FORTESCUE METALS GROUP LIMITED

PILBARA IRON ORE AND INFRASTRUCTURE PROJECT

DESKTOP STUDY AND SITE VISIT

P6514.03-AB Rev 0

25 June 2004

Coffey

P6514.03-AB Rev 0
25 June 2004

Fortescue Metals Group Limited
PO Box 681
Nedlands, WA, 6909

Attention: Mr Ed Heyting

Dear Sir

RE: PILBARA IRON ORE AND INFRASTRUCTURE PROJECT
GEOTECHNICAL DESKTOP STUDY AND SITE VISITS

This letter presents our final report on a geotechnical desktop study and site visits carried out for the above project. This report was finalised following comments received in regard to our draft report dated 24 May 2004.

Please do not hesitate to contact Mr Sean Eyre or the undersigned in regard to any questions.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

DAVID FOULSHAM

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1. INTRODUCTION

This report describes preliminary geotechnical studies carried out by Coffey Geosciences Pty Ltd (Coffey) for Fortescue Metals Group Limited on the East Pilbara Iron Ore and Infrastructure Project, located at Anderson Point in Port Hedland. Anderson Point is the land feature just south of the proposed ship loading facilities shown on Figure 1.

This work was commissioned by the General Manager Sustainable Development, of Fortescue Metals Group Limited, in an authorisation to proceed dated 4 March, 2004. Terms of Reference are contained in the Coffey proposal dated 24 February 2004.

2. PROPOSED DEVELOPMENT

It is understood that Fortescue Metals Group Limited is presently coordinating the environmental impact assessment process for the marine works. The most significant component of these works will be the dredging and the disposal of the dredged spoil. At this stage, we understand that it is planned to use the dredged spoil for structural fill under the plant site and iron ore stockpiles. This may include effectively reclaiming low-lying areas and may therefore need to include the construction of bunds / rock fill seawalls around the perimeter. The proposed dredging plan, including the various zones identified as A to D, are shown on Figure 2.

A key consideration for the use of dredged spoil in reclamation areas will be the volume and nature of the dredge spoil and its suitability for use as structural fill. If significant amounts of the fill cannot be used for structural fill, then the unsuitable materials (eg. Soft / high plasticity muds) will need to be either disposed of offshore or used on-shore in areas where they are not needed for support of structures or stockpiles. Various environmental, land use, land title and forward planning issues will need to be considered to determine the appropriate placement area for such materials.

The features of this proposed iron ore project which are referred to herein and shown on Figures 1 and 2, are the dredging area for the berthing facilities, a port stockyard which covers approximately 50Ha, a rail loop and conveyors between the stockyard and the berths and a car dumper, the site of which has not yet been investigated. The layout of these facilities was very preliminary prior to the first site visit referred to in Section 5.1 and had been further advanced prior to the second site visit referred to in Section 5.2.

3. BACKGROUND INFORMATION

3.1 General

A desktop study of relevant geotechnical information for the Port Hedland Harbour area and Anderson Point in particular has been carried out. The sources of information have essentially been historical records from the combined Soil & Rock Engineering / Coffey Geosciences library and available aerial photography and geological maps identified as follows:

- Geological Map, 1:50,000, Port Hedland, Geological Survey of WA.
- Aerial photograph from the Landonline website
- Geotechnical information collected for the 1984 Port Hedland Harbour dredging works.

3.2 Geological Setting

Anderson Point is a low relief area that is part of the coastal flats of Port Hedland. The coastal flats include tidal mangrove swamps, younger beach and dune shelly sands and extensive flats of mud and silt overlying typically consolidated deposits of red brown silty / clayey sands of the Holocene period which are underlain by variably cemented calcium carbonate rich deposits of the Pleistocene period.

3.3 Estimated Subsurface Sequence

Previous investigations in the Anderson Point area have indicated the following subsurface sequence:

Unconsolidated Sediments	consisting of recent mud deposits, Mangrove muds, carbonate muds and younger beach and dune sands, generally extending from the existing surface / seabed to levels in the range of 0.5m to 2.0m Chart Datum (CD)
Consolidated Sediments	likely to comprise old channel deposits of carbonate sand and gravel, red to brown clayey sand / sandy clay with calcarenite gravels and cobbles extending to levels in the range of 8.0m to 10.0m CD.
Cemented Sediments	variably cemented calcarenite and calcareous materials extending to the lowest levels investigated, typically 12.0m to 15.0m CD

4. OBJECTIVES

The objectives of this study were to provide preliminary advice on the following matters, based on a review of available geotechnical information and two site visits:

- Likely subsurface strata within the project area, including the onshore facilities and the area to be dredged.
- Likely thickness of mud in the zones to be dredged.
- An approximate estimate of the likely volumes of structurally suitable and unsuitable dredge spoil material available in the area to be dredged.
- Likely suitability of the two alternative areas currently proposed for the dredged fill reclamation to support the stockyards.
- Likely thickness of mud in the stockyard area.
- Likely thickness and properties of mud in the mangrove area through which the rail loop and conveyor will run.
- Assessment of the rock face at Anderson Point.
- Suitability of the higher areas near the site as a borrow source for structural fill.

This report is prepared and is to be read subject to the terms and conditions contained in our proposals, dated 24 February, 2004 and 29 April, 2004. Our advice is based on the information stated and on the assumptions expressed herein. Should that information or the assumptions be incorrect then Coffey Geosciences Pty Ltd shall accept no liability in respect of the advice whether under law of contract, tort or otherwise.

5. DESCRIPTION OF FIELDWORK

5.1 Site Visit No. 1

5.1.1 General

Site Visit No. 1 was carried out between 9 March, 2004 and 10 March, 2004, by a Coffey Geotechnical Engineer, and involved the following:

- A visit to the Port Hedland Port Authority to advise of our intended field programme and view relevant geotechnical data.
- A walk-over of the land based part of the site to record surficial geological features.
- Accessing the shallow (ie not previously dredged) part of the port site, via dinghy at low tide.
- A series of hand probes, carried out with metal rods, to estimate the thickness of soft muds / sands in the dredging zones that could be accessed.

Tides during the fieldwork were relatively extreme spring tides with a low tide of 0.7m between 0630 and 0700hrs and a high tide of nominally 7.1m around 1300hrs. Access was therefore available over a significant part of Anderson Point during both mornings, however this area and a significant part of the site to the south became inundated at high tide in the middle of the day.

Access was limited in the Mangrove fringe immediately south of Anderson Point, and very poor in the Mangrove areas along the South-West Creek. During high tide, all areas with Mangrove cover became inaccessible by foot.

5.1.2 Hand Probing, Sampling and Testing

The fieldwork included a total of 52 hand probes across the development area, including a total of 19 probes carried out on Anderson Point. Probing was carried out using either a 2m long or 4m long, 10mm diameter steel rod, which was pushed through the loose surficial soils until refusal was obtained.

The thickness of the loose sands and soft muds were recorded at each location, however, due to significant groundwater interference, no samples could be taken at depth with the hand equipment. All samples were taken from/near the surface, and are representative of the typical surface conditions across the site.

The approximate locations of the hand probes are shown on Figure 1. The results of the hand probing, including MGA94 coordinates are presented on Figure 3, and are further discussed in Section 7.

5.2 Site Visit No. 2

5.2.1 General

Site Visit No. 2 was carried out between 19 May, 2004 and 21 May, 2004, by another Coffey Geotechnical Engineer, and involved the following:

- A series of hand probes from a dinghy with metal rods to estimate the thickness of weak deposits in the shallow part of the port site (Zone B on Figure 2) at low tide, and sampling of the seabed for environmental samples at these locations.
- An assessment of the apparent rock face at Anderson Point, identified during Site Visit No. 1.
- A series of hand probes and shear vane tests along South-West creek at the locations where the rail loop and conveyor alignments cross the creek.

- A series of hand probes, carried out with metal rods, to estimate the thickness of soft muds / sands in the centre of the port stockyard area.
- A series of hand augered boreholes in the high ground near the stockyard, to assess the suitability of this area as a borrow source for structural fill.

Tides during the fieldwork were spring tides with a low tide of 1.70m at around 0530hrs and 1715hrs and a high tide of nominally 6.6m around 1100hrs. Access was therefore available over a significant part of Anderson Point during both mornings and evenings, however access at high tide in the middle of the day was limited to the high ground.

Access was very poor in the Mangrove areas along the South-West Creek, with no more than 30m penetration into the mangroves possible. During high tide, all areas with Mangrove cover became inaccessible by foot.

5.2.2 Hand Probing, Sampling and Testing

The fieldwork included a total of 29 hand probes across the development area. Probing was carried out using an extendable, 16mm diameter steel rod, which was pushed through the loose surficial soils until refusal was obtained.

The thickness of the loose sands and soft muds were recorded at each location, however, due to significant groundwater interference, no samples could be taken at depth with the hand equipment. All samples were taken from/near the surface, and are representative of the typical surface conditions across the site.

The approximate locations of the hand probes are presented on Figure 1. The results of the hand probing, including AMG coordinates are presented on Figure 4, and are further discussed in Section 8.5.

At eleven of the hand probe locations in the mangroves along South-West Creek, shear vane testing was carried out using a nominal 80mm long shear vane. Tests were carried out at 0.5m intervals until refusal was encountered. The depths at which refusal was encountered with the shear vane were generally similar to the depth penetrated with the hand probe.

The results of the shear vane testing are presented in Figure 5, and are further discussed in Section 8.9.

