Douglas Partners
Geotechnics / Environment / Groundwater

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Project 81320
9 July 2013
SAM:kd
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BOC Limited
Riverside Corporate Park
10 Julius Avenue
NORTH RYDE NSW 2113

Attention: Mr Runmin Jiang

Email: runmin.jiang@boc.com

Dear Sirs

Geotechnical Investigation
New Storage Tanks
9 Egret Street, Kooragang Island

1. Introduction

This report presents the results of a geotechnical investigation for proposed new storage tanks to be installed within the existing BOC facility at 9 Egret Street, Kooragang Island. The investigation was commissioned by BOC Limited.

It is understood that the proposed development includes installation of two new 460 tonne storage tanks. Based on information provided by iCubed Consulting (i^3), the storage tanks will be supported on concrete plinths and the working loads applied to each plinth are as follows:

- Tension / compressive load – 900 kN;
- Lateral Load – 185 kN;
- Slab loading 5 kPa.

One of the tank sites has existing concrete plinths which may be used to partially support the tank if feasible. It is understood that the existing plinths are each founded on four bottom-driven ‘Franki’ piles.

BOC advised that the tanks will be lifted into position via a dual crane lift. The actual loads applied to the crane outrigger loads have not been provided for this investigation.

A geotechnical investigation was required to provide information on subsurface conditions including depth to groundwater and comments on:

- Feasible footing types, suitable founding depths and probable settlements; and
- Geotechnical parameters for design of footings.

Assessment of the allowable bearing pressure beneath the crane outriggers to accommodate the load was also required.

For the purposes of the investigation, the client provided the following:

- Drawings by iCubed Consulting Pty Ltd (Elevations and Layout);
- Crane location layout by Borger Cranes (two drawings dated 22 May 2013).

Douglas Partners Pty Ltd (DP) has previously undertaken the following geotechnical investigations at the site:

- Douglas Partners Pty Ltd “Report on Geotechnical Investigation, Proposed Development at BOC facility, Egret Street, Kooragang Island, prepared for ICD (Asia Pacific) Pty Ltd, Report 39402 dated December 2005;
- D.J. Douglas & Partners Pty Ltd “Report on Geotechnical Investigation, Proposed C.I.G. Production Site, Kooragang Island”, prepared for Sinclair Knight & Partners Pty Ltd, Report 10603, dated July 1987;
- Ground Test Pty Ltd “Report on Foundation Conditions, Proposed Carbon Dioxide Plant at Newcastle”, prepared for Commonwealth Industrial Cases Limited, Report 4891, dated 6 May 1975.

The current investigation included two cone penetration tests (CPT) and seven dynamic penetrometer tests. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

The results of the previous investigations have been used to augment the results of the current investigation.

2. Site Description

The site of the proposed upgrade to the existing BOC facility is located on the eastern side of Egret Street, Kooragang Island. The site is bounded to the south by Sims Metal Storage facility.

The ground surface of the site is near level (RL 3.6 AHD to 4.3 AHD) and comprises mainly grass covered sand and concrete pavements.

Figure 1: View of site at CPT 302

Figure 2: View looking east from CPT 302 to CPT 301

The existing tanks are situated on the western side of the BOC site, as shown on Drawing 1, attached.

Reference to the 1:100,000 scale Newcastle Coalfield Geological Series sheet, indicates that the site is underlain by Quaternary alluvium deposits.

Reference to the Department of Land and Water Conservation 1:25,000 Acid Sulphate Risk Map for Newcastle indicates the site lies within an area described as "disturbed terrain", which often includes filled areas, often associated with reclamation of low lying swampland. As such, Acid Sulphate Soil risk is dependent on the origin and properties of the filling material which has been placed on site.

Reclaimed portions of Kooragang Island have hydraulically placed dredged sand fill overlying the natural soils. Previous experience has indicated that the dredged sand fill is generally not potential acid sulphate soils (PASS), however the underlying natural soils are PASS and could generate acid if exposed to oxidation.

3. Field Work Methods

The field work for the geotechnical investigation was undertaken on 25 June 2013 and comprised two cone penetration tests (CPT 301 and 302) and seven dynamic penetrometer tests (Tests 401 to 407) at the locations shown on the attached Drawing 1.

The test locations were set out by a geotechnical engineer relative to site features, including boundary fences and existing plant.

An underground services locator was engaged to confirm the absence of services at test locations.

