

Geotechnical Assessment

Darwin Integrated Live Export Facility

Report Number 41009.80266

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Document Status Record

Report Type: Geotechnical Assessment

Project Title: Darwin Integrated Live Export Facility

Client: Wellard Rural Exports Pty Ltd

Project Document Number: 41009.80266

File Name: 41009.80166_150818_EnviroAg Wellards Darwin Geotechnical Assessment 2015_Rev 0.docx

Revision	Date of Issue	Author	Checked	Quality Assurance	Approved
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Distribution:

	Recipient	No. Copies
Rev.0 : Final Report	Wellard Rural Exports Pty Ltd	1
	GroundTruth Pty Ltd	1

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Executive Summary

GroundTruth Australia Pty Ltd has been engaged by EnviroAg Australia Pty Ltd (EnviroAg) to conduct a geotechnical investigation for the proposed Livingstone Integrated Live Export Facility (ILEF), 2658 Stuart Highway, Livingstone NT. The proposed development is immediately adjacent to the “Santavan” PEQ yard which is on the northern neighbouring property.

The works included;

- a) Drilling of a test bore; and
- b) Excavation of fourteen (14) test pits; and
- c) Testing and compilation of the data obtained.

The objectives of this project were to;

- a) Define the geology of the site; and,
- b) Provide data critical to the design of the ILEF and allow the delivery of detailed design of the proposed key infrastructure.

The site was divided into three zones in accordance with their proposed purposes;

- Zone 1. Export Facility
- Zone 2. Irrigable Area
- Zone 3. Waste Systems

It was found that the top soil across the Livingstone Valley site was slightly acidic to neutral, with a low nutrient composition, presenting a moderately reactive soil. The water and nutrient holding capacities were also very low. The surface soils, when wet, have a low strength whilst the laterite at depth presents a material that can be robust if not too mineralised and kept dry.

Soil aggressivity must be managed to maintain foundation integrity. The top soil has a moderate sand content and is slightly acidic to neutral. It is recommended that this be removed from beneath buildings down to the B Horizons, which consists of cemented ferricrete which is a non-reactive, stable Class A soil. This will also reduce the risk of low soil bearing capacities through the removal of unstable horizons.

Within the proposed irrigation area, the low water and nutrient storing capacities and current nutrient levels within the soil will be negated by the continuous application of irrigation water with a high nutrient content. The phosphorus deficient soils will respond to the application of gypsum, improving nutrient uptake and soil condition.

The geotechnical model and recommendations presented in this report are based on a limited number of test pits and a test borehole, with limited site coverage. Variations in ground conditions occur over relatively short distances and with depth.

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1 Introduction

GroundTruth was engaged by EnviroAg to conduct a geotechnical investigation for assessing the property known as “Livingstone Valley” on Lot 5544 Hundred of Strangways for the suitability for the proposed land use as an Integrated Live Export Facility (ILEF). The location of the property is shown in Figure 1.

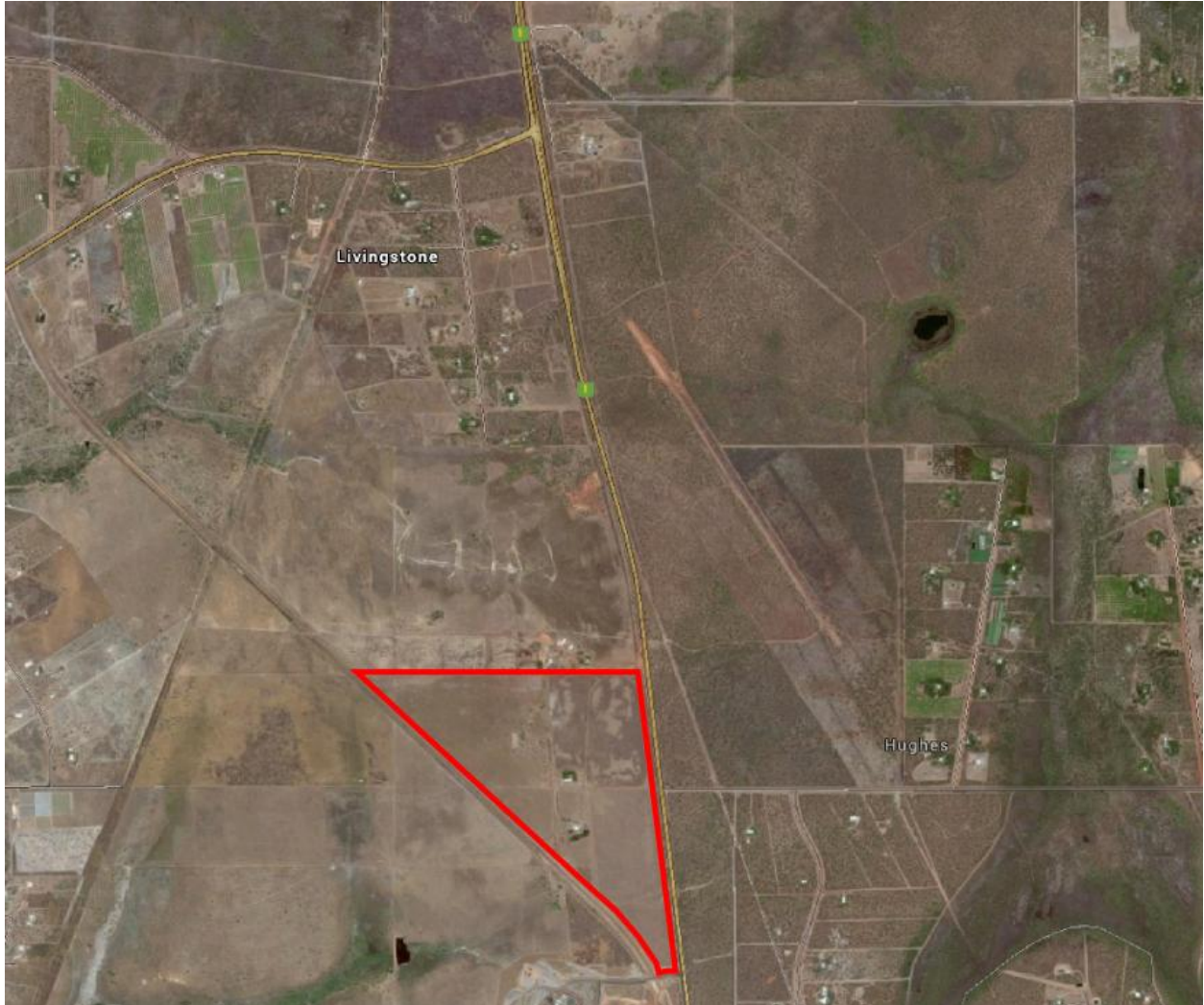


Figure 1 'Livingstone Valley' ILEF site

The site investigations were undertaken in January 2015 and June 2015, in both wet season and dry season conditions.

This report presents the findings from that investigation. The report will allow the delivery of detailed design of the proposed key infrastructure.

2 Site Characteristics

2.1 Geology

The Livingston Valley geology has been described by the Department of Infrastructure, Planning and Environment in the text; “An understanding of the groundwater and surface water hydrology of the Darwin Harbour Plan of Management area” (Haig & Townsend, 2003).

The following provides a summary of the regional geology as described by Haig and Townsend (2003):

- The bedrock geology consists of dolomite, carbonate rocks, sandstone, shale, siltstone, schist, granite and metamorphic rocks. The highest yielding bedrock aquifers are the dolomites and carbonate rocks. Lesser yielding aquifers are found in the fractured sandstones and siltstone. Schist, granite and metamorphic rocks are low yielding aquifers.
- Most of the region is covered with 20 to 50 metres of more recent sandstone, siltstone and claystone. There is a 5 to 10 metre thick layer of laterite ie. a residual clayey layer mainly consisting of hydroxides of iron and aluminium formed under tropical climatic conditions by the weathering of igneous rock that forms a capping layer over most of the area.
- Approximately 50% of the catchment area has moderately to severely water logged soils. Following the periods of high rainfall and runoff, the wetlands that form during the wet season will gradually dry up as shallow groundwater drains. Some wetlands which are “perched” above clay layers persist through the dry season.

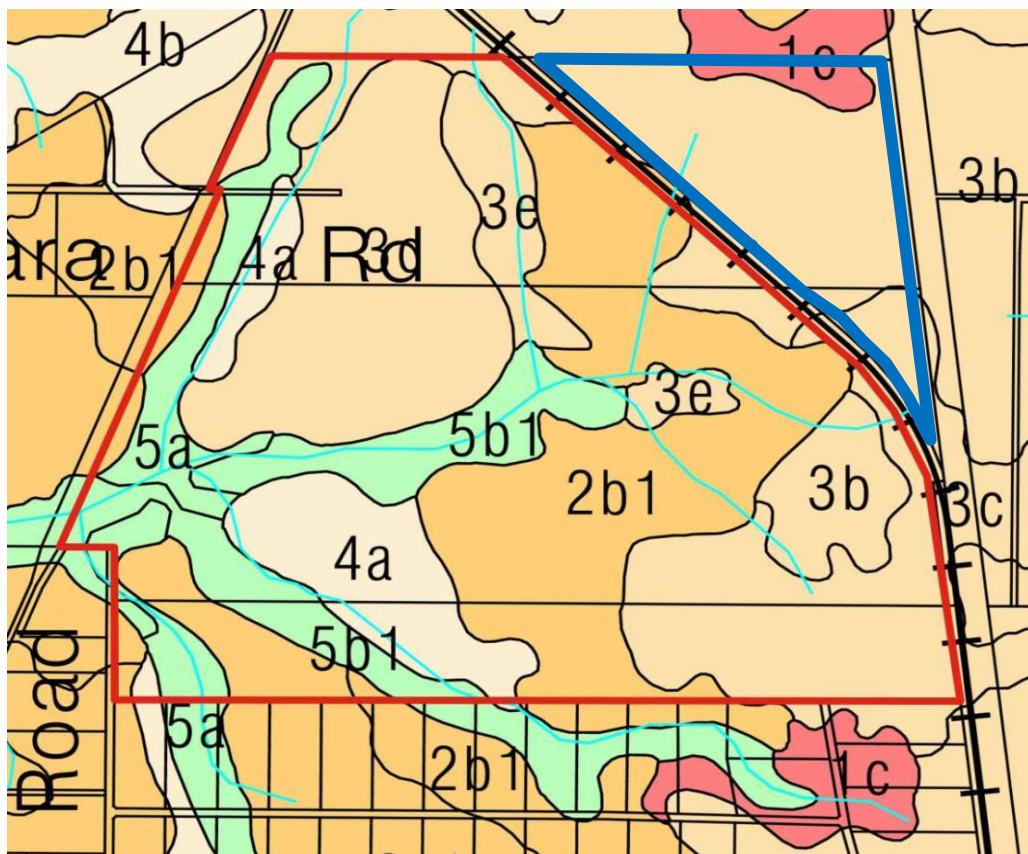


Figure 2 Land Unit of Livingston Valley (Blue Boundary) (Haig and Townsend, 2003)

2.2 Subsurface Conditions

The soils in the upper areas of the “Livingstone Valley” are a classic “Darwin lateritic Red Kandosol”. Kandosols have gravely sandy to loamy surface soil, gradually changing to sandy clay or clay subsoils with really poor

structure, low fertility and (generally) poor water holding capacity. The poor structure and laterite can lead to seasonal waterlogging. This has most certainly been observed on site.

As a general rule the soils are reasonably infertile and generally acidic. Soil samples have been collected for both agronomic and geotechnical testing. With regard to agronomics the soils often need “corrective calcium” additions (gypsum/lime) and typically some boron. With regard to the geotechnical characteristics the surface soils, when wet, have a low strength whilst the laterite at depth presents a material that can be robust if not too mineralised and kept dry.

3 Method of Investigation

3.1 Safety Assessment and Services Location

A 'Dial Before You Dig' request was undertaken for the site and the site was assessed for hazards. Service location was undertaken to identify the location of services prior to drilling.

A desktop assessment of the sites was undertaken using the supplied reports from EnviroAg. A Specialist Engineer and one (1) GroundTruth field assistant travelled to the site. The site was assessed using standard procedures for safety, site attributes and soil characteristics. An onsite safety assessment was undertaken. 'Toolbox talks' were conducted prior to the start of work each day.

3.2 Location of Test Bore Site and Sampling Points

A desk top assessment to bore in the local area was undertaken. It showed that two existing bores existed on the site and several bores had been placed on the adjacent properties; including recent bores on the AACO Meat Processing Facility site.

A test borehole was located by a Specialist Engineer against the local bore logs secured from the NT Government web site for adjacent shallow bores, and in consultation with the drilling company engaged for the test drilling, "Bores NT".

The bore logs for the existing bores on the property are provided in Appendix B. Figure 3 shows the bores located within the vicinity of the site.

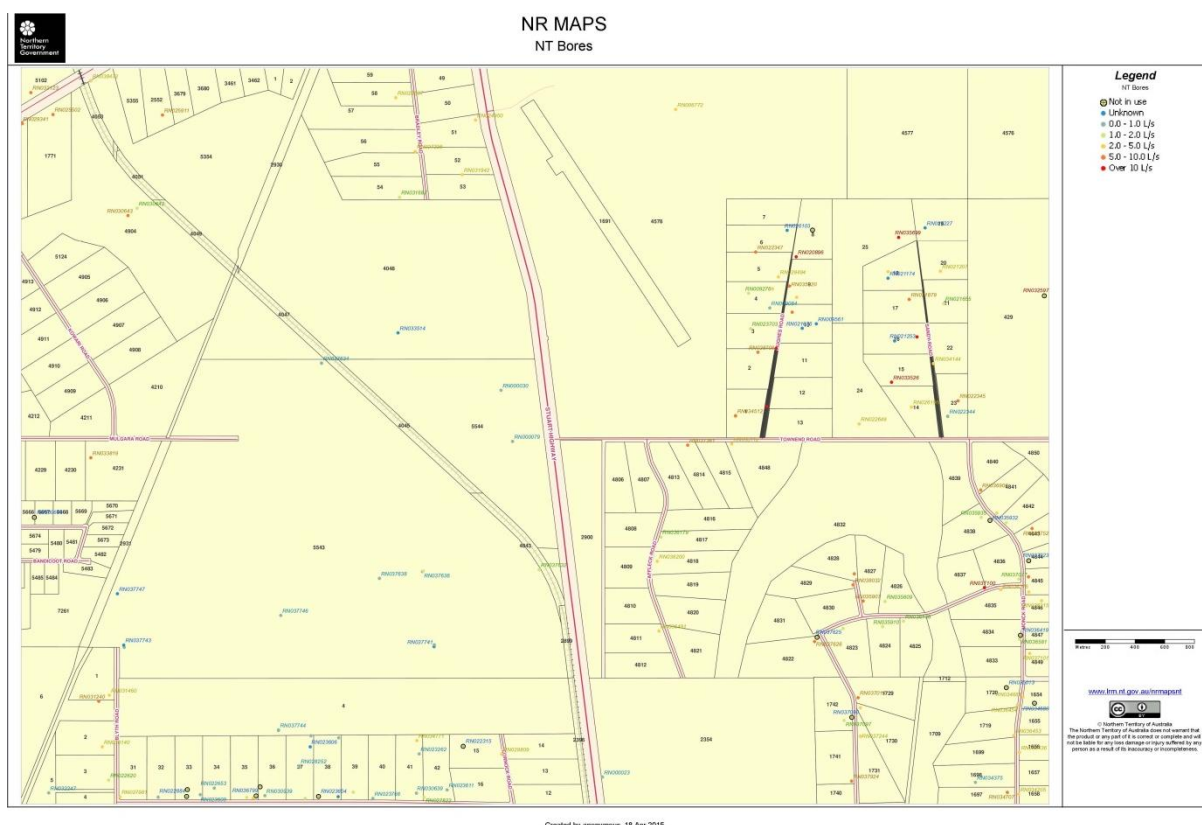


Figure 3 Groundwater bores in the vicinity of the development site

Test pit locations were positioned on the basis of the proposed land use areas in the concept design that was provided to GroundTruth.