A total of 10 hand augered boreholes were drilled with a 75mm hand auger to refusal/collapsing depths varying from 0.9m to 1.8m or to the target depth of 2.0m. Samples were taken representing either a 0.5m depth increment or a change in soil conditions. The results of these hand augered boreholes are presented in Figure 6 and discussed in Section 8.10.

6. DESCRIPTION OF LABORATORY TESTING

Laboratory testing was carried out by Coffey Geoscience's, NATA registered soils laboratory, in accordance with the general requirements of the latest edition of AS 1289.

The extent of testing carried out to provide preliminary geotechnical parameters comprised the following tests:

Site Visit No. 1

- 1 Particle Size Distribution test
- 2 Atterberg Limit tests
- 3 Percent Fines tests

Site Visit No. 2

- 2 Particle Size Distribution tests
- 2 Atterberg Limit tests
- 1 Percent Fines tests
- 2 Modified Compaction tests

Test certificates for the above mentioned tests are attached in Appendix B and the results of the testing are further discussed in Section 8.3.

7. SURFACE AND SUBSURFACE CONDITIONS

7.1 General

The proposed project area is located on Anderson Point, Port Hedland, in the area bounded by two major natural drainage basins, the South West Creek and the South Creek. The extent of the Site Visit No. 1 was divided into 3 separate areas, denoted as Area 1, Area 2 and Area 3, as shown on Figure 1.

The extent of Site Visit No. 2 covered the areas identified in Section 5.2.1.

Surface and subsurface conditions in all the areas of interest from both site visits are discussed in the following Section 7.2 to 7.8.

The photographs referred to herein are presented in Appendix A.

7.2 Dredging Areas

Area 1 is located on Anderson Point in the berthing pocket area of the proposed ship-loading facilities where a significant depth of dredging is proposed. Surface conditions in this area generally comprised sandy sediment with occasional thin muddy areas. Photographs 1 to 4 show the typical ground conditions across Area 1 at low tide. Zone B, on Figure 2, is located to the north and east of Area 1 and was inundated with between 0.4m and 1.0m of water at low tide, as shown on Photograph 16.

The following points are noted about the site conditions and material encountered in Area 1:

- Surface conditions in the centre of Area 1 were undulating, as shown on Photograph 5, and at low tide the eastern side of Area 1 was inundated with nominally 0.5m of water and was generally inaccessible by boat or by foot.
- Access was only available during low tide, as this area was inundated with several metres of water at high tide. Trafficability was generally good during low tide with occasional muddy areas, however access was poor as the tide rose and the surficial soils became saturated. This tends to confirm the visual assessment that the surficial soils are predominantly sandy.

- The thickness of the weaker surficial soils varied from 0.3m to 2.5m, however, based on our observations, the majority of this material varied from 0.6m to 0.8m thick, with occasional pockets of deeper/shallow material.
- At the thickest location, namely Probe #3, a thin band of stiffer material was intersected by the probe at a depth of nominally 1.0m, however, as pressure on the rod was increased, the probe then penetrated to a depth of around 2.5m where it refused on dense granular material.

The following points are noted about the site conditions and material encountered in Zone B:

- Access was available only by dinghy, as the area was inundated even at low tide. The seabed was only accessible at low tide, when it was possible to exit the boat and wade through the water.
- Trafficability by boat was difficult due to the shallow water depth. A more extreme spring tide may expose the seabed in this area, if this was the case then trafficability would be expected to be good by foot and very poor by wheeled vehicle.
- The surficial samples taken from the seabed indicate that the surface is predominantly sandy, with occasional clayey muds and seaweeds. Conditions under foot also felt granular.
- The thickness of the weaker surficial soils was highly variable, ranging from 0.45m to 2.6m, with the thickness at most locations between 1.0m and 2.0m. Upon retrieval of the probes carried out in the sandy zones, no significant clay/mud was observed on the tip of the rod.

7.3 Area 2

Area 2 is located in the area immediately south of Anderson Point where a bunded area is to be constructed to contain dredged spoil. The area was surrounded by a fringe of thick Mangrove vegetation, as shown in Photographs 7 and 8, and surface conditions in and around the Mangrove vegetation generally comprised Mangrove mud, particularly in the north-west corner of Area 2. The centremost parts of Area 2 were devoid of Mangrove trees and surface conditions generally comprised clay/clayey sands and thick grasses, however some elevated shelly / sandy banks were also present and are denoted by the whiter zones shown on Figure 1.

Access was poor due to the surrounding Mangrove trees. The Mangroves were thinner in some areas and a narrow access track had been made through part of the Mangrove (Photograph 8). Access throughout the centre of Area 2, particularly in the sandy/grassed areas, was generally good at low tide, however access was poor as the tide rose and surficial soils became saturated.

The thickness of the weaker surficial soils varied from 2.2m to 3.2m. Upon retrieval of the probes carried out in the sandy zones, no significant clay/mud was observed on the tip of the rod. However, in the central areas, where clays/muds were observed on the surface, significant clay/mud was evident on the retrieved rod.

A single probe was carried out in the Mangrove zone in the north-west corner of Area 2 (Probe #24), and indicated the presence of around 3.5m of soft mud. It should be noted that the upper 0.5m of mud at this location was very soft and trafficability in the surrounding area would be extremely poor.

7.4 Area 3

Area 3 is located to the south of Area 2, where the port stockyard and other operational facilities are planned. Two natural drainage systems surrounded by thick mangroves originate from this area and flow directly into South West Creek (northern system) and South Creek (eastern system). The northern drainage system shown on Photograph 9, extends over a substantial part of the northern end of Area 3.

The eastern drainage system is predominantly outside the boundary of Area 3 however some minor sections of mangrove, likely to contain soft clayey mud, intrude into Area 3 beyond its eastern boundary.

The following site conditions were noted:

- Surface conditions in the southern parts of Area 3 generally comprised sands/clayey sands (Photograph 11), with soft clayey mud present at the (south) end of the northern drainage system (Photograph 10).
- Surface vegetation varied from low lying Mangrove (Photographs 12 and 26) to light grass cover (Photograph 13) or no vegetation (Photograph 25).
- As high tide approached during Site Visit No. 1, the majority of Area 3 became inundated with water, as shown in Photograph 14. At high tide, the Mangrove trees in the northern half of Area 3 were almost completely underwater, as shown in Photograph 15.
- The surface of this area during Site Visit No. 2 at low tide was variably clay or sand, with some areas dry and other areas exhibiting some ponding (Photograph 27).
- Access was poor in all areas where Mangroves were present, particularly in close proximity to the creeks.
- The southern part of Area 3 would generally be suitable for vehicular access during low tide. Trafficability by foot was fair to good, but vehicular access by a wheeled vehicle could be potentially risky due to local soft areas. Based on observations made during the investigation, access to the southern parts of Area 3 would be readily achieved during neap tides.
- It should also be noted that the north-east corner of Area 3 was inaccessible at the time of the investigation due to the presence of thick Mangroves and surface water in excess of 1.0m. This area would only be accessible by foot during low tide.

The following points are noted about the material encountered in Area 3:

- The thickness of the weaker materials in the northern drainage system varied from 0.6m to 2.5m. It should be noted that the majority of these tests were carried out from within the dinghy, however the creek bed appeared to be sandy.
- To the south of the northern drainage system, the thickness of the weaker surficial material decreased from 1.8m (Probe #32) in the north-west corner of Area 3, to around 0.05m (Probe #45) on the south side of Area 3. At the southern end of the stockyard area no weaker soils were evident. The deepest pocket of weak material was encountered in Probe #49, which penetrated to a depth of 2.5m. In the centre of the area, the depth of weaker material was variable, ranging from 0.4m to 2.4m.
- At some locations a hard crust of either sand or stiff clay was observed over a weaker layer. The material evident on the end of the probe was typically clayey, with a higher fines content to the north, closer to the mangroves of the northern drainage system.

7.5 Apparent Rock Face at Anderson Point

The Apparent Rock Face is located on the western side of Anderson Point, at the mouth of the South-West Creek and is shown on Photographs 17 and 18. The rock face was dry at low tide and inundated at high tide. The surface of the rock face was covered in barnacles and other marine life, with a thin covering of mud, as shown in close up on Photographs 19 and 20. These photographs also show that the rock surface is relatively narrow, (approximately 10m in width). This rock face is evident from Aerial Photography taken at low tide (Figure 2), but not at high tide (Figure 1)

Access to the apparent rock face at Anderson Point was available at low tide, when the rock face could be accessed by foot after exiting the dinghy. At high tide the rock face is inundated with several metres of water. Conditions under foot were firm and reasonably stable.

The thickness of weaker surficial soils at the base of the rock face at Anderson Point varied from not present to between 0.6m and 0.8m, at the three locations tested. The material visible at the surface was Sand. It is likely that the surficial soils at the base of the rock face would be affected by localised currents.

The apparent rock face is further discussed in Section 8.8.

7.6 Mangrove Area of Rail Loop

The following site conditions were noted in the mangroves surrounding the South-West Creek along the Rail Loop alignment:

- The surface conditions generally consisted of soft clayey muds and sands.
- Vegetation along almost all of the creek length was mangroves.
- At low tide, a distinct bank of the creek was present, and the dinghy could be exited at any point along the creek to access the mangroves (Photograph 21). As the tide rose, this bank became inundated and at high tide all of the mangroves were inundated (Photograph 22).
- Access was available only by dinghy. Where a bank of the creek was exposed at lower tides, the mangroves could be accessed by foot from the dinghy.
- Conditions under foot were generally trafficable but access into the centre of the mangroves was limited by the thickness of the vegetation. The mangroves in this area were generally short and hence there was limited room underneath the tree canopies to move through the mangroves.