The CPTs were carried out at accessible locations using a custom-built, truck mounted CPT rig, with centrally located hydraulic rams. The cones were advanced at a rate of approximately 20 mm / second and a digital data acquisition system recorded cone tip resistance, friction sleeve resistance, inclination from vertical and encoded depth at measurement intervals of 20 mm. Groundwater measurements were undertaken within the remnant hole upon withdrawal of the CPT rods. The tests were taken to depths of 10 m.

The dynamic penetrometer tests were undertaken at locations that could not be accessed by the cone rig. The tests were undertaken by a geotechnical engineer from DP.

The test locations are shown on Drawing 1, attached, which also shows the location of previous test pits and cone penetration tests (CPT).

4. Field Work Results

The subsurface conditions interpreted from the cone penetration testing are described in detail on the attached CPT charts. These should be read in conjunction with the accompanying notes preceding them, which explain the descriptive terms and classification methods used in the charts and report.

In summary, the subsurface conditions are generally consistent with previous investigations undertaken by Douglas Partners in the vicinity of the site. A summary of the conditions are presented below.

From Depth of (m)	Description
0.0 (surface)	SAND: (Dredged) loose to medium dense
3.3/4.1	SILTY CLAY: Soft to firm, with sand lenses
8.0/8.3	SAND: Dense to very dense
10.0	Depth of investigation

The main exception to the above general profile was the presence of a firm clay layer (0.25 m thick) at 1.5 m depth in CPT 302. This is consistent with subsurface conditions encountered in previous test pits excavated at the site where interbedded soft to firm clay bands in Pits 201 to 205 (Refer Drawing 1 attached), occurring generally between 1.1 m and 1.95 m depth. Some of those clay bands had appeared to be dredged silt/clay trapped within sand.

Groundwater was encountered in CPT 302 at a depths of 1.3 m but hole collapse at 0.7 m precluded groundwater level observations in CPT 301. Previous investigations at the site indicate groundwater levels at depths ranging from 1.2 m to 2.2 m. It should be noted that groundwater levels are transient and are affected by factors such as climatic conditions and soil permeability and could vary with time.

5. Comments

5.1 Subsurface Conditions

The pertinent geotechnical features at this site are discussed below:

- The presence of relatively thin weak clay layers in the dredged sand fill at depths ranging from 1.1 m to 1.95 m. These layers have reduced bearing strength and are not continuous across the site potentially resulting in differential movement between similar sized shallow footings. These weak layers need to be considered for the assessment of the crane outrigger loads;
- The presence of the soft to firm silty clay at depths of 3.3 m to 4.1 m, underlying the upper dredged sands will influence the bearing capacity of shallow footings supported in the overlying sand and can consolidate if there is an increase in net stress in this layer;
- The medium dense to very dense sand layer beneath the soft to firm clay which was encountered at depths of about 8 m is generally used to support piled foundations at Kooragang Island;
- Based on current and previous investigations, groundwater was encountered at depths of 1.2 m to 2.2 m. The presence of groundwater will need to be considered in the choice of piling equipment.

5.2 Footings for Storage Tanks

Based on the subsurface conditions, two footing options have been considered for the support of the storage tanks: shallow pad footings or deep piled footings. A description of each footing type is presented below.

Pad Footings

Large pad footings are installed in the filling at a depth of no greater than 0.5 m. In order to reduce the net increase in stress in the underlying clay, the applied bearing pressure should be limited to 75 kPa.

Due to the presence of discontinuous soft to firm clay layers trapped in the sand filling at 1.1 m to 1.95 m, it is recommended that dynamic penetrometer tests be undertaken during construction to assess the presence of the soft layers. If encountered, the soft to firm layer should be removed by excavation be replaced with compacted clean sand. The sand should be compacted to a relative density of at least 75% density index. It is noted that the weak clay layers are below the groundwater level and dewatering of the excavation is expected to be required.

Based on a compressive working load of 900 kN and an allowable bearing pressure of 75 kPa, the pad footing will need to be 12 m^2 (e.g. 3 m by 4 m). Provided the footing has sufficient stiffness to equally distribute the applied load into the ground, estimated primary and secondary (creep) consolidation beneath the footing is estimated to be in the order of 180 mm to 240 mm over a 50 year design period. There could be additional settlement due to interaction affects between adjacent footings which should be further assessed once footing layout has been confirmed.