3.3 Fieldwork

3.3.1 Test Bore

Fieldwork was carried out in January and June of 2015, collecting soil data using test pits and a test borehole. A test borehole (1) was constructed using the following drilling method:

- Open hole Rotary Air Blast (RAB) drilling with a 300mm drill to a depth of 5.1 m to establish a surface case to hold loose surface material;
- Open hole drilling with a 200mm drill to a depth of 72m; and
- RAB drilling with a 150mm drill, through a 152mm ID casing, to 112m.

The soil strata was sampled and logged at 0.5m intervals. A soil log was photographed. An Engineering log of the borehole is presented in Appendix A. The assessment of consistency and density was based on soil textural characteristics, the relative difficulty of penetration by the drill rig.

Upon completion of the fieldwork, boreholes were backfilled with a combination of bentonite and cuttings. The location of the Test borehole is illustrated in Figure 4.

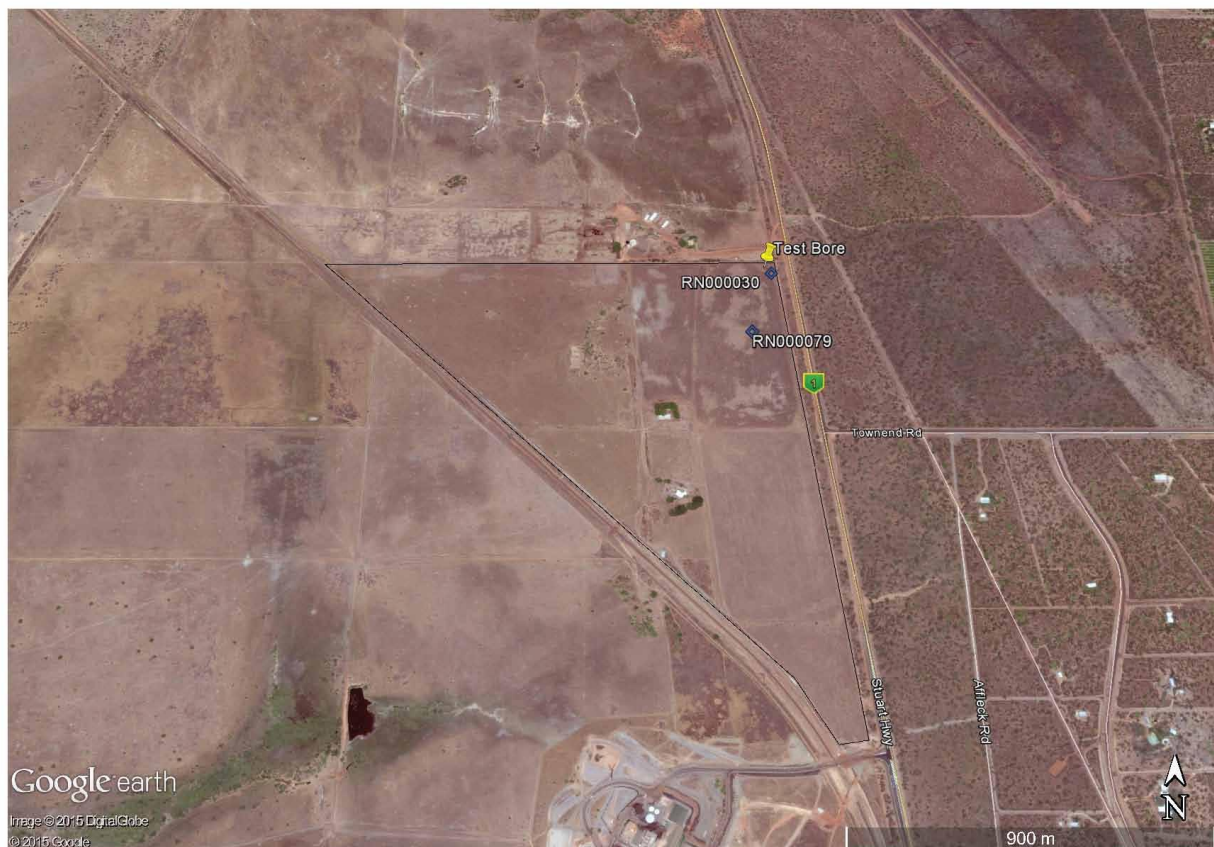


Figure 4 Test bore location

3.3.2 Test Pits

Fourteen test pits (14) were dug with a backhoe to the depth of refusal, varying from 0.5 to 1.2m. The test pit locations are shown in Figure 5.

The field investigations were directed by the Senior Engineer. An Engineering Geologist (Senior Technician) recorded the test results and logged the samples obtained.



Figure 5 Soil test pit locations (Samples taken on the 9th January 2015 are numerical, 2nd June are alphabetical)

3.4 Laboratory Testing

Soil samples were submitted to NATA accredited laboratories for analysis. Soils from TP1, TP2 and TP3 were forwarded for agronomic analysis. Soils from TP7 were sent for geotechnical testing.

Additional test pit samples (TP A, TP B, TP C and TP D) were collected on the 2nd June 2015 from the proposed location of the pens, effluent and water storage pond areas. These samples were specific for geotechnical identification of borrow pit materials for site construction.

3.5 Data Management

The soils physical characteristics were described and entered onto EnviroAg field soil logs with photographs and GPS locations collected for each test pit. Samples were freighted to the Toowoomba office where they were prepared and forwarded to the relevant laboratory for analysis. This was carried out under Chain of Custody (COC) documentation.

All test pit soil samples were air dried and are currently stored at EnviroAg facilities in Toowoomba, QLD.

No surface soil samples were sent for analysis from the test bore hole. Dry samples were collected from cuttings when the open hole auguring was undertaken. The chip samples were then placed in piles on the ground to allow for identification and description in the bore log.

4 Site Conditions

4.1 Site Surface Conditions

The proposed Wellard's ILEF sites is relatively flat and has been completely cleared, ploughed and sown to improved pasture. The land is currently used for grazing stock and pasture for hay production. The site has a general East to West slope of about 2% and a cross fall of approximately 0.5%.

The site is 90.5ha therefore soil characteristics are consistent throughout.

The site has been broken into three (3) proposed zones;

1. Export Facility (TP 4, 6, 8 and 9)(TP A and D)
2. Irrigable (TP 1, 2, 3, 5 and 7)
3. Waste Systems (TP 10) (TP B and C)

The soil profile was shallow with the A horizon averaging to a depth of 0.28 m and the B horizon depth average of 0.77 throughout the fourteen test pits.

Gravel was encountered throughout the A and B horizons with varying depths of (initial) refusal by back hoe investigation, within the ferricrete encountered in the C horizon.

4.2 Test Bore Investigation

The test bore was drilled at the top of the site. A summary of the surface stratigraphy to 10m is provided below in Table 1. Plates of the logged soil samples are provided following the table.

Table 1 Summary of strata at test borehole (GT1) location (131°05'03"E, 12°41'48" N)

Depth (m)	Material Description
0-0.5m	Top soil (Horizons A0,A1,A2, and B1)
0.5-3.0m	Ferricrete
3.0-4.0m	Decomposed silt stone (10-20% clay)
4.0-6.0m	Pink with white chips
6.0-7.0m	Decomposed silt stone with gravel
7.0-8.0	Red sandy silt stone / claystone
8.0-9.0m	Orange silty clay (>50%)
9.0-10.0m	Yellow and orange silt clay

The test bore stratigraphy generally matches that of the existing bores on the property. These bores, while drilled some time ago, were very well logged by the Australian Army.



Figure 6 **Test bore logs**



Figure 7 **Test bore logs (continued)**

A dense moderate to heavy clay was found at 7-10m. This impermeable layer of clay observed at 7-10 metres may be utilised as a viable base lining for holding and storage dams.

The impermeable clay layer will limit the infiltration of nutrients from applied wastewater into water table in the irrigable area, reducing risk of contamination of deeper aquifers through leaching.

Based on the information obtained from the test borehole, a general profile has been developed and is presented in Table 1, to a depth of ten (10) meters. The test bore continues to a depth of 114 meters.

For a detailed description of the subsurface conditions encountered at the borehole locations, refer to the soil borehole log in Appendix A.

4.3 Site Soil Classification

(In accordance with AS 2870)

The soil profile at Livingstone Valley is expressed in Table 2 below.

Table 2 Typical soil profile (results noted from Test Pit 2)

Depth (m)	Horizon	Description
0.0 - 0.10	A1	Dark brown sandy silt trace of clay. Massive structure with humic layer at a A0 with minor gravel
0.10 - 0.20	A2	Light yellow brown sandy silt. Massive structure, saturated, weak and partially leached
0.20 - 0.30	B1	Orange yellow silty, sandy, clay; Massive structure.
0.30 - 0.65	B2	Red silty (20-30%) clay (20-30%) with gravel. Massive structure.
0.65 - 0.90	B3	Red/Yellow gravelly clay. Massive structure with decomposed ferricrete and red yellow mottles.
0.90 - 1.20	C1	Ferricrete rock with red yellow mottles.

The test pits showed the following;

- The A1 horizon consisted of a dark brown silty-sand top soil 0-0.10 m. The A2 horizon was reasonably shallow ranging in depth between 0.10 m and 0.35 m and consisted of a yellow to light yellow-brown sandy silt.
- The B horizon consisted of an orange yellow clayey sandy silt overlying a red silty clay with gravel between a depth of 0.30 m and 0.90m.
- The C horizon consisted of ferricrete and refusal between 0.70 to 1.20 m. In test pit 7 the ferricrete was broken through and a reddish yellow clay with <30 mm sub angular-rounded gravel to 1.50 mm was noted.

Test pits profiles are illustrated in Figure 8 to Figure 13.



Figure 8 **Test Pit 1**



Figure 9 **Test Pit 2**



Figure 10 **Test Pit 4**



Figure 11 **Test pit 5**



Figure 12 Test Pit 6



Figure 13 Test Pit 8

The site soil classification would be generally described as being a **Class M** site in the upper areas and a P site in low lying areas due to the presence of transient, ephemeral shallow ground waters due to water logging during the wet season. Removal of top soils would render a reduced classification of **Class S**.

4.4 Laboratory Analyses

4.4.1 Soil Aggressivity

(In Accordance with AS 2159)

The geotechnical characteristics of the surface soils, when wet, have a low strength whilst the laterite at depth presents a material that can be robust if not too mineralised and kept dry. "Laterite" is simply a continuous cemented layer of iron and aluminium oxides, formed through accumulation of these elements during extreme tropical weathering. In this case we are dealing with ferricrete, which is an iron cemented rock found at depth; below the root zone.

Table 3 Selective soil aggressivity factors

Wellard's Soil Sampling Livingstone Date: 11/01/15 Sample ID				
	pH (aqueous)	EC dS/m	Chloride (mg/kg)	Sulphur (mg/kg)
Guidelines	5.6-8.4	<3	<125	
TP1 0.15-0.30m	7.74	0.04	1	4.6
TP1 0.30-0.60m	7.09	0.03	4	3.3
TP2 0.15-0.30m	5.36	0.02	<0.5	2.2
TP2 0.30-0.60m	6.57	0.03	3	5.2
TP3 0.15-0.30m	6.66	0.07	53	9.3
TP3 0.30-0.60m	5.45	0.02	3	2

Agronomic results were obtained from the SGS laboratory for air dried sample analysis and are noted in from Test Pits 1, 2 and 3 for the depths of 0.15-0.30 m and 0.30-0.60 m.

Soil pH is slightly acidic to neutral throughout the profile with pH ranging from 5.36 to 7.74. Electrical Conductivity levels are negligible throughout the profile and indicate non-saline conditions. Chloride and Sulphur are low, suggesting a **low reactivity soil that is not aggressive**.

4.4.2 P Sorption

Table 4 Phosphorus data 0.30-0.60m bgsl (2nd June 2015)

Sample ID	Total P (mg/kg)	(Available) Phosphorus-Colwell (mg/kg)	P Sorption Capacity (mg/kg)
TP A	61	<0.5	100
TP B	78	<0.5	126
TP C	38	<0.5	73

The Phosphorus-Colwell is a measure of plant-available phosphorus in the soil. The Colwell-P levels are shown to be very low in the surface of the soil. Total P levels are also low and they decrease with increasing soil depth.

The capacity of the soil to absorb Phosphorus is determined by the mineralogy, amount of clay, pH and the temperature of the soil. The insitu soil has a relatively low P sorption capacity as a result of the silty, sandy clay A2 horizon, which has a low absorption and is unreactive. The significant presence of iron at depth would significantly increase the P sorbtion capacity due to ready precipitation of iron phosphates.

It must be noted that P sorption capacity may be reduced by “flooding” of the soil by increasing the solubility of phosphates. The wet season annually inundates the lower parts of “Livingstone Valley” with surface and shallow water. It is for this reason that waste water should be irrigated on elevated areas only.

The low P sorption in surface soils and Phosphorus-Colwell readings, combined with the limited total phosphorus depicts an extremely phosphorus deficient soil. Based on the available data the surface soils in the proposed irrigable area can readily sorb 1400kg/ha/m of soil within the top 1m.

4.4.3 California Bearing Ration

The California Bearing Ration is used to determine the resistance and inherent strength of the subgrade, through the application of force and observing the subsequent penetration.

The soils observed at Livingstone Valley are relatively consistent, varying from orange gravelly, sandy, silty clays to pale brown, sandy silty clays. The minimal variance between the soaked and un-soaked ration and high CBR results showed that the subgrade material is stable.

Test results for the selected samples are presented in Table 5 below. The data show that the ferricrete has merit as a structural material. The clay fines diminish the overall strength of the material and increase the soil plasticity. However they beneficially reduce the permeability such that the compacted material will be essentially impermeable.

Table 5 Geotechnical results (Samples taken 06/01/2015 and 02/06/2015)

Sample ID Location	TP7 Borrow Pit	TP A Export Facility	TP B Waste Systems	TP C Waste Systems	TP D Export Facility
Depth (m)	0.45-0.60m	0.6-1.0m	0.5-0.9m	1.0-2.0m	1.0-2.0m
Soil Description	Orange gravelly sandy silty clay	Red Brown Gravelly Silty Sandy Clay	Pale brown sandy silty clay	Orange brown gravelly silty sandy clay	Orange brown silty sandy clay
CBR % soaked	30	15	7	25	30
CBR % unsoaked	35	14	17	25	30
Liquid Limit %	47	51	52	41	37
Plastic Limit %	19	24	22	20	18
Plasticity Index	28	27	30	21	19
Linear Shrinkage %	12.5	11.5	13	8.5	9.5
Permeability	1×10^{-11} m/s				

4.4.4 Atterberg Limits

(In accordance with AS 1726-1993)

Atterberg limits are a classification of soils based on their mechanical properties at different water contents. Soil strength decreases as water content increases and the soil swells. Fine-grained soils at very high water content possess properties similar to liquids. As the water content is reduced, the volume of the soil decreases and the

soils become plastic. If the water content is further reduced, the soil becomes semi-solid when the volume does not change.