The following observations were made about the material encountered:

- The thickness of soft surficial soils in this area varied from 0.3m in P75 to 1.9m in P74, with probing at most locations indicating between 1.0m and 1.9m of soft muds.
- The material appeared to be clayey in nature but some granular material was evident in the clay retrieved from the end of the probe rod and shear vane.
- The shear vane testing at this locations (presented on Figure 5) revealed peak shear strengths in the range of 6kPa to 17kPa and residual values of 0 to 7kPa.

7.7 Mangrove Area of Conveyor

The conveyor crosses the mangroves at a point upstream on the South-West Creek from the Rail Loop and surface, vegetation and access conditions were similar. The thickness of soft surficial soils in this area varied from 1.4m in P81 to 2.1m in P80.

- The material appeared to be clayey in nature but some granular material was evident in the clay retrieved from the end of the probe rod and shear vane.
- Some irregularity in the effort required to push the probe was evident in this area.
- The shear vane testing at this location (presented on Figure 5) revealed peak shear strengths in the range of 7kPa to 19kPa and residual values in the range of 3kPa to 7kPa.

7.8 High Ground Around Stockyard

This area was nominally 2.0m higher than the surrounding mudflats and remained dry throughout the day. Surface conditions were generally sandy, with low-lying scrub vegetation as shown on Photographs 23 and 24. This area was surrounded to the north, west and east by mudflats influenced by the South-West and South Creeks and the northern drainage system. The area investigated is bordered to the south by a drainage path running roughly west-east across the high ground and consists of one main area and several "islands" which are surrounded by mudflats. To the north, the high ground becomes more broken, with more drainage paths between areas of high ground.

Access was available by 4WD vehicle to all parts of the high ground, with firm ground conditions and limited resistance from the low lying vegetation. The limiting factor in accessing this area is traversing the drainage paths that cross the site (Photograph 28). The tide at the time of the investigation did not reach these paths, and trafficability was fair, however the high tide waters were not far from reaching the height required to inundate at least some of these drainage paths, and therefore caution should be used in leaving vehicles on the far side of these drainage paths at high tide.

Subsurface conditions in the high ground generally consist of clean sands to a depth of between 0.5m and 1.0m, overlying moist clayey sands. The fines content and plasticity of these sands appears to increase with depth. Although the ground surface level was relatively flat in this area, there is considerable variation in the depth at which clayey material is encountered.

8. DISCUSSION AND RECOMMENDATIONS / CONCLUSIONS

8.1 General

Reference is made to the attached Important Information About Your Coffey Report when considering the recommendations and conclusions in this report.

8.2 Subsurface Conditions

The hand probing was part of a preliminary investigation of the surficial material across the proposed project area and, as such, the deeper subsurface soil strata across the site cannot be accurately defined.

Based on our experience in the area, the subsurface profile off Anderson Point, in the proposed dredged zone is expected to comprise unconsolidated surficial sediments, as encountered by the hand probes, extending to depths varying from nominally 0.5m to 2.5m, overlying consolidated sand/clay/gravel sediments to levels in the order of 8.0m to 10.0m CD, overlying variably cemented materials. Aerial photographs of the drainage systems that flank Anderson Point suggest that significant sediments would be transported down these drainage systems during flood events and the more coarser materials (sands and gravels) would be deposited around the point area and that the finer materials (silts and clays) would more likely be carried into the dredged basin where a slow buildup of these materials would occur in time.

Based on the results of the fieldwork, the weaker, higher plasticity, surficial muds are generally thickest in those areas in and around the Mangroves (up to nominally 3.2m thick in Area 2). The thickness of weaker material (muds) in the rail loop area appears to be noticeably less (1.0m to 2.0m). The thickness of this weaker material reduces significantly, to nominally 50mm thick, in the southern parts of Area 3 away from any natural creek areas.

Refer to Section 7 for further discussion on the subsurface conditions in each of the specified areas.

8.3 Laboratory Test Results

The surficial soils at Anderson Point generally comprise alluvial sands and silty / clayey sands, with shell fragments throughout, which have been deposited over time by the South West Creek and South Creek drainage system, probably mainly after flood events.

Observations made during this preliminary fieldwork stage suggest that the material within the berthing pocket is generally granular and would be suitable for use as fill after dredging.

The laboratory testing undertaken indicated the following:

- Sample #1 was taken from Anderson Point (Area 1) and is classified as a medium to coarse grained sand with very low fines content (<2%). It is likely that the fine silts have been washed away during the natural drainage process. Similar sandy zones are also evident within Area 2.
- Samples #2 and #3 were taken from Area 2 and Area 3, and can be classified as silty sand to medium plasticity clayey sands.
- Sample #4 was taken from the Mangrove zone in Area 3, as shown in Photograph 10, and can be classified as a high plasticity sandy clay. Due to the high fines content of this material (88%), vertical drainage through this material is expected to be poor.
- Sample #5 was combined from the near-surface samples taken from the high ground and can be classified as Sand (SP/SM), with a fines content of 10%. A Modified Compaction Test indicated a Maximum Modified Dry Density of 1.84t/m^3 and an optimum moisture content of 10.5%.
- Sample #6 was combined from the deeper samples taken from the high ground and can be classified as a medium plasticity Clayey Sand (SC) with a fines content of 27%. The Atterberg limits test on this sample indicated a Liquid Limit of 33%, a Plasticity Index of 20% and a Linear Shrinkage of 7%. The natural moisture content of this material is 9%. A Modified Compaction Test indicated a Maximum Modified Dry Density of 2.06t/m^3 and an optimum moisture content of 9.0%.
- Sample #7 was taken from the Mangrove zone along the South-West Creek (P80) and can be classified as a medium plasticity Clayey Sand (SC) / Sandy Clay (CI). Based on field observations, a variation in fines content can be expected in the clayey mangrove material. Although the fines content of the clay (47%) is not as high as seen from Sample #4, vertical drainage through this material is still expected to be poor.

The results of the laboratory testing are presented in Appendix B.

8.4 Groundwater / Tidal Levels

Based on observations during the investigation, groundwater levels would be largely influenced by tidal variation and at spring tides, as encountered during this study, the majority of the area was under water, except in the south-west corner, which remained dry.

8.5 Thickness of the Weaker Surficial Material

Based on the results of the hand probing, carried out at various locations across the site, the approximate thickness of the weaker surficial soils have been tabulated in Figure 3, and are discussed above in Section 7.

8.6 Suitability of Areas for Dredged Fill Reclamation

It is understood that the two areas, designated as Area 2 and Area 3 on Figure 1, are currently proposed for dredged fill reclamation, possibly to support future plant facilities. Based on observations made during the fieldwork, and the results of laboratory testing, the following can be concluded:

- Area 2 is suitable for dredged fill reclamation provided it does not extend into the mangrove zone surrounding this area where mangrove mud up to nominally 3.5m could prove difficult to construct starter embankments on (low strength and long consolidation periods). Due to the presence of weak surficial sands, silts and clays/muds across the area, which extend to depths of around 2.5m, we would expect that the consolidation time throughout Area 2 would vary considerably, albeit significantly shorter than any filling on mangrove mud.
- Area 3 is also suitable for dredged fill reclamation, particularly in the southernmost areas and areas devoid of Mangroves and accompanying thick low strength mud. Hand probing indicated that the strength of the surficial soils improved significantly in the southernmost areas, with increasing distance from the Mangrove zones.
- The Mangroves are thickest in the areas immediately surrounding the creeks within Area 3. If starter embankments are to be constructed in mangrove areas, the mangroves within the embankment footprints need to be cut at ground level and laid horizontally to retain the root zone and provide additional base reinforcement and drainage. Additional reinforcement in the form of geosynthetics maybe needed to support the construction equipment and starter embankment.

8.7 Estimated Material Quantities

Based on observations made during the site visit, it is expected that the surficial material to be dredged from Anderson Point (Area 1) generally comprises alluvial silty/sandy sediments, and should provide suitable dredged spoil for reclamation in Area 2 and Area 3. The thickness of the loose surficial material varied between 0.3m and 2.5m, with an average thickness of around 0.9m.

It is understood that the area beneath the proposed port facilities will be dredged to varying depths below the existing seabed. Dredging works will be undertaken in four separate zones, as shown on Figure 2, and described in the following:

Zone A This zone, located immediately north of the proposed berths, has been previously dredged to nominally 9.1m CD, and will require further dredging to nominally 14.6m CD. It should be noted that, whilst this dredged material is expected to be very hard and well cemented, a thin layer of weaker muddy material may have formed on the seabed, due to sediment flowing into the dredged basin from the main creeks including the South West and South Creeks adjacent to Anderson Point.

Zone B This zone is located immediately east of the proposed berths and will require dredging from its existing level, at nominally 0.5m above CD to 9.7m CD. Weaker silty/sandy material is expected to be present to depths varying from 0.5m to 1.0m.

Zone C This zone is located within the berthing pocket and will require dredging from its current level, which varies from nominally between 0.0m CD and 2.5m above CD, to 19.5m CD. Weaker silty/sandy material is expected to be present to depths varying from 0.5m to 2.5m.

Zone D This zone is located immediately south of the berthing pocket and will require battered dredging from its current level to tie in with Area C at 19.5m CD.