The above total settlements and size of the footing required to support the 900 kN working load may preclude the use of shallow footings. If shallow footings are selected, however, differential settlements and resulting tilts of structures could possibly be managed to an extent by designing adjustable connections between the footings and the structures. If this method is used, allowance should be made for differential adjustments at each connection as this is needed to remove tilts.

Long term survey monitoring of the footings must be undertaken to assess differential settlement during the life of the structure to assess differential settlements and timing of re-levelling of the structure or slab.

Flexible services and service connections should be installed to allow for differential movement.

For the design for lateral loads the following parameters could be adopted provided suitable factors of safety are incorporated into the design:

- Passive Earth Pressure coefficient – 3.7;
- Bulk unit weight – 20 kN/m^3 (above water table);
- Base sliding friction – 26^o (between concrete base and sand) for non-piled footings.

Piled Footings

The target layer for piles is the dense sand layer which was encountered at depths of 8.0 m to 8.3 m at the CPT locations. It is understood that additional filling is not proposed at the site and therefore additional pile loads caused by down-drag or negative skin friction are not expected at this site.

Conventional uncased bored piles would not be suitable at this site because of the presence of groundwater and the likely borehole collapse upon withdrawal of the auger if the piles penetrate the underlying saturated sand. Other pile types such as continuous flight auger (CFA) piles could be used to overcome the problems with collapsing conditions.

Alternatively, driven timber piles with a suitable pile cap could be used but consideration should be given to the potential vibration associated with installation of the piles through the upper sand layer. In this regard, the upper sand layer was locally very dense and very hard driving conditions are expected and pre-drilling pile locations may need to be undertaken to enable penetration of the sand and to reduce the risk of vibration. Furthermore, timber piles may not be able to penetrate into the underlying dense sand to develop sufficient tension capacity.

Based on the findings of the investigation, the following parameters are suggested for the design of the footings for lateral and compressive loads.

Table 1: Design Parameters for Piled Footings

Soil Type	Depth to Base of Each Layer (m)		Bulk Density (kN/m3)	Undrained Cohesion (kPa)	Undrained Friction angle (^{o})	Allowable End Bearing Capacity (kPa)	Allowable Shaft Adhesion (kPa)
	CPT 301	CPT 302					
Filling – Sand	4.0	3.0	20	0	35	-	30
Soft to Firm Clay	8.5	9.0	16	15-20	0	-	-
Dense Sand	>10	>10	20	0	38	2000	50

The shaft parameters as presented in Table 1 are for compressive loads. It is recommended that the shaft parameters be downgraded to 75% of the values listed in Table 1 for the assessment of tension capacities for the assessment of CFA piles. The shaft adhesion parameters should be downgraded to 35% for the assessment of tension capacity in driven timber piles to account for the tapering of the pile (although experience has shown that this may be conservative).

The upper 1 m or 1.5 x pile diameter should be ignored in the analysis as required by AS 2159 (Ref 3).

Based on the parameters presented in Table 1, tension loads are expected to govern the pile length.

Based on supporting the plinth using two 0.75 m diameter CFA piles, the installation depth would need to be about 12 m each to account for the nominated tension load of 900 kN (not including the buoyant weight of the pile). Alternatively, a pile group of more than two piles could be considered to reduce pile lengths. Depending on the pile arrangement, additional CPTs may be required to confirm founding depths if the proposed pile depths approach the depth of investigation.

Lateral pile analysis was undertaken using the program PYGMY Ver 3.21, developed by the University of Western Australia. The lateral capacity of piles is governed by the stiffness of the pile and the strength of the upper strata.

The program PYGMY analyses the soil-structure interaction of a vertical single pile subject to lateral loading. The program models the soil resistance applied to the pile using a series of non-linear springs. Several different soil layers can be modelled down the pile length using the program.

The deflection and bending moment was assessed based on the lower bound soil conditions encountered at the site. The results of the analysis are summarised in below for 750 mm diameter CFA pile installed to a nominal depth of 8 m and using an elastic modulus of 30,000 MPa for the concrete pile:

- Lateral Load: 185 kN;
- Pile head deflection: <5 mm;
- Maximum Bending Moment: 160 kNm.

5.3 Footings for Crane Outrigger Loads

For the bearing capacity under proposed crane outrigger loads, two mechanisms are important as follows:

- Shallow failure of the granular fill below the crane;
- Deeper seated punching failure into the clay layer below.