Liquid Limit

The liquid limit of a soil is the lowest water content at which it is like a viscous mud, flowing under its own weight. It is the transition water content between plastic and liquid states. At liquid limit, the soil has (generally) very little strength.

Plastic limit

The plastic limit of a soil is the lowest water content at which it exhibits plastic characteristics. The range of water content, over which the soil remains plastic, is called the plasticity index.

Linear Shrink

Linear Shrinkage is the water content below which a soil sample will not shrink when dried.

The samples taken from the test pits exhibit characteristics of clays of medium (TP 7, TP C and TP D) and high plasticity (TP A and TP B), in accordance with Casagrande's PL-LL Chart (Casagrande, 1948). The liquid limit and plasticity indexes observed place the soils within these respective classification parameters (Table 5).

4.4.5 Particle Size Distribution

Based on grain sizes, the Australian Standards AS1726-1993 groups soils into clays (<0.002 mm), silts (0.002-0.075 mm), sands (0.075-2.36 mm), gravels (2.36-63 mm), cobbles (63-200 mm) and boulders (>200 mm). The particle size distribution for the soils tested are shown in the figure below.

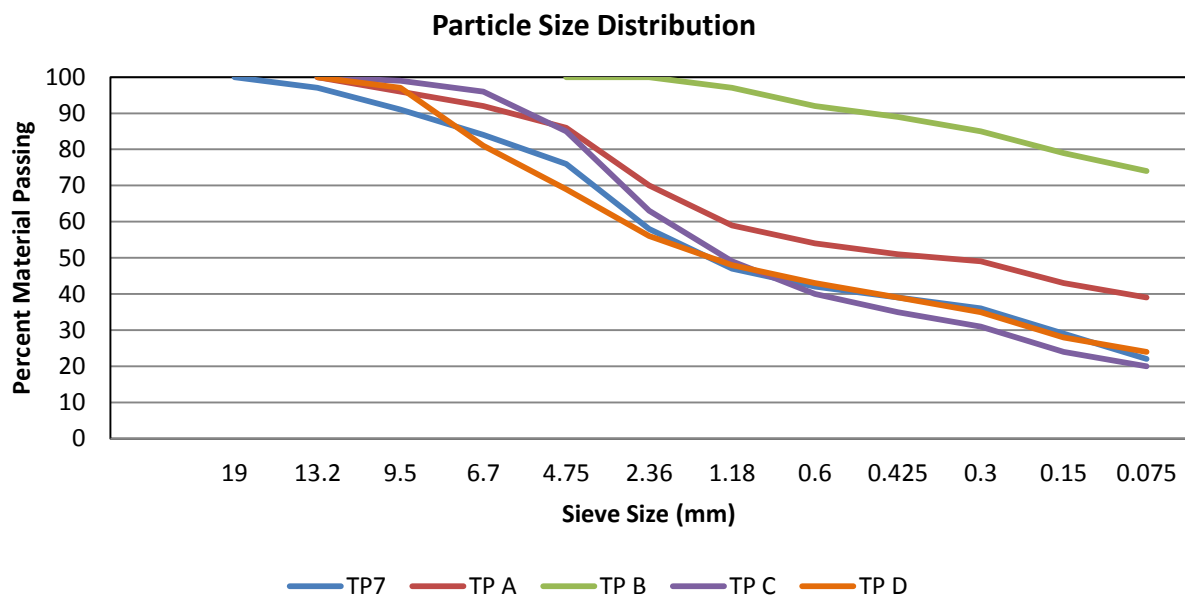


Figure 14 Sample Pits Particle Size Distribution

Test pits 7, A and C are relatively similar and within the parameters of a gravelly, silty sandy clay, of varying colours from orange to red, brown. Test pit D had similar particle size distribution, yet higher silt content than test pits 7, A and C. Test pit B, has significantly finer particles, 74 percent of particles, are smaller than 0.075mm and was observed as a pale brown sandy, silty clay.

4.4.6 Permeability

A selected sample from Test Pit 7 was tested for permeability. This sample was a clay type material found immediately above the ferricrete and below the sandy silty materials comprising the A Horizon. The width of this band of material (B1 Horizon) varies across the site from 0 to 0.5m in depth and in gravel, sand and clay content. It is impermeable with a measured permeability of 1×10^{-11} m/s. This material is suitable for lining of waste water ponds. However it will need to be protected by an armoured layer so it is recommended that a "sandwich" layering of material is used in any dam lining process.

Samples selected for permeability's for pits A-D were found to have such a low permeability that the tests were abandoned. It is expected that the permeability's are less than or equal to the permeability of the sample for Test Pit 7.

5 Discussion of Results

5.1 Geotechnical Attributes

Geotechnical information was gathered at 'Livingstone Valley' on Lot 5544 Hundred of Strangways to determine the suitability for the proposed land use as an Integrated Live Export Facility (ILEF). The geotechnical investigation included surface exploration and subsurface exploration of a site. The digging of test pits and drilling of a test bore provided information about soil conditions at depth.

Atterberg limits were tested; water content measurements and grain size analysis were performed on disturbed samples obtained from the test pit to ascertain the full potential of the site to provide suitable materials for the construction of the proposed ILEF. It was observed that;

- The surface soils are weak and should not be used for any structures; however the sand may be washed (of fines) and then be useful for bedding materials in trenches and drainage zones.
- Ferricrete is found at depth across the entire site, it is stable when wet and reasonably strong. It can be quarried in areas to supply materials for construction.
- Minor areas of gravel and clay can be excavated and used where required
- The clay below the ferricrete horizon will need to be cut for use in storage and holding ponds
- Extracted materials which are unsuitable for construction purposes can be backfilled into quarried areas

The site classification as being a **Class M** site is predicated by the presence of the top soils. With removal of the soils a site soil classification of **Class S** can be applied. (This presumes that any fill used in a building platform is an engineered fill with little shrink swell.)

5.2 Resource Assessment

5.2.1 Ferricrete

Ferricrete is a non-reactive iron cemented rock, found throughout the site, which may be utilised in the construction of pads. A 2.5m layer of ferricrete was observed from 0.5-3.0m when auguring the test bore.

Utilisation of the impermeable layer of clay at 7-8m, with an additional metre added to reinforce the lining of the floor, will result in a depth of 6m. The construction process for the storage pond (135ML), wet weather pond (78ML), clean water storage (30ML) and turkeys nest (12ML) will extract 252,616m³ of ferricrete.

Inferred from the surveys, the potential recoverable amount of ferricrete will be 160,962m³ from the designated borrow zones. If additional amounts are required then local quarrying can be sought.

5.2.2 Clay

There are intermittent horizons of clay throughout the site. The sporadic nature of resources will make quarrying of clay difficult. The low composition of clay in the decomposed silt stone layer below the ferricrete may be utilised in the construction of pads but is insufficient for lining ponds and dams. The dam lining material will have to be excavated from deep zones 6-10m below surface or imported to satisfy construction requirements. Alternately synthetic liners will be used for storages.

A sample was taken from Test Pit 7, and the permeability of the clay was tested to determine if it was a viable source for dam lining material. A permeability of 4.2×10^{-11} (m/sec) was observed, satisfying the AS 1289-1997 requirement of 4.2×10^{-8} .

5.3 Groundwater

The groundwater at the 'Livingstone Valley' site fluctuates with the season. Lower areas become inundated during the 'wet season' due to both slow drainage of rainfall – runoff and presence of transient downslope flows of soil water that surface where the soil profile and slope prevents flows through the soil profile.

This ephemeral groundwater can adversely affect the construction of infrastructure if not correctly managed. Surface and subsurface drainage is required.

Sufficient drainage must be installed to intercept both surface and downslope subsurface drainage and their contributions to surface groundwater.

Application of recycled water to irrigable areas will not occur during the wet season, unless there is a soil water deficit, to reduce recharge of groundwater.

Holding and storage ponds will require additional reinforcement to ensure the lining is not 'pushed out' by any hydraulic pressures caused by subsurface flows. To reduce the risk of structural failure of pond walls and flooring it is recommended that a rock armouring will be applied to improve stability during periods of heightened transient groundwater flow.

6 Conclusion and Recommendations

6.1 Export Facility

The export facility (Zone1) will house the majority of the infrastructure;

- Care takers house;
- Commodity and fodder storage sheds;
- Feed mill
- Freshwater storage (ring tank and clean water tanks), for capture and storage of roof runoff and storage of ground waters for stock water supply;
- Pre-Export Quarantine (PEQ) holding yard (Normalised holding capacity 3,000 SCU, with a 12,000 head 'peak' short term (~4 day average) holding capacity over a 16 day shipment cycle time (25% occupancy)
- Livestock Truck washing facility; and
- 2,000 SCU (Short term) feedlot; for holding stock for up to 30 days;

Soil aggressivity must be managed to maintain foundation integrity. The top soil has a moderate sand content (Table 5) and is slightly acidic to neutral (Table 3), it is recommended that this be removed to the C1 horizon (Table 2), which consists of cemented ferricrete which is a non-reactive, stable Class A soil. Fill material used to build any platform should be of similar material to the ferricrete (e.g. engineered soil fill).

It was observed that the bearing capacity of the soil was low in the upper horizons (when wet). This reaffirms the requirement to strip the topsoil to the C1 ferricrete horizon. If further stability issues occur the soil may be treated with lime to rectify.

The CBR illustrates that the surface soils weaken when wet, which is an annual occurrence in Northern Australia, therefore it is imperative that this is considered when determining pavement design and that foundations are kept as dry as possible through the use of good drainage.

6.2 Irrigable Zone

The irrigable zone (Zone 2), which runs North, South along the Eastern border of the property will require significant nutrient management, to ensure its sustainable use. It will be an irrigation area for treated waste water reuse and hay/fodder production. The soils currently have a low water and nutrient holding capacity (Table 4), yet will respond well to the application of nutrients and water.

The P sorption is dependent on the mineralogy, amount of clay pH and temperature of the soil. The phosphorus deficient soils will respond to the application of gypsum, and organic matter, both of which will improve nutrient uptake and soil condition.

6.3 Waste Systems Zone

The waste systems zone (Zone 3) is situated on the Western border of the property. This zone will primarily consist of waste storage and treatment facilities.

Similarly to Zone 1, where infrastructure is to be located the soil must be stripped to the C1 horizon, where soils of improved stability and reactivity are located. Sufficient drainage around all infrastructure will also be a requirement.

Clay materials in the B1 and B2 should be selectively stripped and used for pond lining materials due to their low permeability.

The silty sandy clays observed will be insufficient for dam construction, as the clay content is too low which is reflected in the CBR (Table 5). If insufficient material is available on site for lining of waste water storages then an alternative source of soil must be found for the lining of the dams or synthetic liners used..

7 Limitations

The geotechnical model and recommendations presented in this report are based on a limited number of test pits and a test borehole, with limited site coverage. Variations in ground conditions occur over relatively short distances and with depth.

8 References

T. Haig and S. Townsend (2003). *"An understanding of the groundwater and surface water hydrology of the Darwin Harbour Plan of Management area"*. Department of Infrastructure, Planning and Environment, PO Box 30, Palmerston NT 0831.

Casagrande, A. (1948). "Classification and identification of soils," Transactions, ASCE, 113, 901-930.

Australian Standard 1289 -1997 (Methods for testing soils for engineering purposes)

Australian Standard 1726 - 1993 (Geotechnical Site Investigations)

Australian Standard 2870 - 2011 (Residential Slabs and Footings)

Australian Standard 2159- 2009 (Piling – Design and Installation)

9 Appendices

Appendix A	Test Bore Log	A-1
Appendix B	Existing Bore Logs	B-1
Appendix C	Soil Sampling Report Sheets	C-1
Appendix D	California Bearing Ratio Report	D-1
Appendix E	Quality of Materials Report	E-1
Appendix F	P Isotherm Report	F-1
Appendix G	Falling Head Test Report	G-1

Appendix A Test Bore Log

Form_06022_A										Bore Construction Log										EA Alliance																			
										Borehole No:										1																			
Office Project No.: 23870										Sheet:										1 of 4																			
Client: Wellard Rural										Date started:										6/05/2015																			
Project Manager: Simon Lott										Date completed:										6/05/2015																			
Project: Wellard Rural Darwin Integrated Live Export Facility (ILEF)										Logged by:										Simon Lott																			
Bore Location: Livingstone Valley										Checked by:										Simon Lott / Nick Bainton																			
Easting: 131 degrees 05' 03"										R.L. at Surface:										Drilling Method: Rotary Air Blast / Mud																			
Northing: 12 degrees, 41' 48"										Surface Drainage: 1° to West										Hole Size: 310mm surface / 200mm / 152mm																			
Datum:										Current Land Use: Grazing / Hay Prodn																													
drilling information										material substance																													
method penetration support water notes, samples, tests, etc. R.L. depth (m) graphic log class. symbol material - soil type: plasticity or particle characteristics, colour, secondary or minor components moisture condition consistency / density index Plasticity pocket penetrometer r (kPa) Annulus Pack Casing Water/ development																																							
RAB 1 2 3 4 C S 0 1 2 3 4 Top soil Ferricrete Decomposed silt stone (10-20% clay) Pink with white chips D D D D																																							
RAB 5 6 7 8 9 Decomposed silt stone with gravel Red sandy silt stone Orange silty clay (>50% clay) Yellow and orange silt M M M M																																							
RAB 10 11 12 13 14 Yellow silt and powdery (soft) Yellow decomposed silt stone with clay content (20-40%) Red and organge decomposed siltstone Orange and yellow siltstone Yellow (bright) siltstone M M M M M																																							
RAB 15 16 17 18 19 White siltstone White-yellow silt Pink siltstone Pink/Yellow-red siltstone M VS M M W																																							
RAB 20 21 22 23 24 Yellow-White silt / decomposed siltstone Light yellow brown decomposed siltstone Light brown decomposed siltstone Redsilt soft and moist (siltstone decomposed) VS																																							
RAB 25 26 27 28 29 Siltstone - light brown Siltstone - light brown - red										Free water																													
RAB 30 31 32 33 34 S S Packer																																							
Method auger screwing* auger drilling* roller/tricone washbore cable tool hand auger pushtube blank bit V bit TC bit *bit shown by suffix e.g. ADT support mud casing nil penetration 1 2 3 4 no resist. ranging to refusal water inflow water outflow notes, samples, tests, etc. U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test N* SPT - sample recovered N _C SPT with solid cone V vane shear (kPa) P pressuremeter B _s bulk sample E environmental sample R refusal classification symbols and soil descriptions based on the unified classification system (ref: AS1726, table A1) moisture D dry M moist W wet W _p plastic limit W _L liquid limit consistency / density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense Plasticity NP Non - plastic T Trace VT Very Low L Low M Medium H High VH Very High EH Extra High																																							
Document Owner: E.A. Systems										Author: GT										Status: Approved										Form_06022_A_Bore Construction Log									
Revision: 2.0										Authorised: S.C.Lott										Issue Date: 27/11/2008										Form Page 1 of 1 Form 3003									