Based on the information presented above, the estimated volume of dredged material has been calculated for each of the above areas, and is presented on Figure 2. Based on this information, the total volume of dredged material is in the order of 3.3M m^3. It should be noted that no allowance has been made for additional sediment deposition that may have occurred through the flow of the adjoining creeks.

It is estimated that the weaker surficial silts/sands will comprise approximately 0.18M m^3 of the total dredged material. No clays/muds unsuitable for structural fill were encountered during the course of this limited investigation in the proposed dredged zone. This preliminary finding could be used for the purpose of initial planning and environmental impact studies. However to undertake detailed engineering design work it is recommended that additional geotechnical investigations are required to confirm this preliminary work and identify the nature and properties of the underlying materials and their suitability for use as structural fill.

8.8 Inspection of Apparent Rock Face at Anderson Point

The rock face identified during Site Visit No. 1 was assessed further during Site Visit No. 2 at low tide, when walking on the rock face was possible. As can be seen from Photographs 17 and 18, the face was in an approximate straight line following the edge of South West Creek. The rock face is approximately 300m long and 10m wide. On visual inspection, it was found that the surface of the apparent rock face was composed of barnacles and other marine life, making a visual assessment of the underlying rock strata difficult.

Three samples of the rock face material were collected. When these samples were broken up, the underlying rock became visible. The rock material present in the samples was a ferricrete composed of predominantly sand sized particles, with a particle size grading similar to the sand encountered in the high ground to the south. Breaking the rock samples required several blows with the geo-pick, suggesting that the rock is very well cemented. At the edge of the rock face where the rock face was broken, sand was visible beneath the barnacle mass, suggesting that the rock face was a capping over soil or more weakly cemented material.

8.9 Mangrove Sections along Rail Loop and Conveyor Alignments

The results of limited hand investigation along the mangrove sections of the rail loop and conveyor indicate up to nominally 2.0m of soft clayey materials with a peak shear strength in the range of 6kPa to 19kPa. Embankments constructed over the area would need to be limited to a maximum height of 2.5m in the initial instance. Additional fill should only be placed after the mud has gained additional strength from consolidation.

Disturbance of the mud during embankment construction should be avoided due to the low residual strength. This could be achieved using geotextiles as reinforcement and to assist in base drainage.

8.10 Suitability of High Ground as Borrow Source

The subsurface conditions encountered in the high ground are generally sandy with some fines at depth. This material is suitable for use as a cohesionless structural fill but it's use may be limited due to the lack of gravel size particles. As the depth of cut increases the nature of the fill material can be expected to become more clayey.

Use of this borrow source will depend on the application. For embankment construction, the more sandy (low fines content) materials should be used as a base drainage layer. The more clayey materials can be used within the upper zone of the embankments. Normally the surface of such embankments would be sheeted with gravelly material which is in short supply.

Preliminary assessments indicate nominally 500,000m^3 of sandy (low fines content) material is available, assuming an average thickness of 700mm. The volume of the underlying more clayey material is likely to be between 500,000m^3 and 1,000,000m^3 assuming the borrow source does not extend below the adjacent mud flat level, ie. maximum thickness of total borrow source is 1.5m to 2.0m.

9. RECOMMENDATIONS FOR FURTHER GEOTECHNICAL INVESTIGATIONS

This report presents the findings of a geotechnical desktop study and two site visits in which investigation using hand implements were carried out. Accordingly, further detailed geotechnical investigations will be required to confirm the following:

- The range of materials to be dredged and their engineering properties.
- The batter slopes to be formed during the dredging operations.
- The foundation conditions along the alignment of the starter embankments for reclamation works.
- Design foundation profiles for the starter embankments.

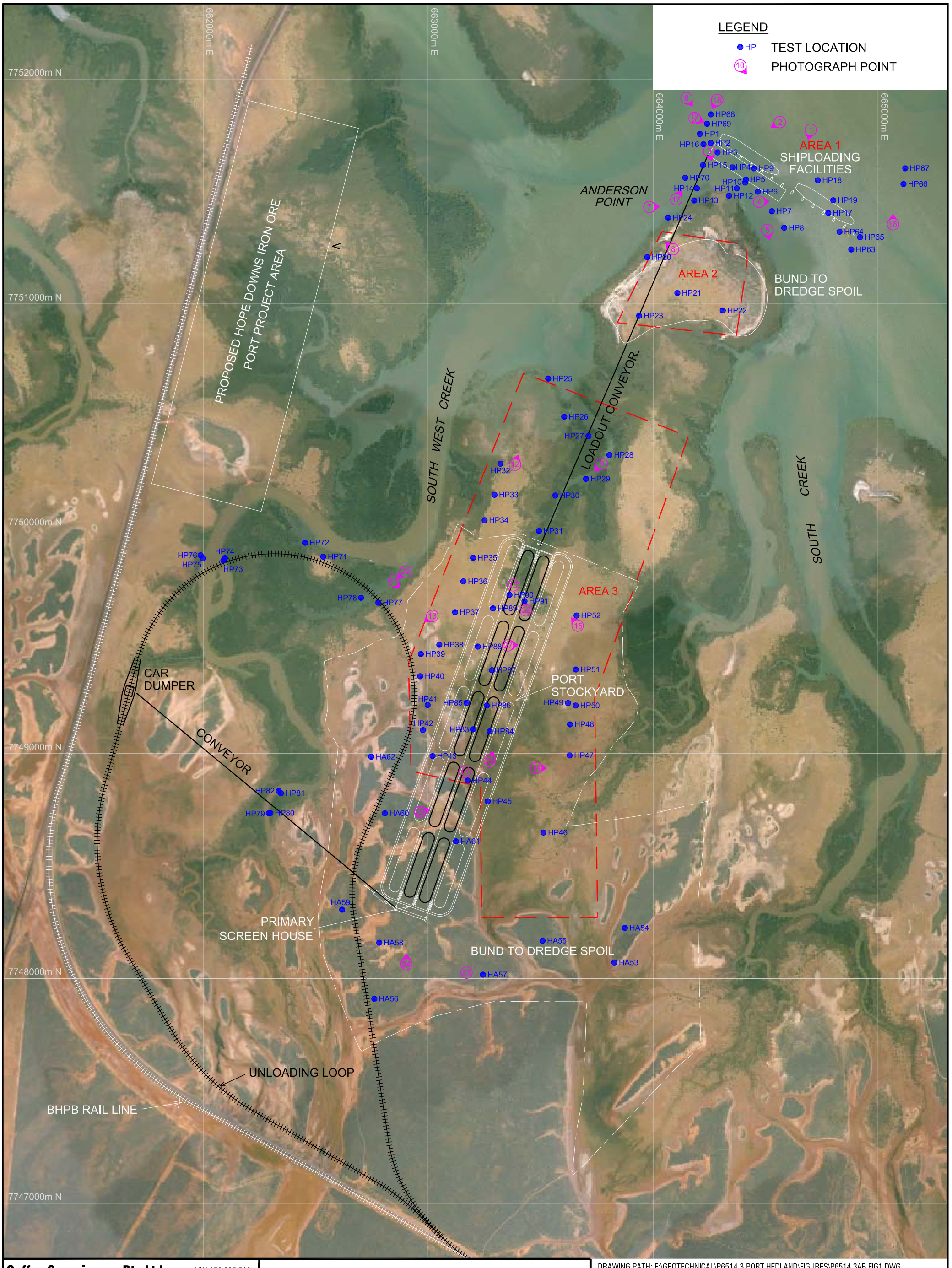
These investigations must be carefully planned to account for the extreme tides and limitations on accessibility.

Detailed foundation investigations for specific facilities that might be considered on the dredged fill areas should be carried out after the dredged fill process has been completed and the area has been levelled out. Such investigations will need to identify the foundation conditions for the design of shallow or deep foundation systems and the need for any ground improvement works that maybe required for the dredged fill and lower strength near surface insitu soils.