The bearing capacity was assessed using BRE guidelines for tracked plant (Ref 2). The bearing capacity is governed by the thickness of sand over the soft clay, the respective strengths of the sand and clay and the width of the loaded area (for a rectangular mat or pad the width is the smaller of the two dimensions). A wider footing reduces the contact pressure for a given load but increases the depth of the ‘stress bulb’ which extends into weaker material.

At this site the presence of the weak clay layers trapped within the dredge sand govern the bearing capacity beneath the out rigger loads supported on the existing sand.

Based on the results of the investigation, it is assessed that the profile can support an allowable short term uniformly distributed bearing pressure of 200 kPa for outrigger loads up to 2 m wide. If greater loads or different load dimensions are proposed, further analysis is required.

DP have not assessed the ability of any existing services or backfilled trenches to accommodate the estimated settlements and applied pressures from crane lifts.

Some settlement (elastic and permanent deformation) of the ground beneath the crane outrigger is likely to occur during the operation of the equipment.

The site drainage should be controlled to prevent surface water ponding on the fill platform.

6. Acid Sulphate Soils

A data review of DP files in the general vicinity of the site has indicated that acid sulphate soil testing was undertaken on soil samples collected from a borehole drilled in Egret Street (west of the site). The testing has indicated that acid sulphate soils are not expected to be present within the upper 2 m of the soil profile. Another investigation undertaken by DP at the corner of Egret Street and Raven Street (north of the site) has indicated similar results.

Previous experience at Kooragang, however, suggests that the underlying natural clays generally have a high risk of being potential acid sulphate soils. It is therefore considered that acid sulphate soils may be disturbed if excavations, such as for installation of buried services or pile spoil from the underlying soft to firm clays, which were encountered below depths of about 3 m.

If the soft to firm clays, encountered below about 1.9 m, are to be disturbed as part of the proposed construction, additional sampling and testing should be undertaken, and an acid sulphate soil management plan will likely be required.

Lowering of the groundwater as part of construction also presents a risk of oxidation of acid sulphate soils, and therefore should not be undertaken without additional assessment and analysis, which will likely also require an acid sulphate soil management plan.

7. References

1. Australian Standard AS 2159-2009 “Piling – Design and Installation”, 2009 Standards Australia.
2. Building Research Establishment Ltd “Working Platforms for Tracked Plant: Good Practice Guide to the Design, Installation, Maintenance and Repair of Ground Supported Working Platforms”, dated 2004.

8. Limitations

Douglas Partners (DP) has prepared this report for this project at 9 Egret Street, Kooragang Island in accordance with DP's proposal dated 17 June 2013 and acceptance received from BOC Limited dated 18 June 2013. This report is provided for the exclusive use of BOC Limited for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Please contact either of the undersigned for clarification of the above as necessary.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

Scott McFarlane
Senior Associate

Stephen Jones
Principal

Attachments: About this Report
Cone Penetration Tests Information Sheet
Cone Penetration Tests (CPT 301 and 302)
Results of Dynamic Penetration Tests
Drawing 1 – Test Location Plan