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drilling information										material substance																																																																													
<table border="1"><tr><th>method</th><th colspan="4">penetration</th><th>support</th><th>water</th><th>notes, samples, tests, etc.</th><th>R.L.</th><th>depth (m)</th></tr><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td></td><td></td><td></td><td></td><td></td></tr></table>										method	penetration				support	water	notes, samples, tests, etc.	R.L.	depth (m)		1	2	3	4						<table border="1"><tr><th>graphic log</th><th>class. symbol</th><th>material - soil type: plasticity or particle characteristics, colour, secondary or minor components</th><th>moisture condition</th><th>consistency / density index</th><th>Plasticity</th><th>pocket penetrometer r (kPa)</th><th colspan="3">Piezometer Construction</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Annulus Pack</td><td>Casing</td><td>Water/development</td></tr></table>									graphic log	class. symbol	material - soil type: plasticity or particle characteristics, colour, secondary or minor components	moisture condition	consistency / density index	Plasticity	pocket penetrometer r (kPa)	Piezometer Construction											Annulus Pack	Casing	Water/development																												
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								Annulus Pack	Casing	Water/development																																																																													
RAB										Siltstone - light brown - red Light tan, grey decomposed siltstone. V soft with some clay content																																																																													
RAB										Red siltstone mix chips, steel grey inclusions																																																																													
RAB										Red & grey siltstone; "fresh"/ hard																																																																													
RAB										Red - brown siltstone; grey - black inclusions																																																																													
RAB										Tan siltstone, round pebble cobble quartz																																																																													
RAB										Tan siltstone, grey inclusions																																																																													
RAB										Red - tan variegated siltstone, green - grey inclusions																																																																													
RAB										White-grey siltstone with red and grey banding/inclusions																																																																													
RAB										White-grey siltstone with red and grey banding/inclusions. Hard black rock in bands																																																																													
RAB										Pink Siltstone (Increase in water)																																																																													
RAB										Pink siltstone; some orange siltstone																																																																													
RAB										Light grey (green tinge) siltstone																																																																													
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RAB										Light grey (green tinge) siltstone									Open hole									Water Inflow																										
RAB										Pink - white siltstone, some yellow and black inclusions																																												
RAB										Dark red - brown siltstone																																												
RAB										Dark red - Dark brown																																												
RAB										Red siltstone, hard chips																																												
RAB										Red siltstone, grey inclusions, softer chips																																												
W										Grey gravel and white quartz gravel in grey silt																																												
W										Grey siltstone with fine sand																																												
W										Grey siltstone with sand; very soft material									Packer																																			
W										Grey stiltstone; with quartz gravel (increase in water)																																												
W										Quartz gravel 5-10mm, grey silt & sand present									Natural pack /																																			
W										Grey sandy gravel 1-10mm; grey silt present									Open hole									Water inflow																										
Method										support									notes, samples, tests, etc.									classification symbols and soil descriptions based on the unified classification system (ref: AS1726, table A1)									consistency / density index									Plasticity								
AS auger screwing*										M mud									U ₅₀ undisturbed sample 50mm diameter									VS very soft									NP Non - plastic																	
AD auger drilling*										C casing									U ₆₃ undisturbed sample 63mm diameter									S soft									T Trace																	
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Form_06022_A										Bore Construction Log										EA Alliance																			
Office Project No.: 23870										Borehole No: 1																													
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		1 2 3 4																																Annulus Pack		Casing		Water/development	
RAB						M				S				105						Grey gravel 2-15mm angular																			
														106																									
														107																									
														108																									
														109																									
W						M				S				110																									
														111																									
														112																									
														113																									
														114																									
																				End of Hole																			

Appendix B Existing Bore Logs



RN000030

N.T.A. WATER RESOURCES BRANCH

BORE DATA SHEET

NAME	Army Bore No. 71	INDEX No.	80/53
LOCALITY	Darwin Zone 4	REG. No.	30
DEPTH	260 feet 79.3m.	FILE No.	
CASINGS	49.1m 151m 76.2m 127m 161' of 6-inch, 250' of 5-inch	PERFORATIONS SCREENS	bottom 36' slotted (38.1 to 49.1m)
LOCATION	80 / 05 / 5.40 E4.15 N	SURFACE LEVEL R.L. 198.85	B.M. LEVEL R.L. DATUM
CONTRACTOR	2/1 ABS. RAE	DRILLER.	DATE STARTED 5/11/43 DATE FINISHED 10/11/43

WATER				STRATA SECTION			
AQUIFERS				DEPTH FEET	CASING	AQU.	SEC.
DEPTH STRUCK	29.3 96	33.5 110					
AQUIFER THICKNESS							
STANDING WATER LEVEL	21.3 70						
PUMP TEST G.P.H.	(1.4) 800	(1.14) 850					
DRAWDOWN LEVEL	36.6 120	10.1 35					
PUMP LEVEL							
DURATION HOURS OF TEST	24	8					
R.L. S.W.L.							
WATER TEMPERATURE °C							
TRANSMISSIBILITY							
STORAGE COEFF.							
ANALYSES							
BINOMIAL CLASSIFICATION							
T. D. S.							
CONDUCTIVITY							
TOTAL HARDNESS							
CHLORIDE							
BICARBONATE							
CARBONATE							
SULPHATE							
NITRATE							
FLUORIDE							
SODIUM							
POTASSIUM							
CALCIUM							
MAGNESIUM							
REG. ANAL. No.							
EQUIPMENT.	Pump Column in bore.						
REMARKS.	(See Bore No. 70 for Plan of site). This bore was deepened from 161' to 260' on 20/10/44.						

E N ZONE 52
726015-8595135 5B815
Humpty Dos 1:10000 Sheet 0606
OKR 24/2/94



RN000079

N.T.A. WATER RESOURCES BRANCH

BORE DATA SHEET

NAME		Army Bore No. 70		INDEX No.		80/61	
LOCALITY		Darwin Zone 4		REG. No.		79	
DEPTH		210 m		FILE No.			
CASINGS 209' 6"				PERFORATIONS SCREENS Bottom slotted 36'			
LOCATION		80 / 05 / 5.40 E1.90 N		SURFACE R.L.		B.M. R.L.	
				LEVEL 191.35		DATUM	
CONTRACTOR		2/1 ABS RAE		DRILLER		Sgt. Moskert	
				DATE STARTED		18/10/43	
				DATE FINISHED		4/11/43	
WATER				STRATA SECTION			
AQUIFERS				STRATA			
DEPTH STRUCK		78		DEPTH FEET		20	
AQUIFER THICKNESS		202		CASING		24	
STANDING WATER LEVEL		180		AQU		24	
PUMP G.P.H.		720		SEC		24	
DRAWDOWN LEVEL		190				24	
PUMP LEVEL						24	
DURATION OF TEST HOURS		24				24	
R.L. S.W.L.						24	
WATER TEMPERATURE °C						24	
TRANSMISSIBILITY						24	
STORAGE COEFF						24	
ANALYSES				24			
BINOMIAL CLASSIFICATION				24			
T.D.S.				24			
CONDUCTIVITY				24			
TOTAL HARDNESS				24			
CHLORIDE				24			
BICARBONATE				24			
CARBONATE				24			
SULPHATE				24			
NITRATE				24			
FLUORIDE				24			
SODIUM				24			
POTASSIUM				24			
CALCIUM				24			
MAGNESIUM				24			
REG. ANAL. No.				24			
EQUIPMENT.				24			
REMARKS.				24			

clay and gravel

85.3

yellow clay

23.8

kaolin with quartz

26.1

yellow clay with quartz

32.3

red slate

38.4

slate and gravel seams

40.2

red slate

61.6

water bearing sand

64.0

BORE DATA SHEET

RESIDENT GEOLOGIST. N.T.

Darcuid. OFFICE.

1 MILE SHEET Darcuid.

BORE No

D52/4-22
IN° 61 RN° 79

BORE SITE

Name of Bore... Army 70

Class of Bore... Domestic Pastoral Lease

Sited by... Date...

Location: Run... Photo... Coords...

Elevation: R.L.

Situation... Miles... of 2.0 yards West of main N.E.
road at 3 1/4 m.p.

DRILLING RESULTS

Date drilled... 1943

Drilled by...

Total Depth... 210' 54"

Standing W. Level... 60' 18.3"

Pump Level...

WATER

Water struck at Supply (gph) Quality

1... 78' 1... 72.0 (0.945)

2... 202' 2... 2...

3... 3... 3...

Present Supply... gph. Date...

Quality of Present Supply...

GEOLOGY

DRILLERS LOG

Depth	Strata	Comments
0-24'	clay. f. gravel	
24'-78'	yellow clay	
78'-86'	red. w. f. g. s. s. m. s.	
86'-106'	yellow clay w. f. g. s.	
106'-126'	red. slate	
126'-132'	slate. f. gravel seams	
132'-202'	red. slate	
202'-210'	water bearing sand	

REMARKS

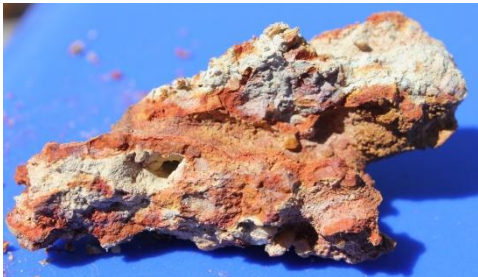
Appendix C Soil Sampling Report Sheets

Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard	Project No:	23919	GPS Zone	52	Easting:	725269.7
Property:	Livingstone	Paddock:	NA	GPS Datum:	MGA	Northing:	8595420
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Pasture	BH or TP No:	A

Profile Description:

Sample No	Horizon	Horizon depth (mm)	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
-	A1	0-100	Brown Grey	Silty Sad	Nil	Low organic matter levels	NA	Nil	Present	No
-	A2	100-300	Off White	Sand	Nil	Bleached	NA	Nil	Present	No
-	B1	350-450	Light Yellow	Silt sand	Massive	Some clay present	NA	10-20%	Present	No
	B2	450-1200	Yellow-Red	Cemented material	Massive	Ferricrete	NA	30-50%	Present	Nil
Sample	B3	1200-2500	Red Brown	Silty, sandy gravel	Nil	Decomposed materials	NA	Nil	Nil	Nil
	C1									

Photo 	Other comments: 	Parent material:	Silt and sandstones
		Surface drainage:	Good
		Surface slope:	1%
		Photos:	Yes
		Collector Name:	Simon Lott
		Signature:	
		Date:	25 th May 2015

Document Owner:	EA Alliance	Author:	G. Chase / S.C. Lott	Status:	Approved	Form_06026_A
Revision:	1.4	Authorised:	S.C. Lott	Issue Date:	22/01/2015	Page 1 of 1

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard	Project No:	23919	GPS Zone	52	Easting:	725449.8
Property:	Livingstone	Paddock:	NA	GPS Datum:	MGA	Northing:	8595295
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Pasture	BH or TP No:	B

Profile Description:

Sample No	Horizon	Horizon depth (mm)	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
-	A1	0-100	Grey	Silty Sand	Nil	Low organic matter levels	NA	Nil	Present	No
-	A2	100-350	Light grey	Sand	Nil	Bleached; deeper band of sand	NA	Nil	Present	No
-	B1	350-600	Yellow	Gravelly silt sand	Massive	Some clay present	NA	10-20%	Present	No
	B2	600-1500	Red	Cemented material	Massive	Ferricrete	NA	30-50%	Present	Nil
Sample	B3	1500-2500	Red	Silty, sandy gravel	Nil	Decomposed materials	NA	Nil	Nil	Nil
	C1									

Photo 	Other comments:	Parent material:	Silt and sandstones
		Surface drainage:	Good
		Surface slope:	1%
		Photos:	Yes
		Collector Name:	Simon Lott
		Signature:	
		Date:	25 th May 2015

Document Owner:	EA Alliance	Author:	G. Chase / S.C. Lott	Status:	Approved	Form_06026_A
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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard	Project No:	23919	GPS Zone	52	Easting:	725720.4
Property:	Livingstone	Paddock:	NA	GPS Datum:	MGA	Northing:	8595170.074
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Pasture	BH or TP No:	A

Profile Description:

Sample No	Horizon	Horizon depth (mm)	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
-	A1	0-100	Brown Grey	Silty Sand	Nil	Low organic matter levels	NA	Nil	Present	No
-	A2	100-300	Light grey	Sand	Nil	Bleached	NA	Nil	Present	No
-	B1	300-450	Yellow	Gravelly silt sand	Massive	Some clay present	NA	10-20%	Present	No
	B2	450-1200	Red	Cemented material	Massive	Ferricrete	NA	30-50%	Present	Nil
Sample	B3	1200-2500	Red	Silty, sandy gravel	Nil	Decomposed materials	NA	Nil	Nil	Nil
	C1									

Photo 	Other comments:	Parent material:	Silt and sandstones
	Ferricrete is porous and massive	Surface drainage:	Good
		Surface slope:	1%
		Photos:	Yes
		Collector Name:	Simon Lott
		Signature:	
		Date:	25 th May 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	726351.725
Property:	Livingstone Valley	Paddock:	Hay	GPS Datum:	MGA 52	Northing:	8594481.066
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP01

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-20cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, partially leached			Y	N
	B1	20-30cm	Orangey yellow	Clayey, sandy silt	Massive				Y	N
	B2	30-65cm	Red	Silty (20-30%) clay (20-30%) with gravel	Massive				Y	N
	B3	65-90cm	Red / Yellow	Gravelly clay	Massive	Decomposed Ferricrete		Red, yellow	Y	N
	C1	90-120 cm		Ferricrete	Rock			Red, yellow	N	N

	Other comments: Refusal in Ferricrete at 1200mm						Parent material:	Sedimentary Formations
							Surface drainage	Good
							Surface slope:	1-2%
							Photos	Yes
							Collector Name	Simon Lott
							Signature:	
							Date:	11 th January 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	726324.579
Property:	Livingstone Valley	Paddock:	Hay	GPS Datum:	MGA 52	Northing:	8594799.029
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP02

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-20cm	Light yellow brown	Sandy silt	Massive	Saturated, weak			Y	N
	B1	20-30cm	Orangey yellow	Clayey, sandy silt	Massive	Graduated			Y	N
	B2	30-65cm	Red	Silty (20-30%) clay (20-30%) with gravel	Massive	Graduated			Y	N
	B3	65-85cm	Red / Yellow	Gravelly clay	Massive	Decomposed Ferricrete		Red, yellow	Y	N
	C1	85-110 cm		Ferricrete	Rock			Red, yellow	N	N

	Other comments:	Parent material:	Sedimentary Formations
	Refusal into weathered ferricrete 1.1m Macro-pores noted at 1.1m	Surface drainage:	Good
		Surface slope:	1-2%
		Photos	Yes
		Collector Name	Simon Lott
		Signature:	
		Date:	11 th January 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	726101.855
Property:	Livingstone Valley	Paddock:	Hay	GPS Datum:	MGA 52	Northing:	8595411.443
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP03