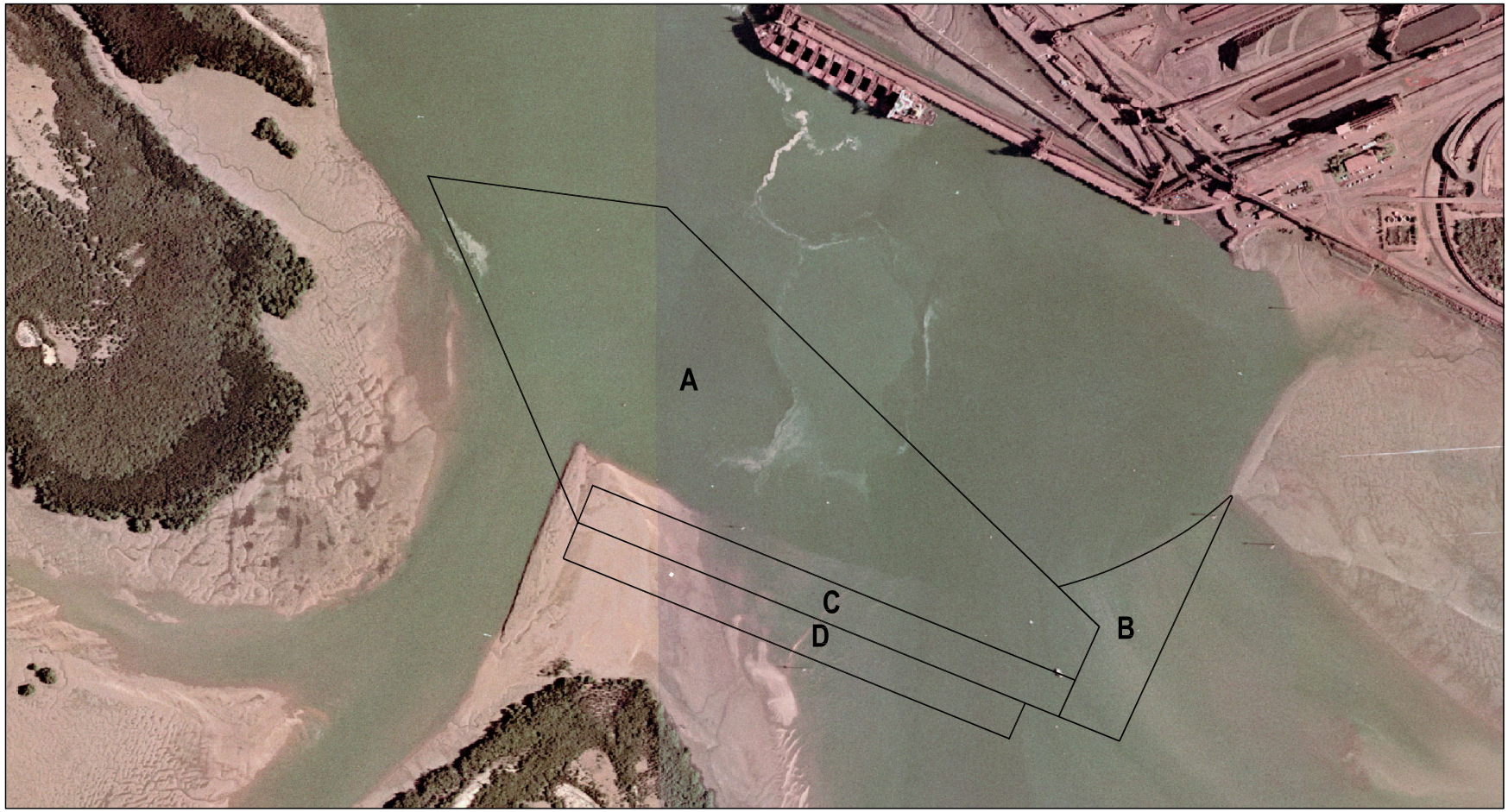
Detailed foundation investigation will also be required for major facilities on the land reclamation areas such as the car dumper, the rail embankment, conveyor support structure and associated facilities.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD



Coffey Geosciences Pty Ltd ACN 056 335 516	Geotechnical | **Resources** | Environmental | **Technical** | Project Management |		DRAWING PATH: F:\GEOTECHNICAL\P6514.3 PORT HEDLAND\FIGURES\P6514.3AB FIG1.DWG
Drawn: SSB	**FORTESCUE METALS GROUP LIMITED**	Drawing No:	0 150 300 450 600 Scale (metres)
Approved:	**PILBARA IRON ORE & INFRASTRUCTURE PROJECT**	**FIGURE 1**	N
Date:	**PRELIMINARY GEOTECHNICAL ASSESSMENT**		Coffey
Scale: 1:15000	**ANDERSON POINT, PORT HEDLAND**	Job No: **P6514/-3AB**	



0 100 200 300 400 500

Approximate Scale (metres)

APPROXIMATE VOLUME OF DREDGED MATERIAL:	APPROXIMATE AREA TO BE DREDGED TO:
ZONE A - 1,500,000m^3	ZONE A - 14.6m, CD
ZONE B - 200,000m^3	ZONE B - 9.7m, CD
ZONE C - 1,100,000m^3	ZONE C - 19.5m, CD
ZONE D - 500,000m^3	ZONE D - AT A BATTER
TOTAL 3,300,000m^3	FROM LEVEL TO 19.5m, CD

DRAWING PATH: F:\GEOTECHNICAL\P6514.3 PORT HEDLAND\FIGURES\P6514.3AB FIG2.DWG

Coffey Geosciences Pty Ltd ACN 056 335 516

Geotechnical | **Resources** | Environmental | **Technical** | Project Management |

Drawn	SSB
Approved	
Date	
Scale	AS SHOWN

FORTESCUE METALS GROUP LIMITED
PILBARA IRON ORE & INFRASTRUCTURE PROJECT
PRELIMINARY GEOTECHNICAL ASSESSMENT
ANDERSON POINT, PORT HEDLAND

Drawing No:

Job no: **P6514/3-AB**

Coffey

HAND PROBE TEST RESULTS (9 MARCH, 2004)

Testing at Anderson Point (Area 1)

Point	Easting	Northing	Thickness of Weaker Material	Additional Observations
1	664208	7751756	0.6	0.8m thick at water's edge
2	664256	7751716	0.7	Refusal on dense granular material
3	664287	7751674	2.5	Thin, stiff layer at nominally 1.0m
4	664353	7751607	1.5	Refusal on dense granular material
5	664414	7751553	0.7	Refusal on dense granular material
6	664466	7751499	0.5	Refusal on dense granular material
7	664528	7751412	1.4	Refusal on dense granular material
8	664583	7751339	1	Refusal on dense granular material
9	664448	7751603	0.6	Refusal on dense granular material
10	664410	7751540	0.6	Refusal on dense granular material
11	664372	7751514	0.6	Refusal on dense granular material
12	664338	7751481	0.85	Refusal on dense granular material
13	664183	7751460	1.6	Refusal on dense granular material
14	664195	7751514	0.7	Refusal on dense granular material
15	664222	7751617	0.65	Refusal on dense granular material
16	664224	7751710	0.7	Refusal on dense granular material
17	664779	7751405	0.3	Water depth nominally 0.5m
18	664732	7751550	0.8	Water depth nominally 0.8m
19	664801	7751461	0.9	Water depth nominally 0.7m

Testing in Area 2

Point	Easting	Northing	Thickness of Weaker Material	Notes
20	663974	7751208	2.5	Cohesionless sandy zone
21	664108	7751048	3.2	Muddy (water near surface)
22	664310	7750971	2.5	Muddy (water near surface)
23	663938	7750947	2.2	Muddy (water near surface)
24	664067	7751384	3.5	Very soft mud to 0.5m

Testing in northern drainage system (Area 3)

Point	Easting	Northing	Thickness of Weaker Material	Notes
25	663534	7750668	1.1	Water depth nominally 1.3m
26	663605	7750498	1.3	Water depth nominally 1.1m
27	663713	7750413	2.5	Water depth nominally 0.8m
28	663806	7750328	1	Water depth nominally 0.8m
29	663702	7750222	1.3	Water depth nominally 0.7m
30	663566	7750148	0.7	Water depth nominally 0.6m
31	663493	7749990	0.6	Water depth nominally 0.7m

Testing in Area 3

Point	Easting	Northing	Thickness of Weaker Material	Notes
32	663322	7750289	1.8	Refusal on dense granular material
33	663295	7750151	1.6	Refusal on dense granular material
34	663251	7750038	1.4	Refusal on dense granular material
35	663200	7749871	1	Refusal on dense granular material
36	663157	7749766	0.9	Refusal on dense granular material
37	663120	7749629	0.75	Refusal on dense granular material
38	663050	7749484	0.75	Refusal on dense granular material
39	662968	7749443	0.65	Refusal on dense granular material
40	662965	7749344	0.25	Hard crust at surface, overlying stiff clay
41	662998	7749216	0.6	Refusal on dense granular material
42	662977	7749105	0.5	Refusal on dense granular material
43	663020	7748989	0.3	Refusal on dense granular material
44	663176	7748880	0.15	Refusal on dense granular material
45	663265	7748788	0.05	Thin sand layer, overlying stiff clay
46	663513	7748649	0.65	Refusal on dense granular material
47	663629	7748992	0.6	Refusal on dense granular material
48	663631	7749130	0.4	Refusal on dense granular material
49	663622	7749225	2.4	Tested in water (local deep zone)
50	663656	7749214	1.1	Tested in water
51	663657	7749374	1	Tested in water
52	663660	7749614	1.3	Tested in water

FIGURE 3

HAND AUGERED BOREHOLE SUMMARY (19 & 21 MAY, 2004)

Testing in High Ground Near Port Stockyard

Point	Easting	Northing	Subsurface Profile
53	663828	7748071	Dry sand to 1.0m
54	663875	7748225	Dry sand to 0.9m
55	663509	7748168	Dry sand to 0.9m, moist clayey sand to 1.2m, refusal at 1.6m on coarse, rounded black gravel.
56	662761	7747910	Dry sand to 0.6m, moist clayey sand to 2.0m
57	663244	7748017	Dry sand to 0.8m, moist clayey sand to 2.0m
58	662783	7748159	Dry sand to 0.5m, moist clayey sand to 2.0m
59	662618	7748306	Dry sand to 0.8m
60	662808	7748735	Dry sand to 0.8m, including some calcareous sediments, refusal at 0.8m
61	663124	7748610	Dry sand to 0.6m, moist clayey sand to 1.8m
62	662747	7748986	Dry sand to 0.5m, moist clayey sand to 1.0m

HAND PROBE TEST RESULTS (19 & 21 MAY, 2004)

Testing in Area B

Point	Easting	Northing	Thickness of Weaker Material	Water Depth	Notes
63	664881	7751242	1.3	0.4	Granular, Refusal on dense granular material
64	664829	7751321	1.7	0.6	Granular, Refusal on dense granular material
65	664920	7751297	0.45	0.5	Granular, Refusal on dense granular material
66	665113	7751533	1.25	0.35	Granular, Refusal on dense granular material
67	665121	7751603	2.6	0.15	Granular with some thin soft zones