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Cone Penetration Tests

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

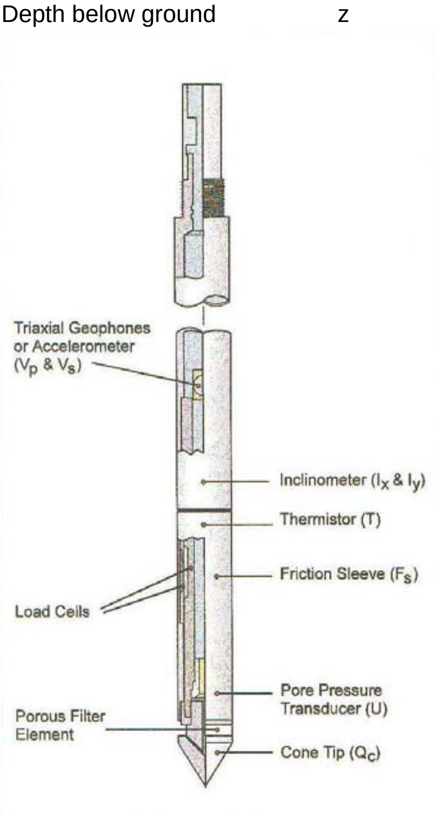

Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

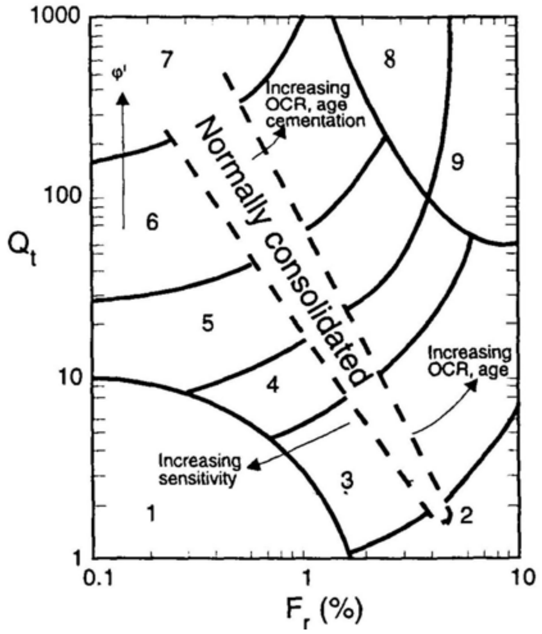

Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

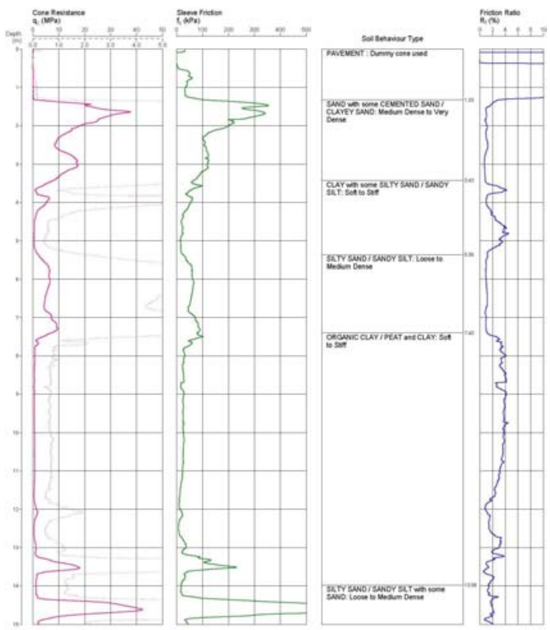

Figure 4: Sample Cone Plot

CONE PENETRATION TEST

CLIENT: BOC LTD

PROJECT: PROPOSED STORAGE TANK