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-30cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, leached			Y	N
	B1	30-40cm	Light orangey yellow	Clayey, sandy silt	Massive	Graduated			Y	N
	B2	40-60cm	Red	Silty (20-30%) clay (20-30%) with gravel	Massive	Graduated			Y	N
	B3	60-85cm	Red / Yellow	Gravelly clay	Massive	Decomposed Ferricrete		Red, yellow	Y	N
	C1	85-115 cm		Ferricrete	Rock			Red, yellow	N	N

	Other comments: Refusal at 1150mm on Ferricrete Water ingress at 1100mm; standing water level at 1500mm						Parent material:	Sedimentary Formations
							Surface drainage	Good
							Surface slope:	1-2%
							Photos	Yes
							Collector Name	Simon Lott
							Signature:	
							Date:	11 th January 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	725744.945
Property:	Livingstone Valley	Paddock:	Gravel Pit	GPS Datum:	MGA 52	Northing:	8595162.627
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP04

Profile Description:										
Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-35cm	Light grey	Clayey, sandy gravel		Course gravel; saturated, carrying water			Y	N
	B1	35-50cm	Light orangey yellow	Clayey, sandy silt	Massive	Graduated			Y	N
	B2	50-60cm	Red	Silty clay with gravel	Massive	Graduated			Y	N
	B3	60-85cm	Red / Yellow	Clayey Gravelly	Massive	Decomposed Ferricrete; saturated, carrying water		Red, yellow	Y	N
	C1	85-115 cm		Ferricrete	Rock			Red, yellow	N	N



Other comments: Transient flowing water in A2 horizon overlying B1 Transient flow in B2 overlying Ferricrete	Parent material:	Sedimentary Formations
	Surface drainage	Good
	Surface slope:	2-3%
	Photos	Yes
	Collector Name	Simon Lott
	Signature:	
	Date:	11 th January 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	725932.016
Property:	Livingstone Valley	Paddock:	Below Stables	GPS Datum:	MGA 52	Northing:	8594944.791
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP05

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-15cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	15-30cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, leached			Y	N
	B1	30-45cm	Light orangey yellow	Clayey, sandy silt	Massive	Graduated			Y	N
	B2	40-75cm	Red	Silty clay with gravel	Massive	Graduated			Y	N
	B3	75-90cm	Red / Yellow	Gravelly clay	Massive	Decomposed Ferricrete		Red, yellow	Y	N
	C1	90-115 cm		Ferricrete	Rock			Red, yellow	N	N



Other comments: Transient flows in B3 Water rises through Ferricrete through macro pores	Parent material:	Sedimentary Formations
	Surface drainage	Good
	Surface slope:	1-2%
	Photos	Yes
	Collector Name	Simon Lott
	Signature:	
	Date:	11 th January 2015

Document Owner:	EA Alliance	Author:	G. Chase / S.C. Lott	Status:	Approved	Form_06026_A
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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	725986.673
Property:	Livingstone Valley	Paddock:	Below Stables	GPS Datum:	MGA 52	Northing:	8594687.614
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP06

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-35cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, leached, with enclaves of gravel			Y	N
	B1	35-50cm	Red	Clayey, sandy silt	Massive	Graduated			Y	N
	B2	50-65cm	Red	Silty clay trace of gravel	Massive	Graduated; thin layer of decomposed Ferricrete; variable in thickness			Y	N
	C1	65-75 cm		Ferricrete	Rock	Very hard		Red, yellow	Y	N

	Other comments:	Parent material:	Sedimentary Formations
	Quartz gravel enclaves in B1 and B2; very angular	Surface drainage	Good
	Refusal at 70cm	Surface slope:	1-2%
	Shallow profile on the lower slope close to the railway line	Photos	Yes
	Down boundary fence below old machinery shed	Collector Name	Simon Lott
		Signature:	
		Date:	11 th January 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	725744.548
Property:	Livingstone Valley	Paddock:	Machinery Shed	GPS Datum:	MGA 52	Northing:	8594917.168
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP07

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-20cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, partially leached			Y	N
	B1	20-30cm	Orangey yellow	Clayey, sandy silt	Massive				Y	N
	B2	30-65cm	Red	Silty (20-30%) clay (20-30%) with gravel	Massive				Y	N
	B3	65-80cm	Red / Yellow	Gravelly clay	Massive	Decomposed Ferricrete		Red, yellow	Y	N
	C1	80-110 cm	Red/yellow	Ferricrete	Massive	Blocky ferricrete		Red, yellow	Y	Y
	C2	110-150cm	Reddish yellow	Cleyey gravel	Nil	Gravel <30mm sub angular-rounded		Nil	Y	N

	Other comments: Ferricrete weaker than in other test pits; broke through Ferricrete; clayey gravel beneath; bulk sample collected.						Parent material:	Sedimentary Formations
							Surface drainage	Good
							Surface slope:	0-1 %
							Photos	Yes
							Collector Name	Simon Lott
							Signature:	
							Date:	11 th January 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	725592.224
Property:	Livingstone Valley	Paddock:	Bottom paddock (southern)	GPS Datum:	MGA 52	Northing:	8595066.05
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP08

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-35cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, leached, with enclaves of gravel			Y	N
	B1	35-40cm	Red	Clayey, sandy silt	Massive	Graduated; thin layer of decomposed Ferricrete; variable in thickness			Y	N
	C1	40-45 cm		Ferricrete	Rock	Very hard		Red, yellow	N	N



Other comments: Very shallow profile. Some water transient above ferricrete.	Parent material:	Sedimentary Formations
	Surface drainage	Good
	Surface slope:	1-2%
	Photos	Yes
	Collector Name	Simon Lott
	Signature:	
	Date:	11 th January 2015

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Document Owner:	EA Alliance	Author:	G. Chase / S.C. Lott	Status:	Approved	Form_06026_A
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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	725540.281
Property:	Livingstone Valley	Paddock:	Below Stables	GPS Datum:	MGA 52	Northing:	8595350.255
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP09

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-15cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	15-30cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, leached			Y	N
	B1	30-50cm	Light orangey yellow	Clayey, sandy silt	Massive	Graduated			Y	N
	B2	50-55cm	Red	Silty clay with gravel	Massive	Graduated			Y	N
	C1	55+ cm	Red/yellow	Ferricrete	Massive	Very hard		Red, yellow	Y	Y

	Other comments:	Parent material:	Sedimentary Formations
	Land very saturated and soft Test pit filled with water from transient flows	Surface drainage	Very poor
		Surface slope:	<1 %
		Photos	Yes
		Collector Name	Simon Lott
		Signature:	
		Date:	11 th January 2015

Document Owner:	EA Alliance	Author:	G. Chase / S.C. Lott	Status:	Approved	Form_06026_A
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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard Rural	Project No:	23870	GPS Zone	52	Easting:	725404.868
Property:	Livingstone Valley	Paddock:	Bottom NW	GPS Datum:	MGA 52	Northing:	8595470.775
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Grass	BH or TP No:	TP10

Profile Description:

Sample No	Horizon	Horizon depth	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
	A1	0-10cm	Dark brown	Sandy Silt Trace of clay	Massive	Humic layer at a A0; minor gravel		Nil	Lots	N
	A2	10-30cm	Light yellow brown	Sandy silt	Massive	Saturated, weak, leached			Y	N
	B1	30-50cm	Light orangey yellow	Clayey, sandy silt	Massive	Saturated, graduated			Y	N
	B2	40-75cm	Red	Silty clay with gravel	Massive	Graduated			Y	N
	B3	75-100cm	Red / Yellow	Gravelly clay	Massive	Decomposed Ferricrete		Red, yellow	Y	N
	C1	100+ cm	Red/yellow	Ferricrete	Massive	Hard		Red, yellow	Y	Y

Other comments: Land very saturated and soft A2 + B1 deep and very weak Back hoe bogged. Test pit filled with water from transient flows	Parent material:	Sedimentary Formations
	Surface drainage	Very poor
	Surface slope:	<1 %
	Photos	No
	Collector Name	Simon Lott
	Signature:	
	Date:	11 th January 2015

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Form_06026_A	Agronomic Soil Sampling Report Sheet	EA Alliance
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Client:	Wellard	Project No:	23919	GPS Zone	56	Easting:	725869
Property:	Livingstone	Paddock:	NA	GPS Datum:	MGA	Northing:	8594892
Aspect:	Westerly	Current land use:	Grazing	Vegetation:	Pasture	BH or TP No:	D

Profile Description:

Sample No	Horizon	Horizon depth (mm)	Munsell Colour	Texture	Structure	Comments	pH	Mottles	Roots	Cracks
-	A1	0-100	Brown Grey	Silty Sand	Nil	Low organic matter levels	NA	Nil	Present	No
-	A2	100-250	Light grey	Sand	Nil	Bleached	NA	Nil	Present	No
-	B1	250-450	Yellow	Sand	Massive	Silt and some clay present	NA	10-20%	Present	No
	B2	450-1800	Red	Cemented material	Massive	Ferricrete	NA	30-50%	Present	Nil
Sample	B3	1800-2500	Red	Silty, sandy gravel	Nil	Decomposed materials	NA	Nil	Nil	Nil
	C1									

Photo 	Other comments:	Parent material:	Silt and sandstones
		Surface drainage:	Good
		Surface slope:	1%
		Photos:	Yes
		Collector Name:	Simon Lott
		Signature:	
		Date:	25 th May 2015

Document Owner:	EA Alliance	Author:	G. Chase / S.C. Lott	Status:	Approved	Form_06026_A
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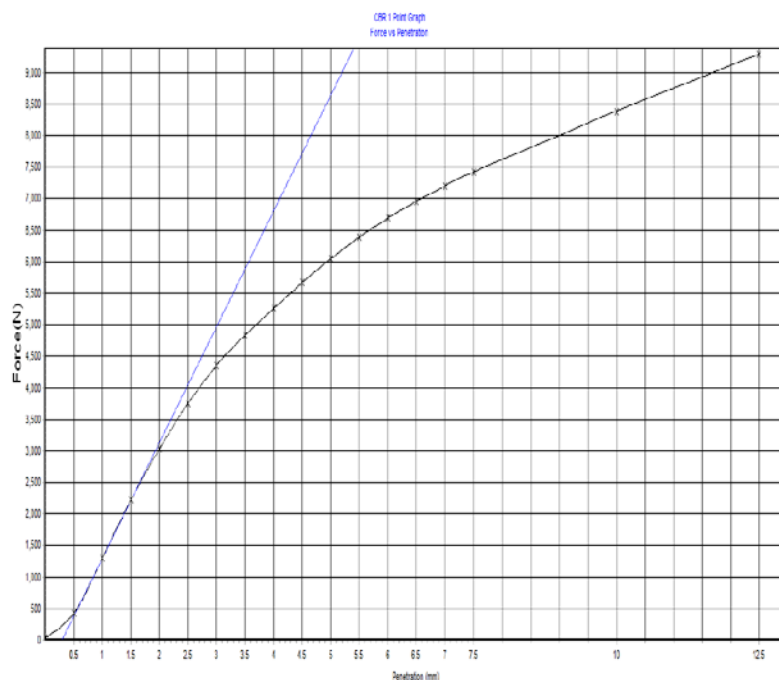
Appendix D California Bearing Ratio Report

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 1
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/02/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 1 of 2	

Sample Number :	15231	SAMPLE LOCATION	
Date Sampled :	2/02/2015	Test Pit 7	
Date Tested :	13/02/2015	Wellard Rural	
Sampled By :	Client		
Sampling Method :	As Received		
Material Source :	Darwin	Lot Number :	
Material Type :	-	Test Number :	
Remarks :			

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.885
Optimum Moisture Content (%) :	16.2
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	99.0
Dry Density Before Soak (t/m ³) :	1.885
Dry Density After Soak (t/m ³) :	1.885
Moisture Content Before Soak (%) :	16.0
Moisture Content After Soak (%) :	17.5
Density Ratio After Soak (%) :	100
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	17.8
Total Moisture Content - After Penetration (%) :	16.9
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	30
CBR 5.0mm (%) :	30
CBR Value (%) :	30

Site Selection :	Client Selected
Soil Description :	Orange Gravelly Sandy Silty Clay



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Drew Obst

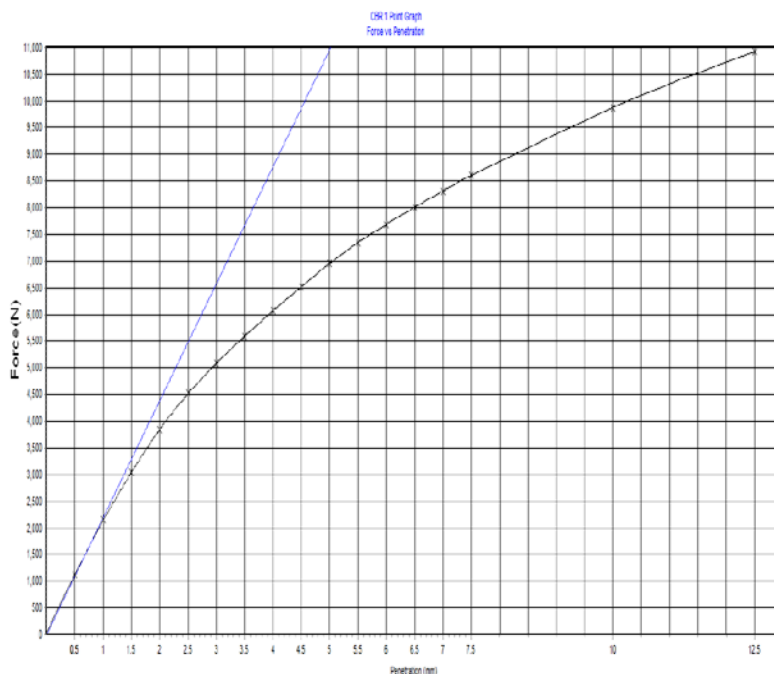
Drew Obst - Technical Manager
NATA Accreditation Number :
2117

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 1
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/02/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 2 of 2	

Sample Number :	15366	SAMPLE LOCATION	
Date Sampled :	2/02/2015	Test Pit 7	
Date Tested :	9/02/2015	Wellard Rural	
Sampled By :	Client		
Sampling Method :	As Received		
Material Source :	Darwin	Lot Number :	
Material Type :	-	Test Number :	
Remarks :			

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.885
Optimum Moisture Content (%) :	16.2
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100.5
Achieved Percentage of OMC :	97.5
Dry Density Before Soak (t/m ³) :	1.891
Dry Density After Soak (t/m ³) :	-
Moisture Content Before Soak (%) :	15.8
Moisture Content After Soak (%) :	-
Density Ratio After Soak (%) :	-
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	-
Total Moisture Content - After Penetration (%) :	15.9
Soak Condition :	Unsoaked
Soak Period (days) :	-
Swell (%) :	-
CBR Surcharge (kg) :	-
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	35
CBR 5.0mm (%) :	35
CBR Value (%) :	35

Site Selection :	Client Selected
Soil Description :	Orange Gravelly Sandy Silty Clay