Apparent Rock Face

Point	Easting	Northing	Thickness of Weaker Material	Notes
68	664257	7751843	0.6	Sandy, water depth 0.1m
69	664240	7751801	0	Sandy, water depth 1.0m
70	664143	7751561	0.8	Sandy, water depth 0.2m

Testing in Rail Loop

Point	Easting	Northing	Thickness of Weaker Material	Notes
71	662534	7749876	1	Generally mud, some granular material
72	662453	7749938	0.8	Generally mud, some granular material
73	662090	7749859	1.6	Generally mud, some granular material
74	662097	7749870	1.9	Generally mud, some granular material
75	661998	7749869	0.3	Mostly granular, water depth 0.1m
76	661989	7749882	1	Mostly granular
77	662779	7749671	1.6	Under 3.1m water, Smooth
78	662702	7749693	1.55	Under 2.3m water, refusal on clay

Testing in Conveyor Area, (Note - High tide, tests performed high on bank)

Point	Easting	Northing	Thickness of Weaker Material	Notes
79	662292	7748735	1.95	Granular below 1.5m
80	662299	7748736	2.1	Very smooth probing
81	662346	7748824	1.4	Irregular strength
82	662336	7748834	1.5	Irregular strength

Testing in Centre of Stockyard

Point	Easting	Northing	Thickness of Weaker Material	Notes
83	663200	7749108	0	Stiff clay
84	663274	7749099	0.3	Refusal on clay
85	663172	7749226	2.1	Stiff crust on surface, refusal on dense granular material
86	663261	7749214	1.15	Refusal on clay
87	663284	7749371	2.1	Wet on surface, Refusal on clay
88	663221	7749476	0.8	Hard sand crust on surface, Refusal on dense granular material
89	663289	7749646	0.7	Surface wet, refusal on clay
90	663362	7749706	1.05	Edge of mangroves, refusal on clay
91	663429	7749678	2.3	Edge of mangroves, refusal on clay

FIGURE 4

SHEAR VANE TEST RESULTS

S_U/S_{UR} (kPa)

LOCATION	DEPTH 0.3m	0.8m	1.3m	1.8m
71	14/7	9/4		
72	13/6	10/4		
73	6/3	13/4	12/3	
74	10/3	9/3	13/4	17/4
75	13/4	R		
76	13/4	14/4	17/4	R
77	7/0			
78	–			
79	12/4	12/6	13/4	17/4
80	7/3	7/3	16/7	19/6
81	R			
82	43/7	12/4		

All tests were conducted to the depth at which weaker materials were encountered with the probe, unless prior refusal was encountered.
Test 77 was not conducted to full depth due to the location under water.
Test 78 was not conducted due to shear vane damage.

FIGURE 5

APPENDIX A

PHOTOGRAPHS TAKEN DURING SITE VISIT

Photograph 1 – View of Anderson Point (eastern side).

Photograph 2 – View of Anderson Point (western side).

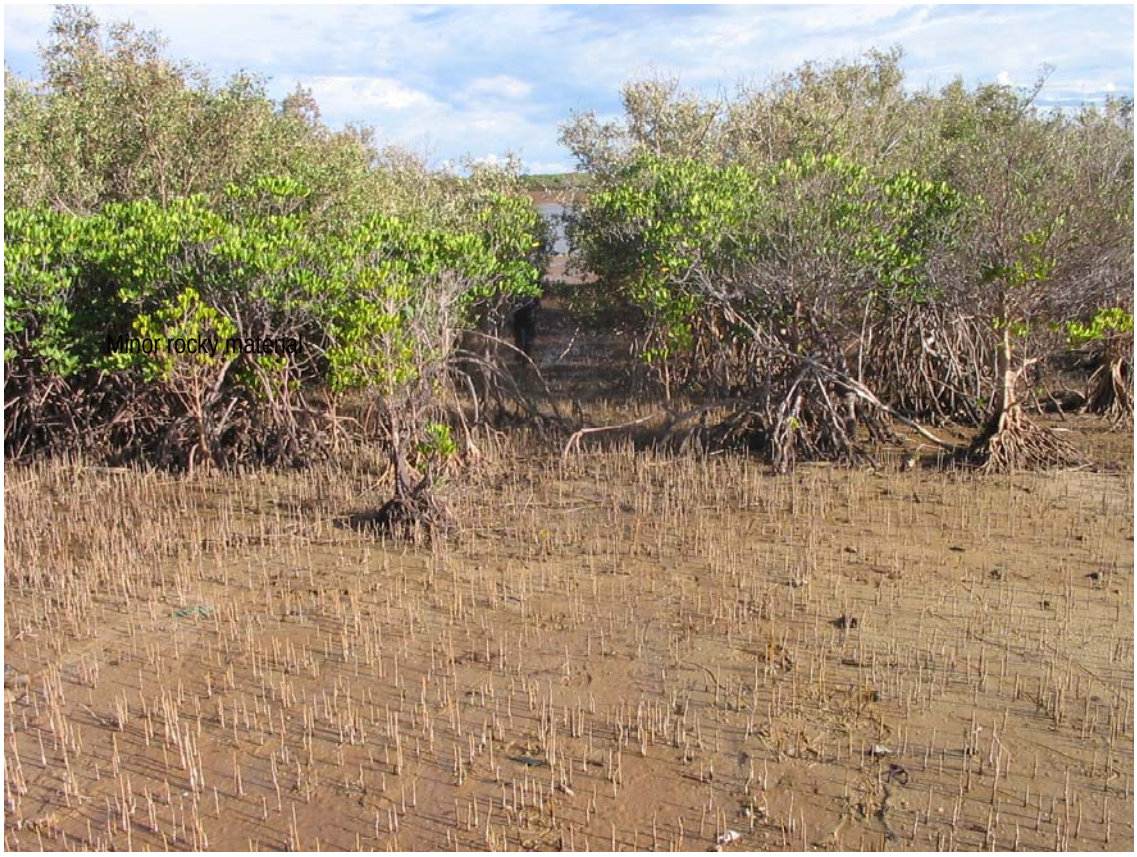
Photograph 3 – Typical surface conditions at Anderson Point (low tide).

Photograph 4 – Typical view of waters edge at Anderson Point (low tide).

Photograph 5 – Undulating surface caused by tidal movements and currents in the South West and South East Creeks.

Photograph 6 – Elevated ridge adjoining the South West Creek.

Photograph 7 – Typical view of the Mangrove fringes surrounding Area 2.



Photograph 8 – View of a narrow track through a relatively thin Mangrove zone.

Photograph 9 – View of the northern drainage system.

Photograph 10 – View of typical soft clayey muds in the Mangrove zone of Area 3.

Photograph 11 – Typical view of shallow surficial sands / silty sands in Area 3.

Photograph 12 – Low lying Mangrove areas in the north-west parts of Area 3.

Photograph 13 – Typical view of surface cover in the south-west parts of Area 3.

Photograph 14 – View of the southern parts of Area 3 during high tide.

Photograph 15 – View of the central parts of Area 3 during high tide.

Coffey

APPENDIX B

RESULTS OF LABORATORY TESTING

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical | Resources | Environmental | Technical | Project Management

24 Hasler Road, Herdsman, WA, 6017
Ph: (08) 9347 0000 Fax: (08) 9347 0099

particle size distribution

client : *Fortescue Metals Group*

principal :