LOCATION: 9 EGRET ST, KOORAGANG ISLAND

REDUCED LEVEL: 4.0 AHD

COORDINATES: 384344E 6360978N MGA

CPT 301

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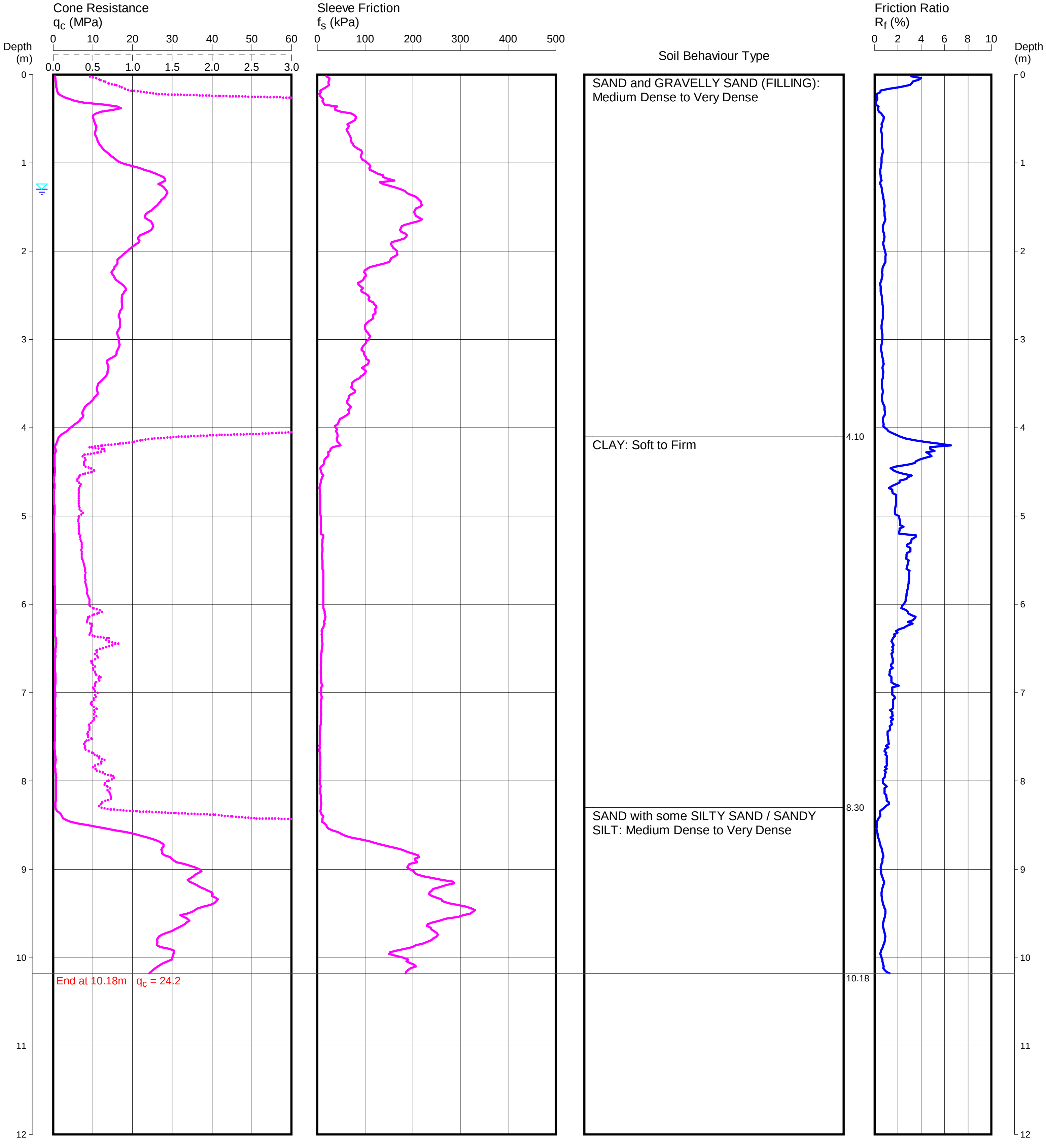
DATE 25/6/2013

PROJECT No: 81320



REMARKS: HOLE COLLAPSE AT 0.7m DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 1.30m depth (assumed)

File: P:\81320\Field\CPT 301.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BOC LTD