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Drew Obst

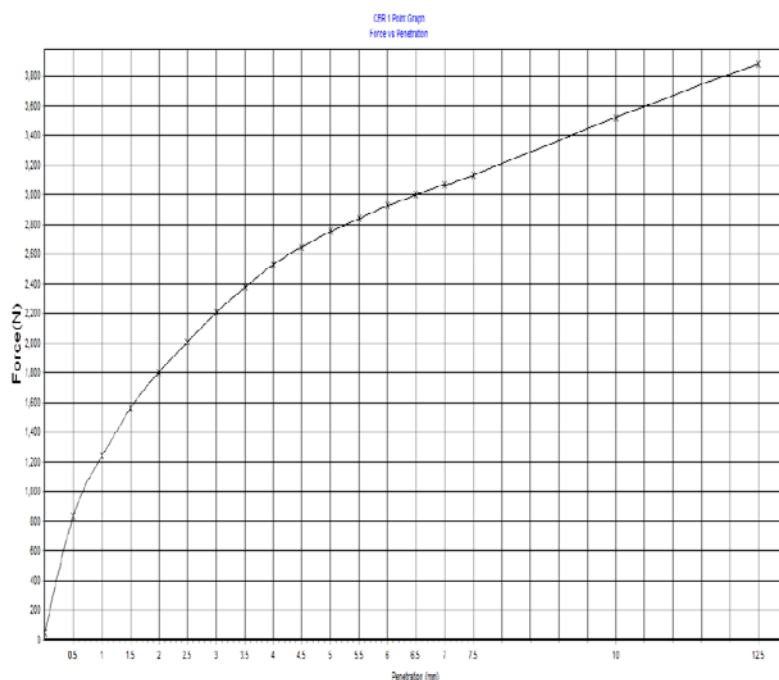
Drew Obst - Technical Manager
NATA Accreditation Number :
2117

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 1 of 8	

Sample Number :	151817	SAMPLE LOCATION	
Date Sampled :	2/06/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit A	
Sampling Method :	As Received	# 1	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.758
Optimum Moisture Content (%) :	18.6
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	99.5
Achieved Percentage of OMC :	103.0
Dry Density Before Soak (t/m ³) :	1.751
Dry Density After Soak (t/m ³) :	1.75
Moisture Content Before Soak (%) :	19.1
Moisture Content After Soak (%) :	20.6
Density Ratio After Soak (%) :	99
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	21.5
Total Moisture Content - After Penetration (%) :	20.1
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	15
CBR 5.0mm (%) :	14
CBR Value (%) :	15

Site Selection :	Client Selected
Soil Description :	Red Brown Gravelly Silty Sandy Clay



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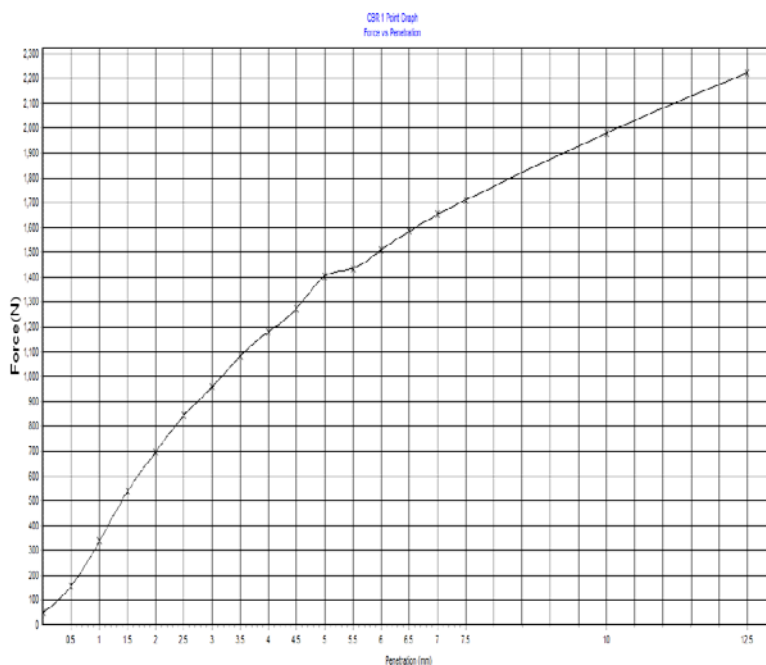
Tim Miller - Technician
NATA Accreditation Number :
2117

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 2 of 8	

Sample Number :	151818	SAMPLE LOCATION	
Date Sampled :	2/06/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit A	
Sampling Method :	As Received	# 2	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.674
Optimum Moisture Content (%) :	19.3
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	102.0
Dry Density Before Soak (t/m ³) :	1.671
Dry Density After Soak (t/m ³) :	1.64
Moisture Content Before Soak (%) :	19.7
Moisture Content After Soak (%) :	23.3
Density Ratio After Soak (%) :	98
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	27.2
Total Moisture Content - After Penetration (%) :	22.8
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	2.0
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	7
CBR 5.0mm (%) :	7
CBR Value (%) :	7

Site Selection :	Client Selected
Soil Description :	Pale Brown Sandy Silty Clay



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Tim Miller

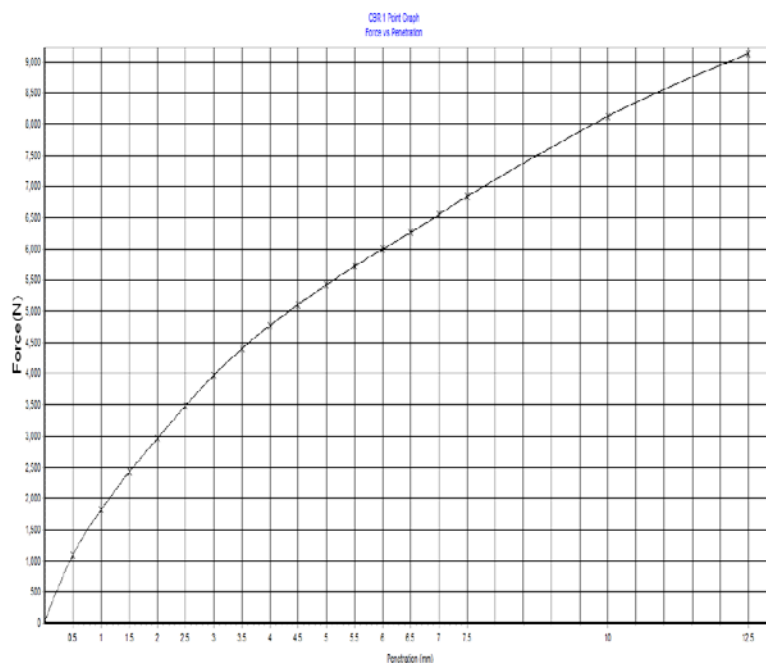
Tim Miller - Technician
NATA Accreditation Number :
2117

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 3 of 8	

Sample Number :	151819	SAMPLE LOCATION	
Date Sampled :	2/06/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit B	
Sampling Method :	As Received	#3	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.943
Optimum Moisture Content (%) :	14.3
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	101.5
Dry Density Before Soak (t/m ³) :	1.940
Dry Density After Soak (t/m ³) :	1.94
Moisture Content Before Soak (%) :	14.5
Moisture Content After Soak (%) :	15.5
Density Ratio After Soak (%) :	100
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	16.4
Total Moisture Content - After Penetration (%) :	14.8
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	25
CBR 5.0mm (%) :	25
CBR Value (%) :	25

Site Selection :	Client Selected
Soil Description :	Orange Brown Gravelly Silty Sandy Clay



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Full

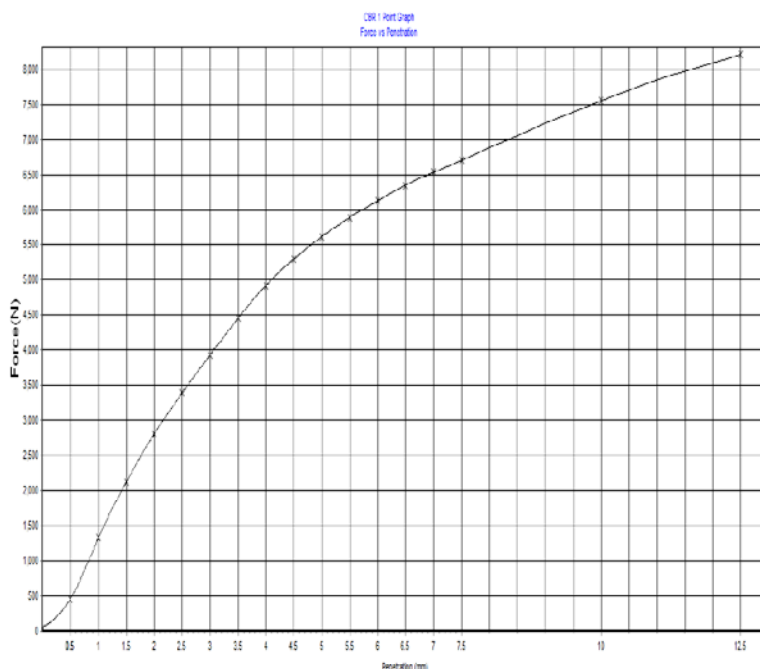
Tim Miller - Technician
NATA Accreditation Number :
2117

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 4 of 8	

Sample Number :	151820	SAMPLE LOCATION	
Date Sampled :	2/06/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit B	
Sampling Method :	As Received	# 4	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.912
Optimum Moisture Content (%) :	14.1
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	99.5
Achieved Percentage of OMC :	102.5
Dry Density Before Soak (t/m ³) :	1.907
Dry Density After Soak (t/m ³) :	1.91
Moisture Content Before Soak (%) :	14.4
Moisture Content After Soak (%) :	15.6
Density Ratio After Soak (%) :	100
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	16.5
Total Moisture Content - After Penetration (%) :	14.8
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	30
CBR 5.0mm (%) :	30
CBR Value (%) :	30

Site Selection :	Client Selected
Soil Description :	Orange Brown Silty Sandy Clay



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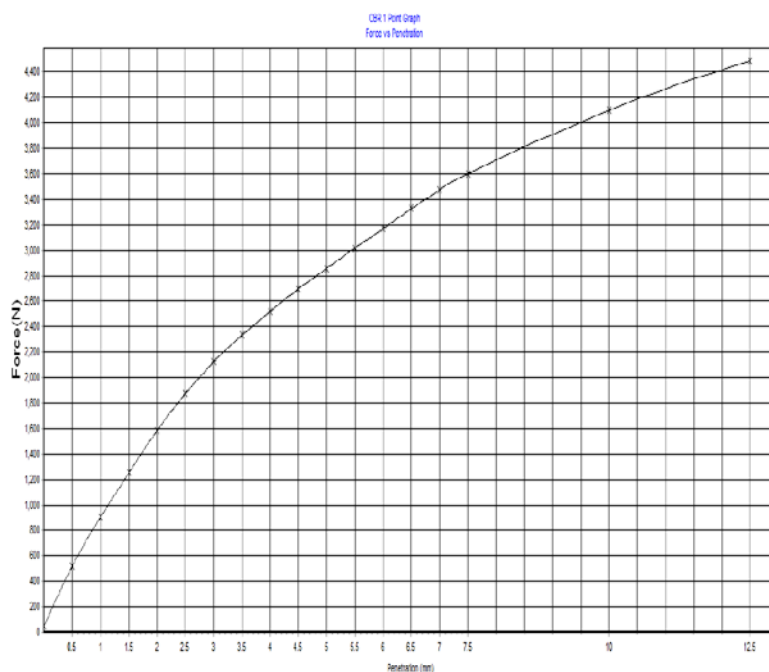
Tim Miller - Technician
NATA Accreditation Number :
2117

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 5 of 8	

Sample Number :	151971	SAMPLE LOCATION	
Date Sampled :	19/05/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit A	
Sampling Method :	As Received	# 1	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.758
Optimum Moisture Content (%) :	18.6
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	99.5
Achieved Percentage of OMC :	103.0
Dry Density Before Soak (t/m ³) :	1.751
Dry Density After Soak (t/m ³) :	-
Moisture Content Before Soak (%) :	19.1
Moisture Content After Soak (%) :	-
Density Ratio After Soak (%) :	-
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	-
Total Moisture Content - After Penetration (%) :	-
Soak Condition :	Unsoaked
Soak Period (days) :	-
Swell (%) :	-
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	14
CBR 5.0mm (%) :	14
CBR Value (%) :	14

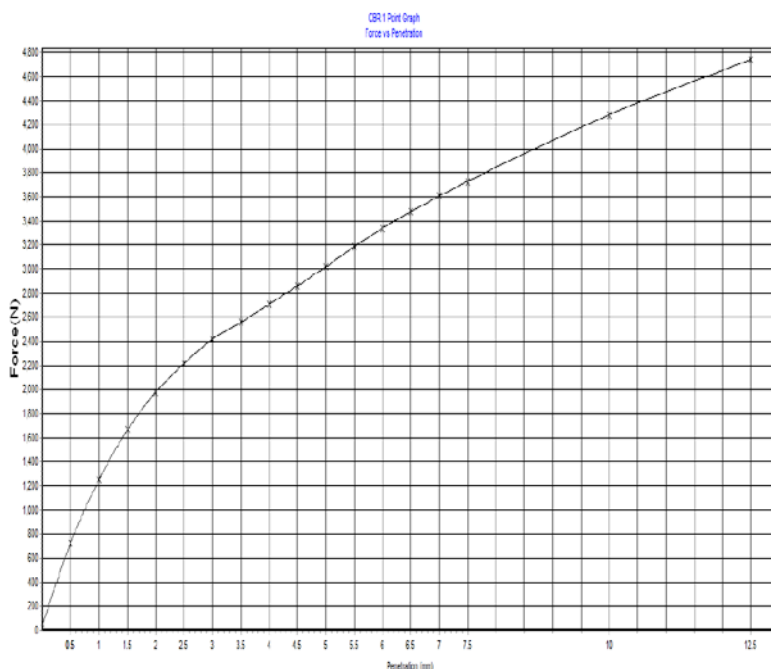
Site Selection :	Client Selected
Soil Description :	Red Brown Gravelly Silty Sandy Clay

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 6 of 8	

Sample Number :	151972	SAMPLE LOCATION	
Date Sampled :	19/05/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit A	
Sampling Method :	As Received	# 2	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.674
Optimum Moisture Content (%) :	19.3
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	102.0
Dry Density Before Soak (t/m ³) :	1.671
Dry Density After Soak (t/m ³) :	-
Moisture Content Before Soak (%) :	19.7
Moisture Content After Soak (%) :	-
Density Ratio After Soak (%) :	-
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	-
Total Moisture Content - After Penetration (%) :	-
Soak Condition :	Unsoaked
Soak Period (days) :	-
Swell (%) :	-
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-