project : *Anderson Point Preliminary Investigation*

location : *Port Hedland*

job no : *P6514/03*

laboratory : *PERTH*

report date : *27 May 2004*

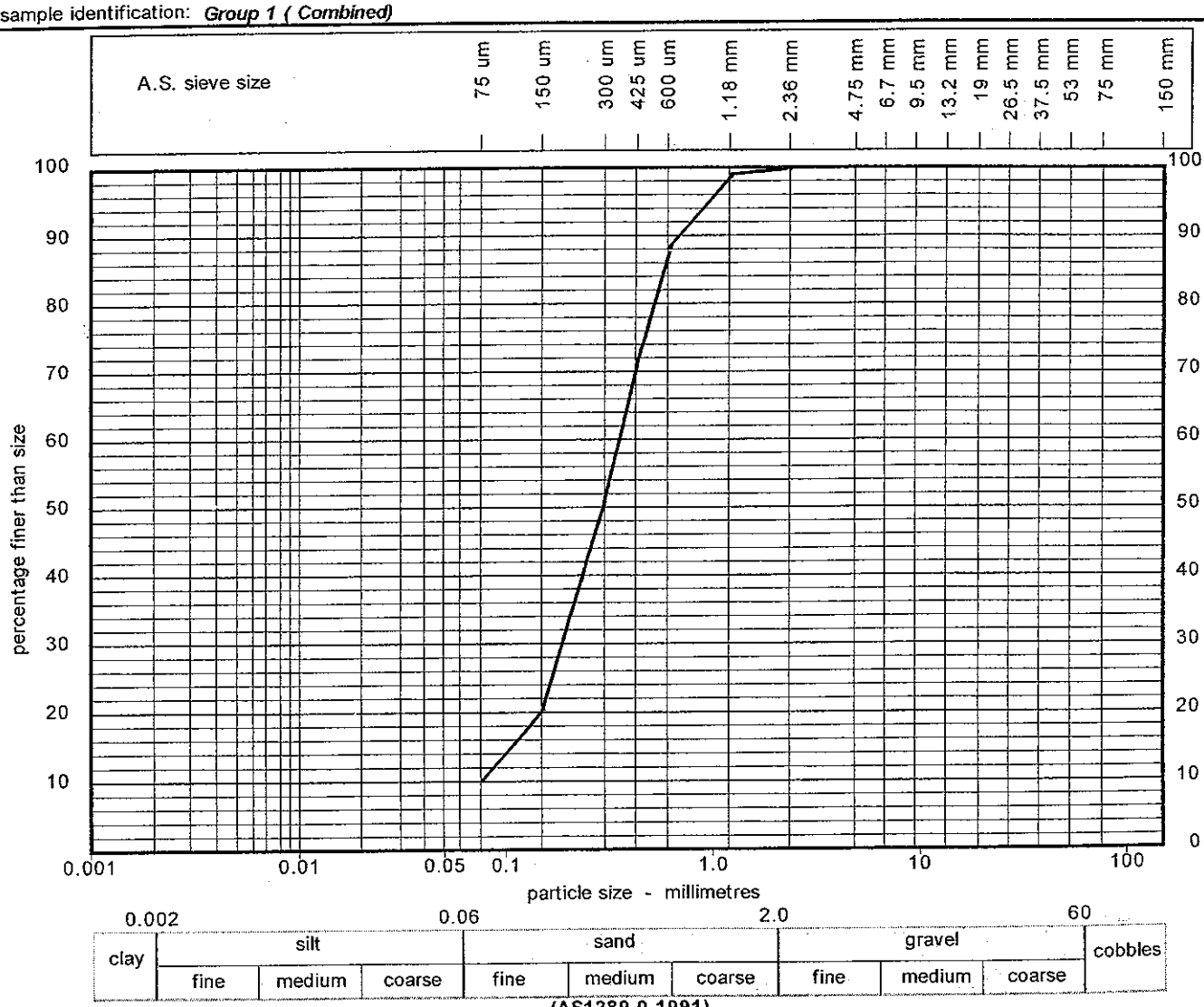
test report : *LB3408*

test procedure : *AS1289 3.6.1*

depth :

sample no : *LB3408*

sample identification: *Group 1 (Combined)*



Atterberg Limit :

liquid limit	%	-
plastic limit	%	-
plasticity index	%	-
linear shrinkage	%	-
natural moisture	%	-

Sample History

natural state ☐
air dried ☐
oven dried ☐
other ☐

Preparation Method

dry sieving ☐
wet sieving ☐

Linear Shrinkage

Mould size mm
crumbing ☐
curling ☐

classification :

Group 1 (Combined)
HA53@0.0-0.5m, HA53@0.5-1.0m, HA54@0.0 -0.5m, HA54@0.5-1.0m, HA55@0.0 -0.5m, HA55@0.5-0.8m, HA56@0.0-0.5m, HA57@0.0 -0.5m, HA58@0.0-0.5m, HA61@0.0-0.4m,

Notes: Sample tested as received.

NATA Accredited Laboratory No. 431

Date : *27/05/2004*

Authorised Signature:

(M.E Castle)

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical | Resources | Environmental | Technical | Project Management

24 Hasler Road, Herdsman, WA, 6017
Ph: (08) 9347 0000 Fax: (08) 9347 0099

particle size distribution & atterberg limits

client : *Fortescue Metals Group*

principal :

project : *Anderson Point Preliminary Investigation*

location : *Port Hedland*

job no : *P6514/03*

laboratory : *PERTH*

report date : *27 May 2004*

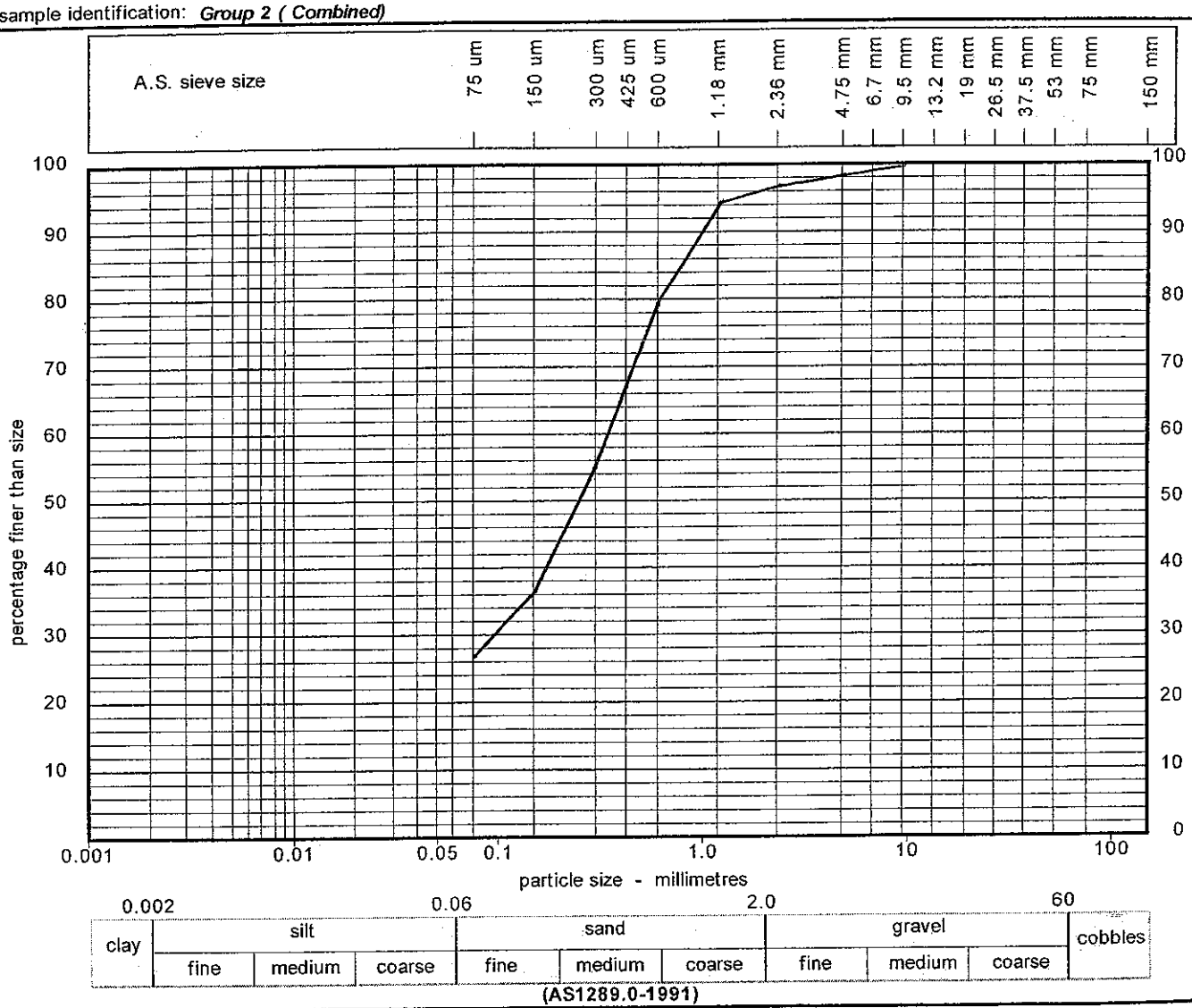
test report : *LB3409*

test procedure : *AS1289 2.1.1,3.1.2, 3.2.1, 3.4.1, 3.6.1*

depth :

sample no : *LB3409*

sample identification: *Group 2 (Combined)*



Atterberg Limit :

liquid limit	%	*33*
plastic limit	%	*13*
plasticity index	%	*20*
linear shrinkage	%	*7*
natural moisture	%	*9.1*

Sample History

natural state ☐
air dried ☒
oven dried ☐
other ☐

Preparation Method

dry sieving ☒
wet sieving ☐

Linear Shrinkage

Mould size *125* mm
crumbing ☐
curling ☐

classification :

Group 2 (Combined)
HA55@0.9-1.2m, HA56@0.6-0.7m, HA56@1.0 -1.2m, HA57@1.0-1.2m, HA58@0.7 -0.9m, HA61@1.6-1.8m

Notes: Sample tested as received.

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NATA Accredited Laboratory No. 431

Date : *27/05/2004*

Authorised Signature:

(M.E Castle)

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical | Resources | Environmental | Technical | Project Management

24 Hasler Road, Herdsman, WA, 6017
Ph: (08) 9347 0000 Fax: (08) 9347 0099

test results

client :	*Fortescue Metals Group*	job no :	*P6514/03*
principal :		laboratory :	*PERTH*
project :	*Anderson Point Preliminary Investigation*	report date :	*27 May 2004*
location :	*Port Hedland*	test report :	*LB3410*
test procedure :	*AS1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1* *AS1289 3.6.1 (Part) % finer than 0.075mm*	test date :	*26/05/2004*

Laboratory Number		LB3410
Sample Identification		P80 @ 0.0 - 0.5m
Liquid Limit	%	*38*
Plastic Limit	%	*14*
Plasticity Index	%	*24*
Linear Shrinkage	%	*8*
Sample History		*Air Dried*
Preparation Method		*Dry Sieved*
Nature of Shrinkage		*Flat*
Percent finer than 0.075mm	%	*47*
Moisture Content "as received"	%	*37.0*

remarks :

Note: Sample tested as received.