PROJECT: PROPOSED STORAGE TANK

LOCATION: 9 EGRET ST, KOORAGANG ISLAND

REDUCED LEVEL: 3.4 AHD

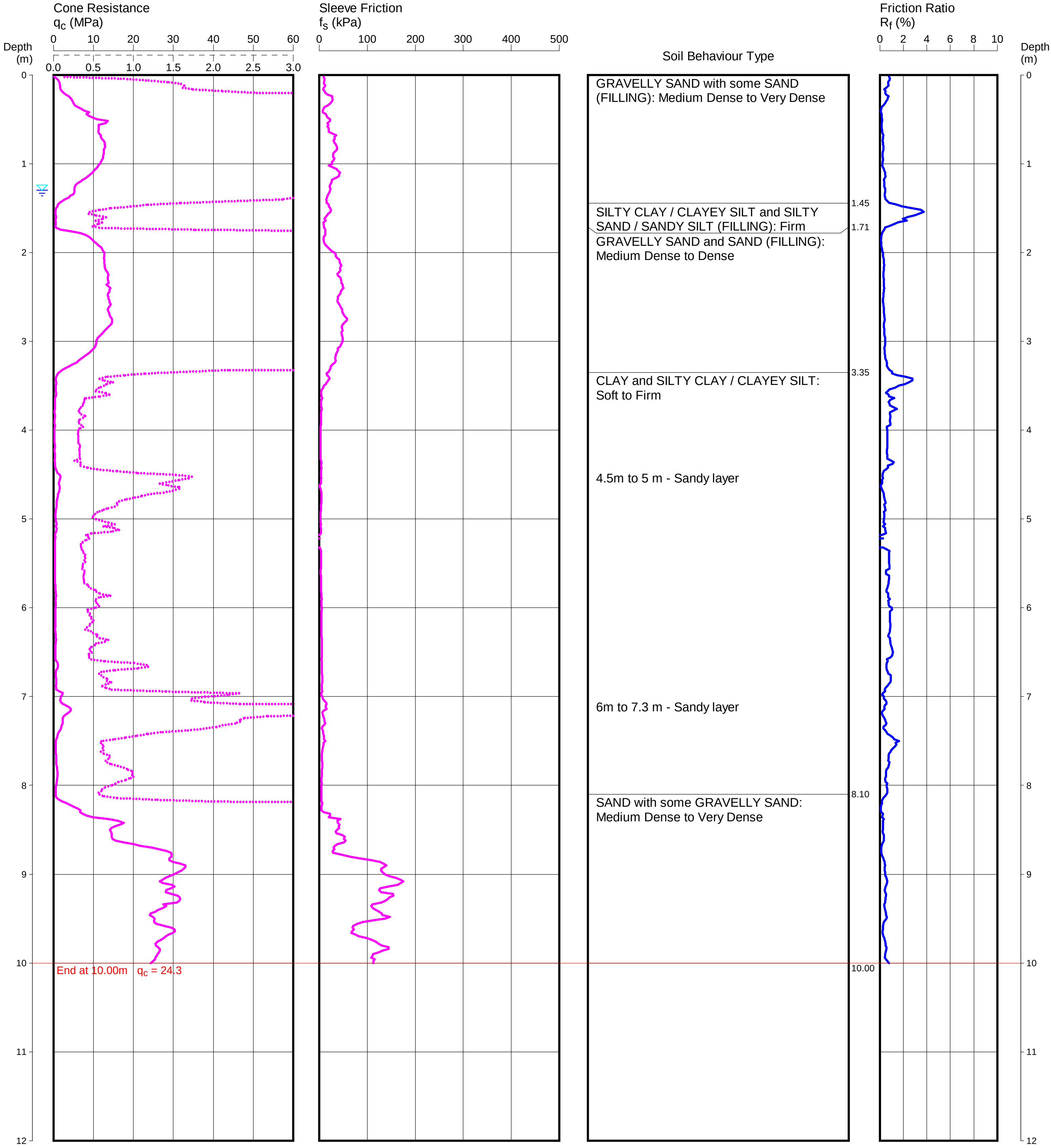
COORDINATES: 384344E 6360978N MGA

CPT 302

Page 1 of 1

DATE 25/6/2013

PROJECT No: 81320



REMARKS: GROUNDWATER OBSERVED AT 1.3m DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 1.30m depth (assumed)

File: P:\81320\Field\CPT 302.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners
Geotechnics / Environment / Groundwater

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Results of Dynamic Penetrometer Tests

