECTED 1 ▼ PIEZOMETRIC	
						Logger NOV/12 JRC Geolog. NOV/12 GO Page 2 of 2	

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAPHY	RECOVERY PERCENTAGE R.Q.D.	TESTS AND SAMPLING			GEOTECH. ZONE
										S.P.T.	Tests		



OBSERVATIONS:

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S11



0 – 8,0 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S11



8,0 – 15,20 m

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE
GEOTECHNICAL SURVEY
BOREHOLE S11



15,2 – 19,09 m