NATA Accredited Laboratory No. 431

Date : *27/05/2004*

Authorised Signature:

M.E Castle

Coffey Geosciences Pty Ltd ACN 056 335 516

Form No L2.1W4 Version 5.1

Geotechnical | **Resources** | Environmental | **Technical** | Project Management
24 Hasler Road, Herdsman, WA, 6107 Ph: (08) 9347 0000 Fax: (08) 9347 0099

moisture/density relationship - graph C

job no : P6514/03
report no : LB3408/1

client : Fortescue Metals Group
principal :
project : Anderson Point Preliminary Investigation
location : Port Hedland

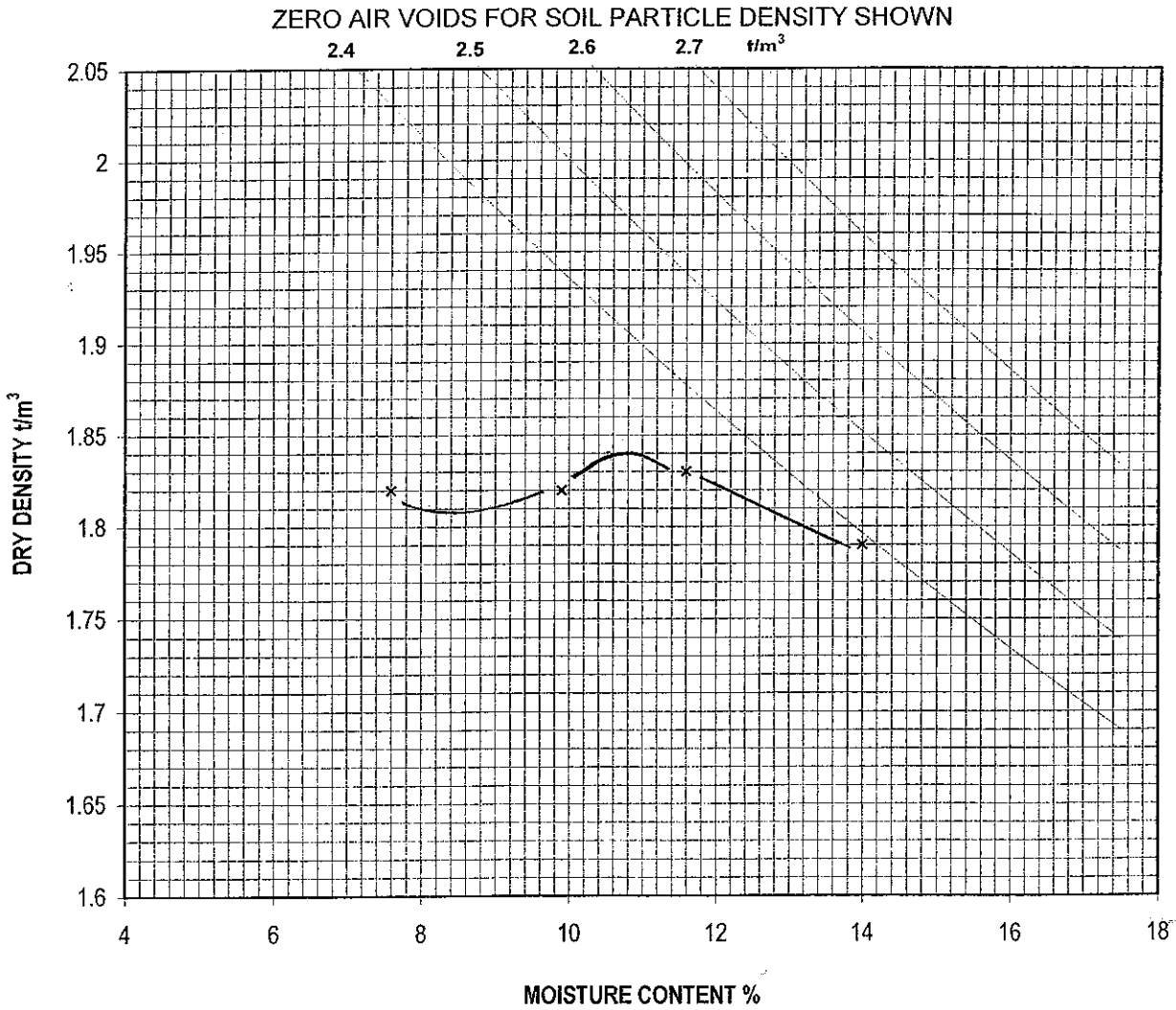
date : 26/05/2004
laboratory : Perth
tested by : AN
checked by : MEC

test procedure(s) : AS1289 5.2.1
soil particle density : - t/m^3

maximum dry density : 1.84 t/m^3
optimum moisture content : 10.5 %

sample identification : · Group 1 (Combined Sample)

% retained 19mm sieve: 0 %



material classification :

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Authorised Signatory: (M.E Castle)
NATA Accredited Laboratory No. 431 Date:27/05/04

Coffey Geosciences Pty Ltd ACN 056 335 516

Form No L2.1W5 Version 5.1

Geotechnical | **Resources** | Environmental | **Technical** | Project Management
24 Hasler Road, Herdsman, WA, 6107 Ph: (08) 9347 0000 Fax: (08) 9347 0099

moisture/density relationship - graph D

job no : P6514/03
report no : LB3409/1

client : Fortescue Metals Group
principal :
project : Anderson Point Preliminary Investigation
location : Port Hedland

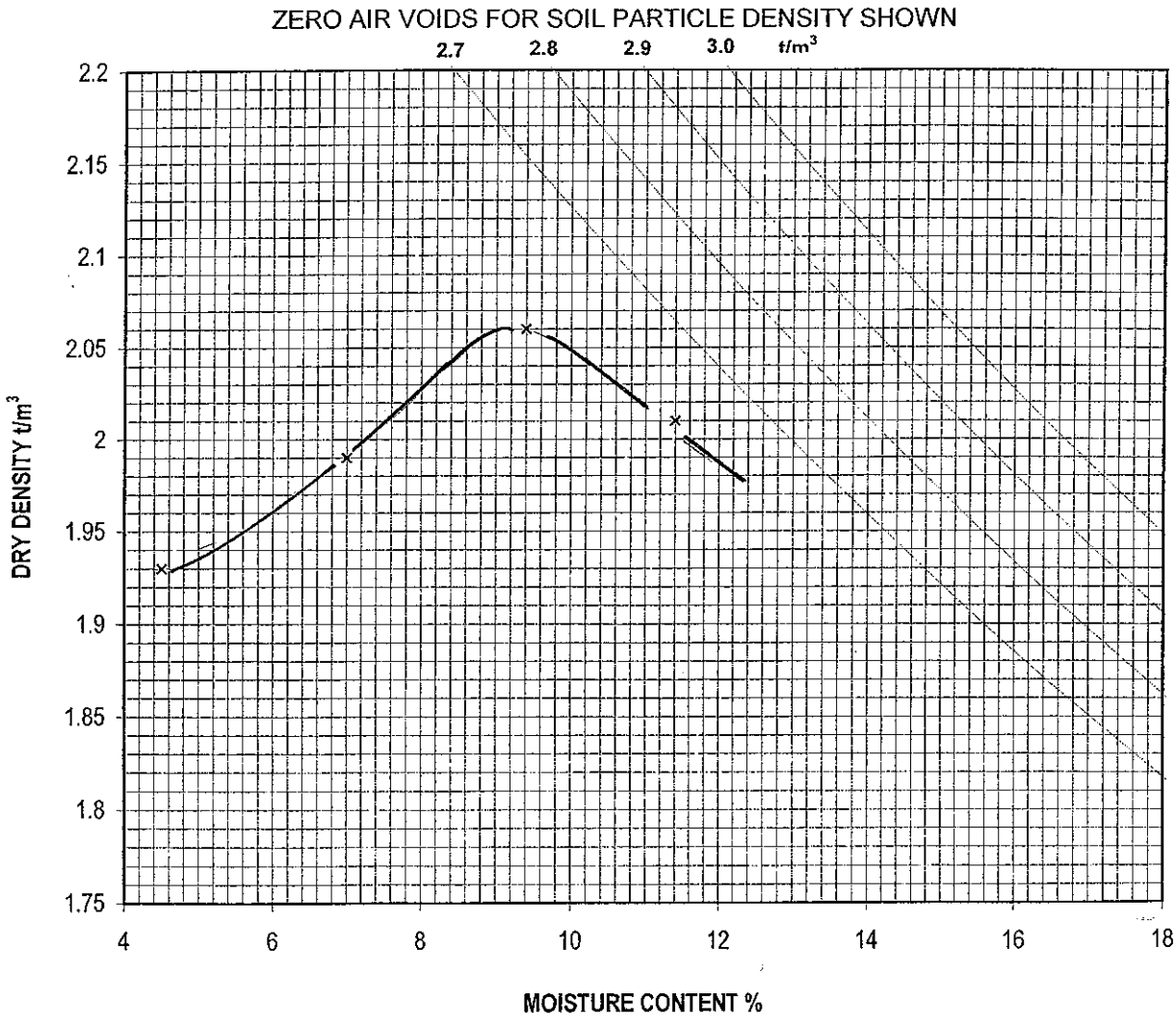
date : 26/05/2004
laboratory : Perth
tested by : AN
checked by : MEC

test procedure(s) : AS1289 5.2.1
soil particle density : - t/m^3

maximum dry density : 2.06 t/m^3
optimum moisture content : 9.0 %

sample identification : Group 2 (Combined Sample)

% retained 19mm sieve: 0 %



material classification :

Authorised Signatory: (M.E Castle)
NATA Accredited Laboratory No. 431 Date:27/05/04

Information

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Coffey Geosciences Pty Ltd ABN 057 056 335 516

Coffey

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design toward construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

** For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, National Headquarters, Canberra, 1987.*