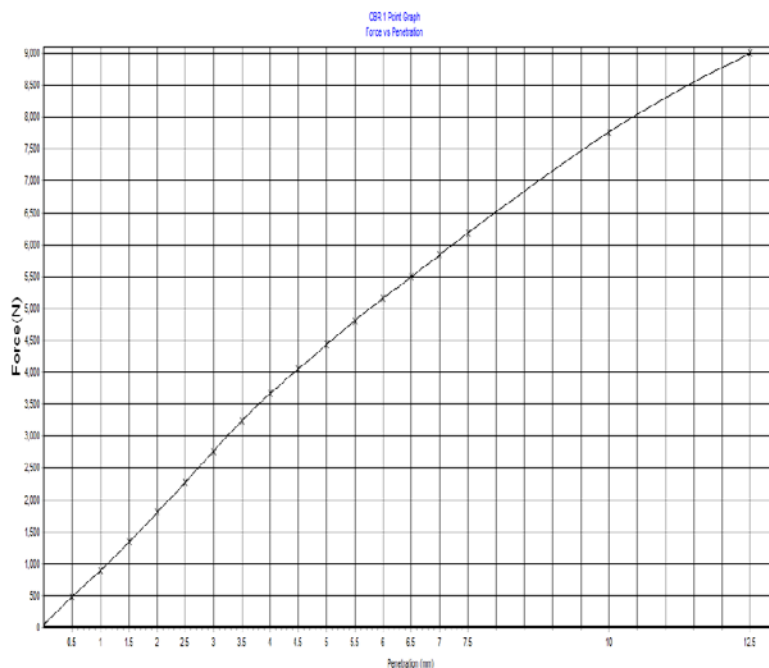


California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 7 of 8	

Sample Number :	151973	SAMPLE LOCATION	
Date Sampled :	19/05/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit B	
Sampling Method :	As Received	#3	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.943
Optimum Moisture Content (%) :	14.3
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	101.5
Dry Density Before Soak (t/m ³) :	1.940
Dry Density After Soak (t/m ³) :	-
Moisture Content Before Soak (%) :	14.5
Moisture Content After Soak (%) :	-
Density Ratio After Soak (%) :	-
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	-
Total Moisture Content - After Penetration (%) :	-
Soak Condition :	Unsoaked
Soak Period (days) :	-
Swell (%) :	-
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	18
CBR 5.0mm (%) :	25
CBR Value (%) :	25

Site Selection :	Client Selected
Soil Description :	Orange Brown Gravelly Silty Sandy Clay



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Tim Miller

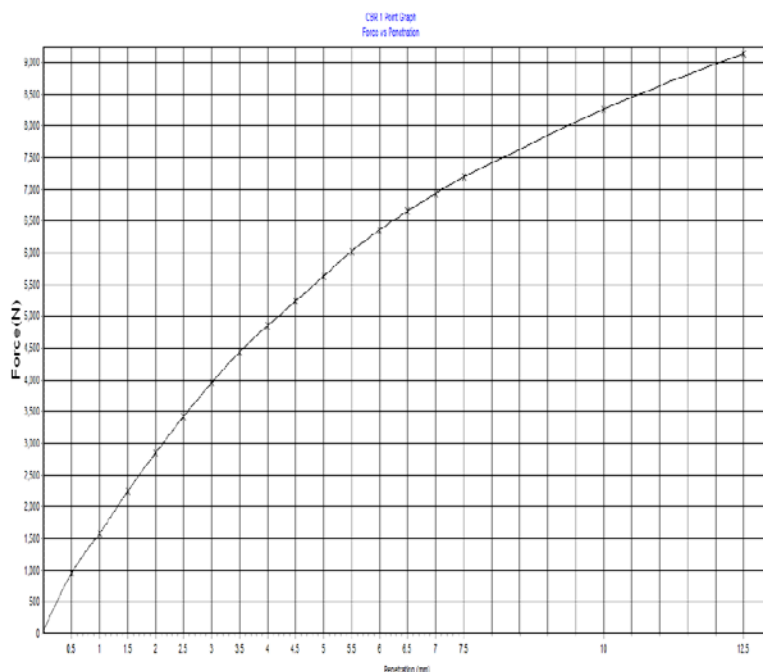
Tim Miller - Technician
NATA Accreditation Number :
2117

California Bearing Ratio Report (1 Point)

Client :	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 8
Address :	Po Box 1775, Armidale, QLD, 2350	Report Date :	16/06/2015
Project Number :	15019	Order Number :	
Project Name :	Material Testing	Test Method :	AS1289.6.1.1
Location:	Wellard Rural , Toowoomba	Page 8 of 8	

Sample Number :	151974	SAMPLE LOCATION	
Date Sampled :	19/05/2015	Wellard Rural	
Date Tested :	15/06/2015	Darwin	
Sampled By :	Client	Test Pit B	
Sampling Method :	As Received	# 4	
Material Source :	Supplied		
Material Type :	-		
Remarks :	-		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m ³) :	1.912
Optimum Moisture Content (%) :	14.1
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	102.0
Dry Density Before Soak (t/m ³) :	1.907
Dry Density After Soak (t/m ³) :	-
Moisture Content Before Soak (%) :	14.4
Moisture Content After Soak (%) :	-
Density Ratio After Soak (%) :	-
Field Moisture Content (%) :	-
Top Moisture Content - After Penetration (%) :	-
Total Moisture Content - After Penetration (%) :	-
Soak Condition :	Unsoaked
Soak Period (days) :	-
Swell (%) :	-
CBR Surcharge (kg) :	4.75
Oversize (%) :	0
Oversize Material Replaced (%) :	-



CBR 2.5mm (%) :	25
CBR 5.0mm (%) :	30
CBR Value (%) :	30

Site Selection :	Client Selected
Soil Description :	Orange Brown Gravelly Silty Sandy Clay



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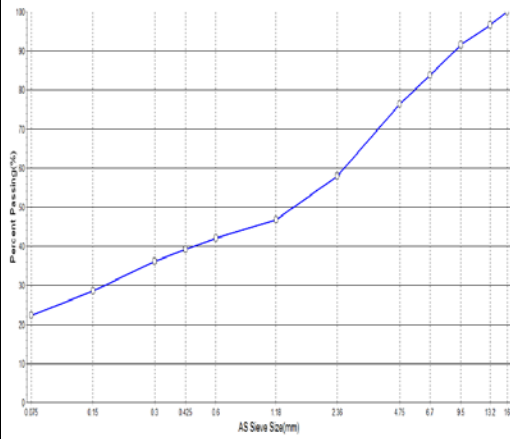
Full

Tim Miller - Technician
NATA Accreditation Number :
2117

Appendix E Quality of Materials Report

Quality of Materials Report

Client:	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 2
Client Address:	Po Box 1775 Armidale QLD 2350	Report Date:	16/02/2015
Job Number:	15019	Order Number:	-
Project:	Material Testing	Page 1 of 1	
Location:	Wellard Rural , Toowoomba	Sample Location	
Lab No:	15231	Test Pit 7	
Date Sampled:	2/02/2015	Wellard Rural	
Date Tested:	5/02/2015	Spec Description: -	
Sampled By:	Client	Lot Number: -	
Sample Method:	As Received	Spec Number: -	
Material Source:	Darwin		
For Use As:	-		
Remarks:	-		

Test Method:	A.S. Sieve Sizes	Specification Minimum	Percent Passing	Specification Maximum
	75.00 mm			
	53.00 mm			
	37.50 mm			
	26.50 mm			
	19.00 mm		100	
	13.2 mm		97	
	9.50 mm		91	
	6.7 mm		84	
	4.75 mm		76	
	2.36 mm		58	
	1.18 mm		47	
	0.600 mm		42	
	0.425 mm		39	
	0.300 mm		36	
	0.150 mm		29	
	0.075 mm		22	
AS1726 Soil Classification: -				

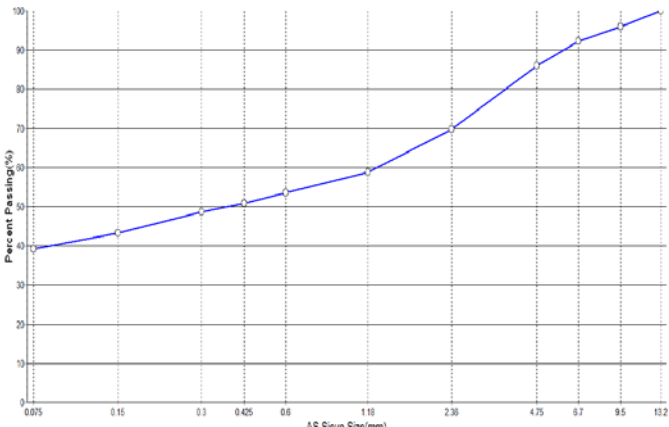
Atterberg Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289.3.9.2		47	
Plastic Limit (%)	AS1289.3.2.1		19	
Plasticity Index	AS1289.3.3.1		28	
Linear Shrinkage (%)	AS1289.3.4.1		12.5	

 Accredited for compliance with ISO / IEC 17025	Approved Signatory	Form Number
	 Drew Obst - Technical Manager NATA Accred No:2117	AQUAL-REP-3

Get it Right from the Ground Up

Quality of Materials Report

Client:	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 9
Client Address:	Po Box 1775 Armidale QLD 2350	Report Date:	17/06/2015
Job Number:	15019	Order Number:	-
Project:	Material Testing	Page 1 of 4	
Location:	Wellard Rural , Toowoomba	Sample Location	
Lab No:	151817	Wellard Rural	
Date Sampled:	2/06/2015	Darwin	
Date Tested:	15/06/2015	Test Pit A	
Sampled By:	Client	#1	
Sample Method:	As Received	Spec Description: -	
Material Source:	Supplied	Lot Number: -	
For Use As:	-	Spec Number: -	
Remarks:	-		

Test Method:	AS1289.3.6.1	A.S. Sieve Sizes	Specification Minimum	Percent Passing	Specification Maximum
		75.00 mm			
		53.00 mm			
		37.50 mm			
		26.50 mm			
		19.00 mm			
		13.2 mm		100	
		9.50 mm		96	
		6.7 mm		92	
		4.75 mm		86	
		2.36 mm		70	
		1.18 mm		59	
		0.600 mm		54	
		0.425 mm		51	
		0.300 mm		49	
		0.150 mm		43	
		0.075 mm		39	
AS1726 Soil Classification: -					

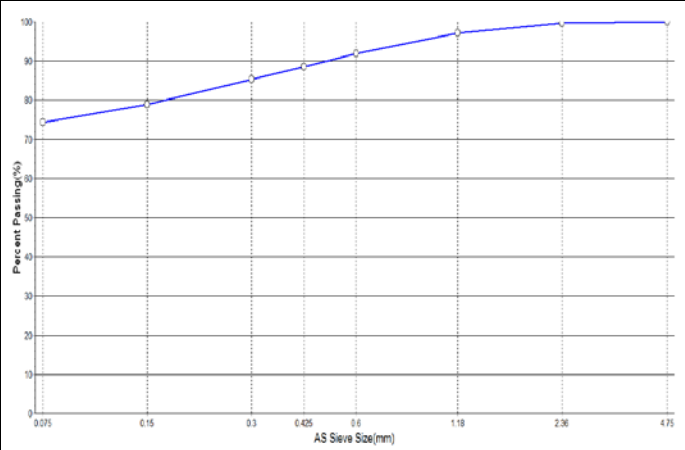
Atterberg Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289.3.9.2		51	
Plastic Limit (%)	AS1289.3.2.1		24	
Plasticity Index	AS1289.3.3.1		27	
Linear Shrinkage (%)	AS1289.3.4.1		11.5	
P.I. x % Passing 0.425 mm			1377	
L.S. x % Passing 0.425 mm			586.5	
Ratio of % Passing (0.075 / 0.425)			0.76	

 Accredited for compliance with ISO / IEC 17025	Approved Signatory	Form Number
	 Tim Miller - Senior Technician NATA Accred No:2117	AQUAL-REP-3

Get it Right from the Ground Up

Quality of Materials Report

Client:	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 9
Client Address:	Po Box 1775 Armidale QLD 2350	Report Date:	17/06/2015
Job Number:	15019	Order Number:	-
Project:	Material Testing	Page 2 of 4	
Location:	Wellard Rural , Toowoomba	Sample Location	
Lab No:	151818	Wellard Rural	
Date Sampled:	2/06/2015	Darwin	
Date Tested:	15/06/2015	Test Pit A	
Sampled By:	Client	#2	
Sample Method:	As Received	Spec Description: -	
Material Source:	Supplied	Lot Number: -	
For Use As:	-	Spec Number: -	
Remarks:	-		

Test Method:	A.S. Sieve Sizes	Specification Minimum	Percent Passing	Specification Maximum
	75.00 mm			
	53.00 mm			
	37.50 mm			
	26.50 mm			
	19.00 mm			
	13.2 mm			
	9.50 mm			
	6.7 mm			
	4.75 mm		100	
	2.36 mm		100	
	1.18 mm		97	
	0.600 mm		92	
	0.425 mm		89	
	0.300 mm		85	
	0.150 mm		79	
	0.075 mm		74	
AS1726 Soil Classification: -				

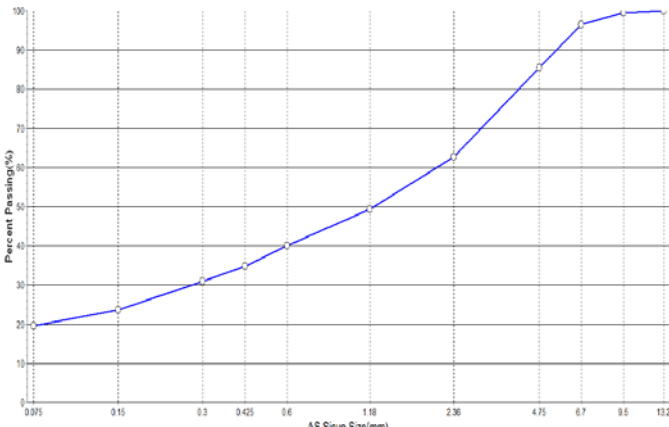
Atterberg Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289.3.9.2		52	
Plastic Limit (%)	AS1289.3.2.1		22	
Plasticity Index	AS1289.3.3.1		30	
Linear Shrinkage (%)	AS1289.3.4.1		13.0	
P.I. x % Passing 0.425 mm			2848	
L.S. x % Passing 0.425 mm			1157	
Ratio of % Passing (0.075 / 0.425)			0.83	

 Accredited for compliance with ISO / IEC 17025	Approved Signatory	Form Number
	 Tim Miller - Senior Technician NATA Accred No:2117	AQUAL-REP-3

Get it Right from the Ground Up

Quality of Materials Report

Client:	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 9
Client Address:	Po Box 1775 Armidale QLD 2350	Report Date:	17/06/2015
Job Number:	15019	Order Number:	-
Project:	Material Testing	Page 3 of 4	
Location:	Wellard Rural , Toowoomba	Sample Location	
Lab No:	151819	Wellard Rural	
Date Sampled:	2/06/2015	Darwin	
Date Tested:	15/06/2015	Test Pit B	
Sampled By:	Client	#3	
Sample Method:	As Received	Spec Description: -	
Material Source:	Supplied	Lot Number: -	
For Use As:	-	Spec Number: -	
Remarks:	-		

Test Method:	AS1289.3.6.1	A.S. Sieve Sizes	Specification Minimum	Percent Passing	Specification Maximum
		75.00 mm			
		53.00 mm			
		37.50 mm			
		26.50 mm			
		19.00 mm			
		13.2 mm		100	
		9.50 mm		99	
		6.7 mm		96	
		4.75 mm		85	
		2.36 mm		63	
		1.18 mm		49	
		0.600 mm		40	
		0.425 mm		35	
		0.300 mm		31	
		0.150 mm		24	
		0.075 mm		20	
AS1726 Soil Classification: -					