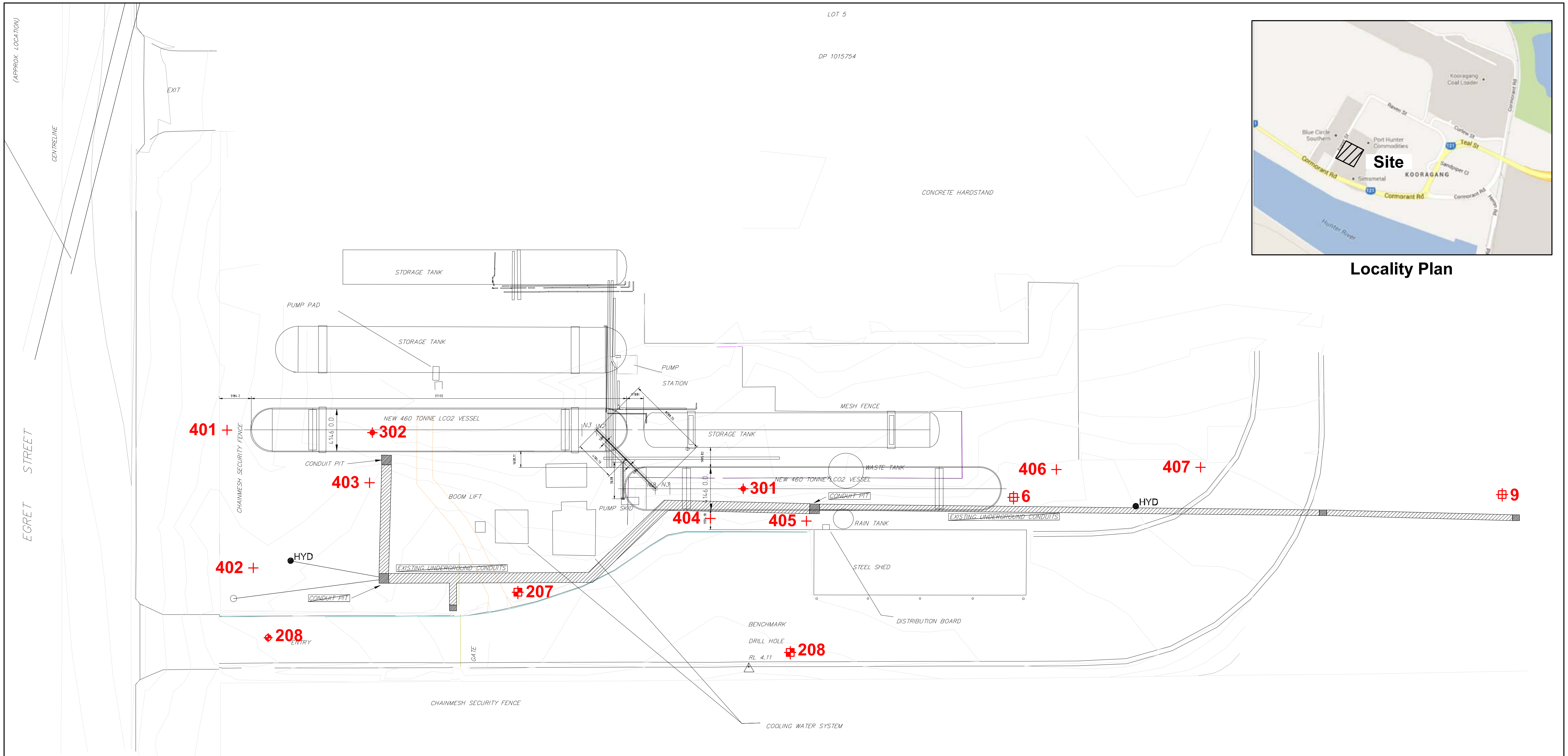
Client	BOC Limited	**Project No.**	81320
Project	New Storage Tanks	**Date**	25/06/2013
Location	BOC Facilities, Kooragang Island	**Page No.**	1 of 1

Test Locations	401	402	403	404	405	406	407			
RL of Test (AHD)										
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 – 0.15	2	3	2	1	1	2	2			
0.15 – 0.30	3	8	5	1	1	2	2			
0.30 – 0.45	6	10	6	5	4	5	4			
0.45 – 0.60	7	15	11	10	8	5	10			
0.60 – 0.75	5	15	15	15	7	3	11			
0.75 – 0.90	6	11	16	11	8	6	16			
0.90 – 1.05	18	16	22	16	10	7/75 mm	20			
1.05 – 1.20	19	16	14	18	14	(bouncing)	16			
1.20 – 1.35										
1.35 – 1.50										
1.50 – 1.65										
1.65 – 1.80										
1.80 – 1.95										
1.95 – 2.10										
2.10 – 2.25										
2.25 – 2.40										
2.40 – 2.55										
2.55 – 2.70										
2.70 – 2.85										
2.85 – 3.00										
3.00 – 3.15										
3.15 – 3.30										
3.30 – 3.45										
3.45 – 3.60										

Test Method AS 1289.6.3.2, Cone Penetrometer ☐
AS 1289.6.3.3, Sand Penetrometer ☑

Tested By KMF
Checked By SAM

Remarks Ref = Refusal, 25/110 indicates 25 blows for 110 mm penetration



LOT 4

DP 1015754

NOTE: Base drawing from Layout-Vessel Installation 460 tonne LC02 Storage Tanks by BOC Gases Australia Ltd, Ref No. C1208-120

0 2 4 6 8 10 15 20 30 40m

1:400 @ A3

LEGEND

- Approximate Cone Penetration Test Location (current investigation)
- Approximate Dynamic Penetration Test Location (current investigation)
- Approximate Test Pit Location (previous investigation, Report 39402)
- Approximate Dynamic Penetration Test Location (previous investigation, Report 39402)
- Approximate Test Pit Location (previous investigation, Report 10603)

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: BOC Ltd		TITLE: **Test Location Plan**	PROJECT No: 81320
OFFICE: Newcastle	DRAWN BY: PLH	**Proposed Storage Tanks**	DRAWING No: 1
SCALE: 1:400@A3	DATE: 09.07.2013	**Egret Street, Kooragang Island**	REVISION: 0