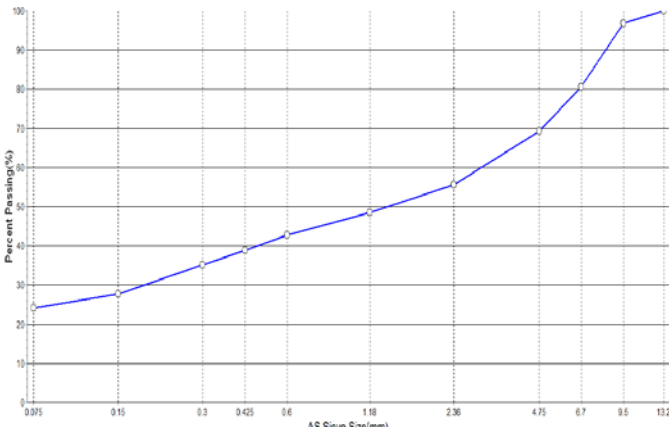
Atterberg Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289.3.9.2		41	
Plastic Limit (%)	AS1289.3.2.1		20	
Plasticity Index	AS1289.3.3.1		21	
Linear Shrinkage (%)	AS1289.3.4.1		8.5	
P.I. x % Passing 0.425 mm			770	
L.S. x % Passing 0.425 mm			297.5	
Ratio of % Passing (0.075 / 0.425)			0.57	

	Accredited for compliance with ISO / IEC 17025	Approved Signatory	Form Number
		 Tim Miller - Senior Technician NATA Accred No:2117	AQUAL-REP-3

Get it Right from the Ground Up

Quality of Materials Report

Client:	Enviro Ag Australia Pty Ltd	Report Number:	15019 - 9
Client Address:	Po Box 1775 Armidale QLD 2350	Report Date:	17/06/2015
Job Number:	15019	Order Number:	-
Project:	Material Testing	Page 4 of 4	
Location:	Wellard Rural , Toowoomba	Sample Location	
Lab No:	151820	Wellard Rural	
Date Sampled:	2/06/2015	Darwin	
Date Tested:	15/06/2015	Test Pit B	
Sampled By:	Client	#4	
Sample Method:	As Received	Spec Description: -	
Material Source:	Supplied	Lot Number: -	
For Use As:	-	Spec Number: -	
Remarks:	-		

Test Method:	AS1289.3.6.1	A.S. Sieve Sizes	Specification Minimum	Percent Passing	Specification Maximum
		75.00 mm			
		53.00 mm			
		37.50 mm			
		26.50 mm			
		19.00 mm			
		13.2 mm		100	
		9.50 mm		97	
		6.7 mm		81	
		4.75 mm		69	
		2.36 mm		56	
		1.18 mm		48	
		0.600 mm		43	
		0.425 mm		39	
		0.300 mm		35	
		0.150 mm		28	
		0.075 mm		24	
AS1726 Soil Classification: -					

Atterberg Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289.3.9.2		37	
Plastic Limit (%)	AS1289.3.2.1		18	
Plasticity Index	AS1289.3.3.1		19	
Linear Shrinkage (%)	AS1289.3.4.1		9.5	
P.I. x % Passing 0.425 mm			780	
L.S. x % Passing 0.425 mm			370.5	
Ratio of % Passing (0.075 / 0.425)			0.62	

 WORLD RECOGNISED ACCREDITATION	Accredited for compliance with ISO / IEC 17025	Approved Signatory	Form Number
		 Tim Miller - Senior Technician NATA Accred No:2117	AQUAL-REP-3

Appendix F P Isotherm Report



P ISOTHERM RESULTS

Client: Enviroag
Laboratory No: BA007505.001

Marking: TP1 - 30-60 BA006933.002

Colwell P mg/kg	0.39
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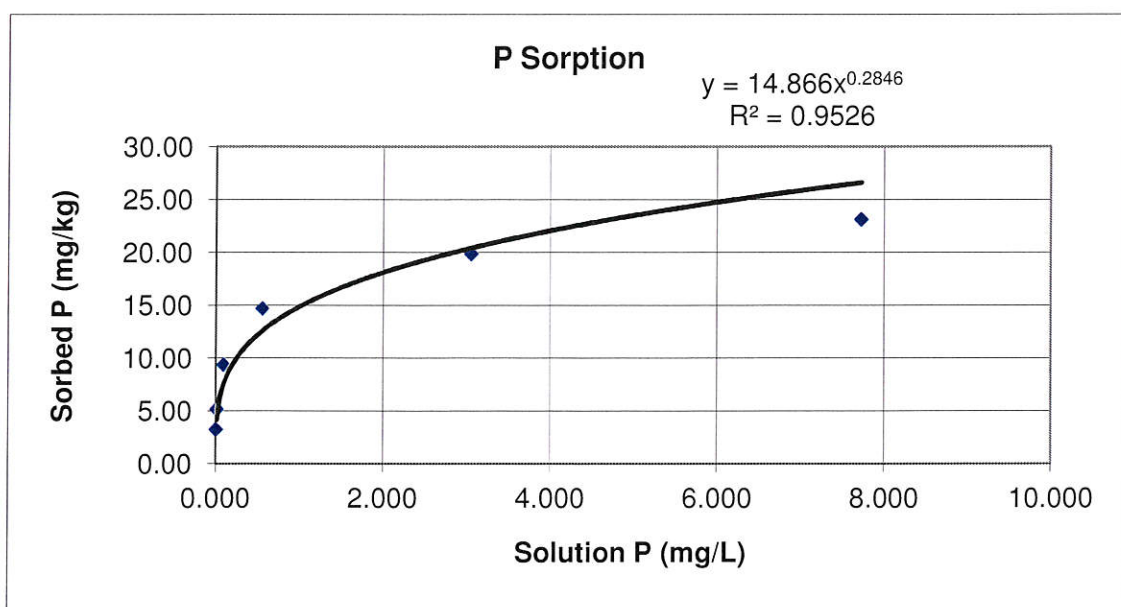
$$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$$

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
3	0.113673	0.3	0.011	3.28	4.16
5	0.204871	0.5	0.020	5.19	4.92
10	0.994061	1.0	0.099	9.40	7.71
20	5.66074	2.0	0.566	14.73	12.64
50	30.5032	5.0	3.050	19.89	20.42
100	77.2533	10.0	7.725	23.14	26.60

a	14.866
b	0.285
R ²	0.953

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
12	15	24	29	35	45





P ISOTHERM RESULTS

Client: Enviroag
Laboratory No: BA007505.002

Marking: TP2 - 30-60 BA006933.004

Colwell P mg/kg	0.39
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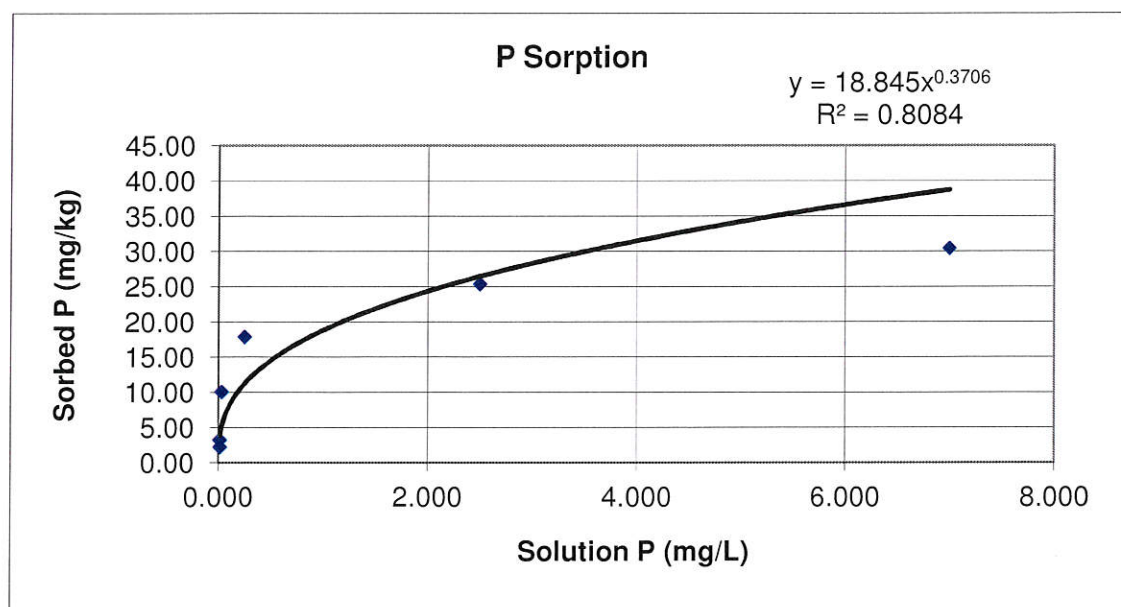
$$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$$

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
2	0.174372	0.2	0.017	2.22	4.20
3	0.14579	0.3	0.015	3.24	3.93
10	0.31531	1.0	0.032	10.07	5.23
20	2.50905	2.0	0.251	17.88	11.29
50	25.0139	5.0	2.501	25.38	26.47
100	69.9172	10.0	6.992	30.47	38.74

a	18.845
b	0.371
R ²	0.808

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
15	19	34	44	57	80





P ISOTHERM RESULTS

Client: Enviroag
Laboratory No: BA007505.003

Marking: TP3 - 30-60 BA006933.006

Colwell P mg/kg	0.33
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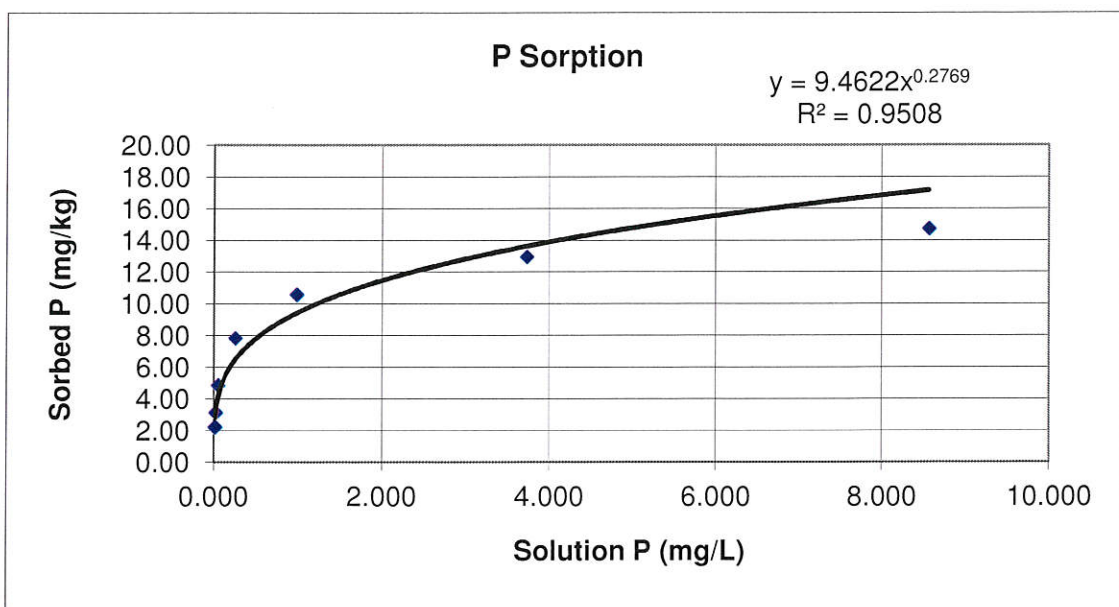
$$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$$

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
2	0.119276	0.2	0.012	2.21	2.78
3	0.210603	0.3	0.021	3.12	3.25
5	0.488704	0.5	0.049	4.84	4.10
10	2.50985	1.0	0.251	7.82	6.45
20	9.77268	2.0	0.977	10.56	9.40
50	37.3901	5.0	3.739	12.94	13.63
100	85.6165	10.0	8.562	14.71	17.15

a	9.462
b	0.277
R ²	0.951

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
8	9	15	18	22	28



Appendix G Falling Head Test Report

PERMEABILITY BY FALLING HEAD TEST REPORT

Test Method AS 1289 6.7.2, 5.1.1, KH2 (Based on K H Head (1988) Manual of Laboratory Testing, 10.7)

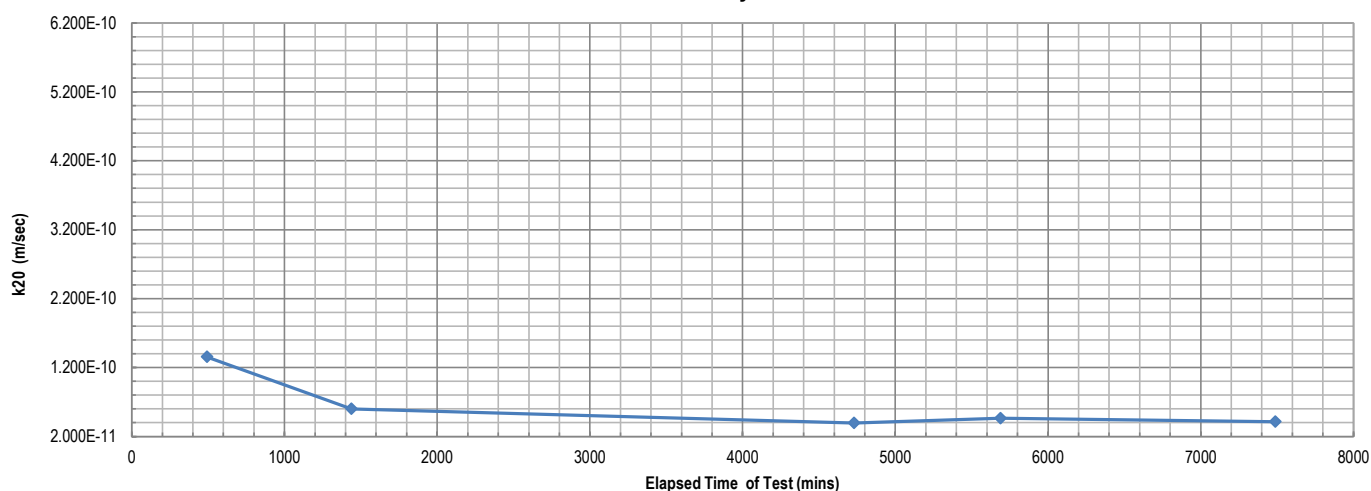
Client	Soiltech Testing Services Pty Ltd	Report No.	15020142-FHPT
Project	23870	Test Date	3/3/2015-9/3/2015
		Report Date	9/03/2015
Client ID	15231 TP7	Depth (m)	Not Supplied
Description	SANDY SILTY CLAY-red	Sample Type	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	AS1289.5.1.1 - Standard Compaction		
Maximum Dry Density (t/m ³)	1.89	Hydraulic Gradient	31.5
Optimum Moisture Content (%)	16.2	Surcharge (kPa)	0.0
Placement Moisture Content (%)	16.9	Head Pressure Applied (kPa)	12.36
Moisture Ratio (%)	104.1	Water Type	Deaerated
Placement Wet Density (t/m ³)	2.19	Percentage Material Retained/Sieve Size (mm)	0 % /9.5 mm
Density Ratio (%)	99.4	Sample Height and Diameter (mm)	40.02 / 61.8 mm

PERMEABILITY $k_{(20)} = 4.2 \times 10^{-11}$ (m/sec)

Permeability



Remarks: The above specimen was remoulded to a target of 100% of Standard Dry Density and at 100% of Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

Page: 1 of 1

REP06301

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory



C. Park



Laboratory No. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated.

Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details.

Trilab Pty Ltd ABN 25 065 630 506

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING