Geotechnical Investigation Report

29 Grey Street, Clarence Town, NSW, 2321

Submitted To

Williams River Steel

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1 Introduction

Williams River Steel has engaged Intrax Consulting Engineers Pty Ltd (Intrax) to conduct a geotechnical investigation for the proposed new bar, dining, and function centre development at 29 Grey Street, Clarence town, NSW, 2321.

The scope of work and terms and conditions of our engagement are set out in the Intrax-Client service agreement reference number JN142140 dated 22nd August 2024. Approval to proceed was given by Kris Webb via signed quotation document dated 20th August 2024.

1.1 Project Description

Williams River Steel has provided Intrax with layout drawings for review and to provide project background. The provided drawings, Job number JN613132, drawing number A03, Issue 3 dated 31st July 2024, demonstrate that the development shall comprise of a new proposed bar, dining, and function centre, with associated outdoor spaces, a grass courtyard, and a 36-space carpark, featuring designated entry and exit points to facilitate efficient vehicular access and circulation. The proposed foundation types, layouts or design loads have not been provided to Intrax for incorporation into this report. Intrax has assumed that there are no unusually high loads for this type of development.

1.2 Objectives and Scope

The objective of the investigation was to document ground and subsurface conditions in order to assess the founding conditions throughout the footprint of the proposed development.

The scope of work included:

- Preparation of health, safety, and environmental documents
- Mobilisation of staff and equipment including a preliminary desktop assessment and DBYD lodgement
- Engagement of suitable qualified subcontractors for underground service location
- Drilling of 4 boreholes to a maximum depth of 3 metres below ground level (mbgl) or early refusal
- Drilling of 6 boreholes to a maximum depth of 2 metres below ground level (mbgl) or early refusal
- Dynamic cone penetrometer (DCP) testing adjacent to borehole locations to depth of 1.5m
- NATA accredited laboratory testing of selected samples
- Reinstatement of boreholes with soil cuttings for make safe
- Analysis and review of field geotechnical test information and the preparation of this report.

The objectives of this report are to:

- Present the findings of the geotechnical site investigation
- Geological, topographical and land use setting
- Classify the site reactivity in accordance with AS2870-2011
- Classify the site subsoil category in accordance with AS1170.4-2007 for earthquake design
- Foundation discussion and recommendations suitable for the proposed development.
- Provide recommendations and design parameters for shallow and deep foundation systems
- Provide recommendations on design CBR values and young’s modulus for pavement design
- Provide commentary on construction issues
- List any additional recommended geotechnical investigations or site inspections

1.3 Acknowledgement of Country

Intrax acknowledge the Traditional Owners of the land on which this investigation was carried out. We pay our respects to their Elders, past and present, and the Aboriginal Elders of other communities.

2 Completed Investigations

2.1 Desktop assessment

A review of geological maps from the Geological Survey of New South Wales, aerial photography, and a search of Intrax' internal project records were used to assess the anticipated site conditions prior to attending site and to aid in identification of the geological origin.

2.2 Field Investigations

The fieldwork was conducted on 22nd August 2024, generally in accordance with the proposed scope of work.

Prior to commencement of intrusive investigations, the borehole locations were checked for underground services by Utility Mapping Service, who completed electromagnetic wand detection and ground penetrating radar scanning of the area.

The boreholes (BH01 to BH10) were drilled using a Christie Engineering drill rig. Dynamic Cone Penetrometer (DCP) tests were completed adjacent to each borehole to depth of 1.5m.

Selected soil samples were retrieved from the substrata for laboratory testing. All test locations were backfilled using the generated spoil.

All materials were described in accordance with the visual and tactile method presented within AS1726 (2017): Geotechnical Site Investigation. Test positions were recorded using a hand-held GPS unit or mobile phone app, which typically report a horizontal accuracy of +/- 5 m. Relative vertical levels from hand-held GPS units are unreliable and are therefore not reported.

The test locations are shown on the site plan provided in Appendix A. Logs from the boreholes and an explanatory sheet outlining the terms and symbols used on the logs is presented in Appendix B.

2.3 Laboratory Testing

Disturbed soil samples collected during borehole drilling were transported to the Intrax Scoresby laboratory for testing. Testing completed is summarised in Table 2-1.

Table 2-1: Completed lab testing

Laboratory Test	Quantity
Atterberg Limits & Linear Shrinkage	2
Particle Size Distribution (PSD)	2
Soaked California Bearing Ratio (CBR)	3
Linear Shrinkage	2
Shrink-Swell Index	1

The results of laboratory testing are summarised in Section 3 and test reports provided in Appendix C.

3 Site Conditions

3.1 Site Description

The site is located at 29 Grey Street, Clarence Town, NSW 2321. (-32.58761663505509, 151.78045083705186).

The site located in Clarence Town, which is approximately 50km north of Newcastle, lies within a gently sloping valley, surrounded by rural landscapes and low-lying plains, with nearby river systems contributing to the area's natural drainage patterns. At the time of the investigation, there was no existing buildings, aside from a salon shop situated on the southern end of the site. The site is gently sloping upwards from the front to the rear of the property, with a surface consisting of uneven, and overgrown grass. The site is bounded by residential houses to the west and north, Queen Street to the south, and Grey Street to the east. The salon shop was present on the southern end of the site as early as 2004, according to the available imagery.

Pertinent site features are visible in the site plan (refer to Appendix A) which is based on aerial imagery. Site conditions on the date of inspection are visible in the attached photographs in Appendix C.

3.2 Regional Geology

The surface geology underlying the site has been mapped by the Geological Survey of New South Wales. The digital seamless geological map for the area indicates that the surface geology is Wallaringa Formation, the primary rock type in the Wallaringa Formation is pink to brown, thick-bedded lithic sandstone, conglomerate and granitoids, minor sandstone. These deposits were formed during the Permian period, and the geology is indicative of a marine environment where fine-grained sediments settled over time. An extract of the local geological map is provided below.

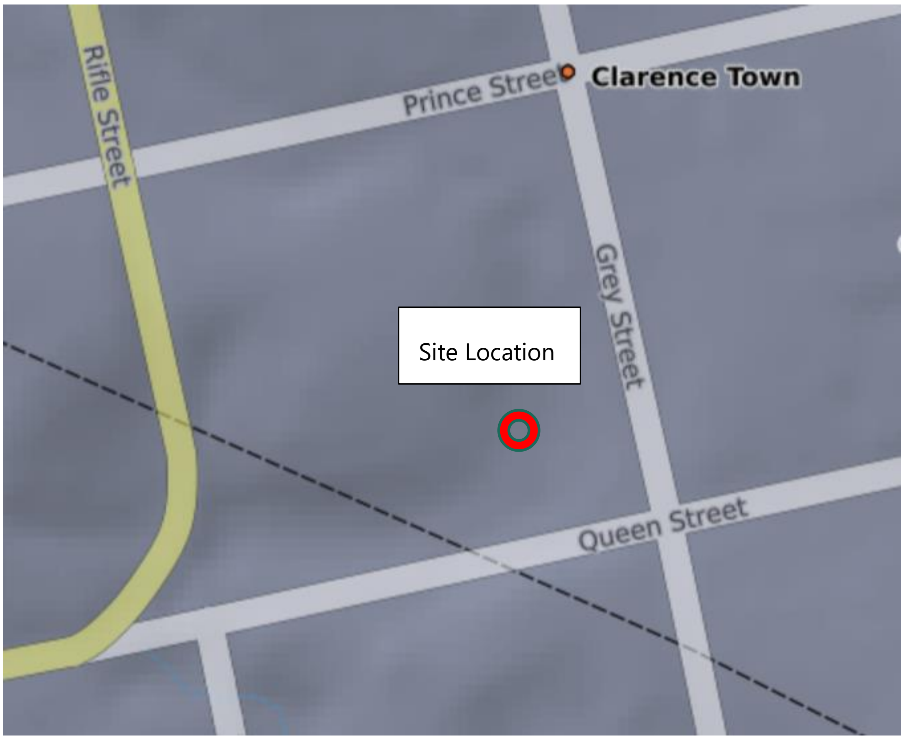

Figure 3-1: Extract of local geology, Geological Survey of NSW (Source: MinView Geoscience NSW)

3.3 Subsurface Conditions

The geotechnical units encountered within the boreholes consisted of the following generalised materials.

Table 3-1: Geological units

Unit	Description, material, relative consistency. Extent of occurrence
Fill/Topsoil	Topsoil-Sandy Silt (ML), fine to medium grained sand, loose, light grey, and brown; low plasticity; wet of plastic limit, ranging from medium to dense. DCP blow counts per 100 mm ranged from 1 to 3 blows with a recorded average of 1. Encountered from surface in all boreholes to a maximum depth of 0.3 m. Except in BH09, where it continues to a maximum depth of 0.5m.
Sandy Silt or Silty Sand	Alluvial Soil-Sandy Silt (ML), low plasticity, grey, orange brown; trace fine-medium grained sand. Moist near the plastic limit, stiff to hard. DCP blow counts per 100 mm ranged from 2 to 15 blows with a recorded average of 8. Alluvial Soil-Silty Sand (SM), fine to medium grained, orange brown and light brown, moist, loose. DCP blow counts per 100mm ranged from 2 to 4. Encountered below the fill in boreholes (02,05,07,08) to a depth of between 0.2 to 1.3 m.
Sandy CLAY or Clayey Sand	Residual Soil- Sandy Clay (CI), low plasticity, light grey, and orange, brown, trace fine-medium grained sand. Moist near the plastic limit, stiff to hard, DCP blow counts per 100 mm ranged from 2 to 16 blows with a recorded average of 9. Encountered below the fill in boreholes (01,03,04,07,10) to a depth of between 0.2 to 1.3 m. Except in BH06, where it continues to a maximum depth of 2.4m Residual Soil-Clayey Sand (SC), fine to medium grained, light brown and orange brown, low plasticity clay, medium dense
Sandstone (XW)	Recovered as Sandy Clay/Clayey Sand (SC), medium plasticity, fine to medium grained sand, light grey- light orange, brown, extremely weathered, very low to low strength
Sandstone (HW)	Sandstone, fine to medium grain, light grey- light orange, brown, highly weathered, or better sandstone, inferred low strength

Ground conditions encountered within the completed boreholes are interpreted to be generally consistent with the mapped surface geology and published information. Given the nature of ground materials, it should be anticipated that some variation in the above ground profile will exist throughout the site. The profile described above is a generalised ground model of the site.

3.3.1 Ground Water

Groundwater was not encountered in any borehole location except in BH06 where ground water was encountered at the depth of 1.2 m below ground level during borehole drilling.

It is noted that no groundwater monitoring well was installed during the site investigation program. Slow seepage through low permeability materials would not have been evident during the short period of time the borehole remained open during drilling activities.

Substrata conditions encountered are such that infiltration and occurrence of perched water at the interface between different material layers may occur. The implications of perched groundwater or the potential for perched water infiltration into open excavations should be considered during design and construction.

3.4 In-situ Test Results

Dynamic Cone Penetrometer (DCP) tests were conducted from surface level, adjacent to each borehole. The DCP results displayed a wide range of values, reflecting the inconsistent nature of the material. DCP test results are summarised in the table below which shows blows per 100 mm of penetration.

Table 3-2: DCP – Blows per 100 mm of penetration

Depth (m)	BH01	BH02	BH03	BH04	BH05	BH06	BH07	BH08	BH09	BH10
0 to 0.1	0	1	1	1	0	0	0	0	0	0
0.1 to 02	1	1	3	2	0	0	2	0	1	1
0.2 to 0.3	0	2	4	4	6	1	1	0	0	2
0.3 to 0.4	4	2	6	6	4	1	8	4	1	2
0.4 to 0.5	6	2	12	8	3	1	8	4	3	3
0.5 to 0.6	4	4	16	16	5	2	11	7	5/70 mm R	3
0.6 to 0.7	4	5	12/50 mm R	16	3	2	15	9		5
0.7 to 0.8	7	8		12/50 mm R	5	3	12/80 mm R	8		8
0.8 to 0.9	9	10/30 mm R			5	4		12		12
0.9 to 1.0	7				3	7		15		24/90 mm R
1.0 to 1.1	10				2	7		25		
1.1 to 1.2	13				2	8		15/50 mm R		
1.2 to 1.3	11/25 mm R				2	12				
1.3 to 1.4					3	13				
1.4 to 1.5					4	14				
					6	12				
1.5 to 1.6					21/90 mm R	9				
1.6 to 1.7										
1.7 to 1.8										
1.8 to 1.9										
1.9 to 2.0										
2.0 to 2.1										
2.1 to 2.2										
2.2 to 2.3										
2.3 to 2.4										
2.4 to 2.5										

Legend

🟨	Fill/Topsoil	🟩	Sandy Clay/Clayey Sand
🟧	Sandy Silt/Silty Sand	🟥	Weathered Sandstone

3.5 Laboratory Test Results

A summary of laboratory test results is provided in tables below, full laboratory test reports are attached in Appendix C.

3.5.1 Soil Classification Tests

Soil samples were obtained for classification testing, comprising moisture content, Atterberg limits, linear shrinkage, and particle size distribution. Test results are summarised in the table below. These results indicate the both natural clay and silt is low plasticity soil with low expansive nature.

Table 3-3: Classification test results (moisture content, Atterberg Limits, Linear Shrinkage & Particle Size Distribution)

Sample Location	Sample Depth (m)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Fines (%)	Sand (%)	Gravel (%)	PI x % < 0.425
BH01	0.3-1.0	13	28	15	6.5	57	37	6	1092
BH05	0.4-1.0	15	21	6	3	38	56	6	1080

3.5.2 California Bearing Ratio (CBR)

Bulk soil samples were obtained to determine the laboratory soaked CBR values. Following compaction testing to determine the standard maximum dry density (SMDD) and standard optimum moisture content (SOMC) for compaction of each material, samples were prepared at SMDD and SOMC then soaked for a period of 4 days under an applied surcharge of 4.5kg. The results of the soaked CBR tests are summarised in the table below. These results indicate the site has inconsistent CBR.

Table 3-4: Soaked CBR laboratory test results

Sample Location	Sample Depth (m)	Optimum Moisture Content (%)	Field Moisture Content (%)	Moisture Content Upper 30 mm (%)	Swell (%) after soaking	CBR Value (%)
BH01	0.3-1.0	16	18.7	20.6	0.5	4.5
BH02	0.2-0.4	12.8	15.7	15	0	16
BH05	04-1.0	12.2	26.1	12.8	0	18

3.5.3 Shrink-Swell Index

Shrink-Swell Index tests were carried out on undisturbed 50 mm thin-walled push tube samples. The test results are summarised in the table below.

Table 3-5: Shrink-swell index test results

Sample Location	Sample Depth (m)	Unit/Material Description	Moisture Content (%)	Shrink (%)	Swell (%)	Shrink-Swell Index, Iss (%)
BH10	0.5 to 0.8	Sandy Clay	15.3	0.9	1	0.8

4 Ground Model

A geotechnical ground model has been developed based on the available information compiled within this geotechnical investigation. The ground model is a generalised and simplified representation of the site conditions. The accuracy of the presented ground model is limited to the extent and detail of ground data available. Intrax considers this ground model to be suitable for design of the proposed development outlined within Section 1. This ground model should be revisited and modified as necessary where additional geotechnical data becomes available or the development changes from that described within this report.

Table 4-1: Geotechnical material parameters

Unit	Y	Su	c′	φ′	ν	E′	Est. UCS
	kN/m^3	kPa	kPa	Degree		MPa	Mpa
Fill	17	-	-	28	0.20	5	-
Alluvial Sandy SILT	19	75	4	25	0.30	10	-
Alluvial Silty SAND	17	-	-	30	0.20	5	-
Residual Sandy CLAY	19	75	4	26	0.35	10	-
Residual Clayey SAND	18	-	-	32	0.30	15	-
Sandstone (XW)	20	180	18	35	0.30	50	1
Sandstone (HW)	21	250	25	38	0.30	60	2

Notes: g: bulk unit weight, Su: undrained shear strength, c′: drained cohesion; ϕ': drained friction angle, E′: drained elastic modulus, v: drained Poisson's ratio, UCS: Uniaxial compressive strength, mbgl: metres below ground level

Mohr-Coulomb design parameters and modulus values presented in the weathered rock units are provided for the rock mass. Rock mass properties are determined via assessment through RocScience software RocLab 1.0

Material properties are based on the findings of the intrusive investigations, typical material properties, previous experience, and available published information. Where site specific test data is available it is used to determine material properties. In the absence of test results, typical material properties, previous experience and available published information are adopted.

5 Site Classifications

5.1 Residential Slabs and Footings – AS 2870

It is noted that the AS2870 classification is strictly only applicable to Class 1 and 10a structures in accordance with the Building Code of Australia, generally referring to residential dwellings or other lightweight structures. Notwithstanding the above, the classification is a useful measure of site reactivity and can be considered in the design of numerous lightweight structures likely to be influenced by surface movements resulting from soil suction (moisture) changes. Intrax understands proposed development is a new bar, dining and function centre and therefore does not within the scope of AS2870.

After considering the area geology, the soil profile encountered in the borehole, and the climatic zone of the area, this site has been classified as CLASS P due to abnormal moisture conditions to the north and presence of trees and dense vegetation on the site with respect to Australian Standard 2870-2011 "Residential Slabs and Footings". It is anticipated that the seasonal surface movement under normal moisture conditions are in the order of 20mm to 40mm.

In accordance with Clause 2.5.2 of AS2870 (2011) where the site cut exceeds 500 mm, a second site investigation is recommended. As such.

- Where the cut depth exceeds the lesser of 0.25 x Hs or 0.5 m (but is less than 1 m) the relevant design engineer may choose to design for a reduced crack zone from first principles.
- Where the cut depth is more than 1.0 m, a secondary investigation is encouraged to confirm the effects of the cut on the site classification.

In assessing the classification for this site, unless specifically noted, this report has not considered any future tree(s) to be planted as part of either the site, adjacent sites, or roadside landscaping. If additional information regarding tree or groundwater content is known by the owner, future owner, any stakeholder, or any consultant, this information must be provided to the design engineer to ensure that the footing system is adequate for the conditions which are expected.

Should alternative or additional geotechnical investigation data covering the project site be available, Intrax should be provided with this documentation. It is a condition of this report that any information the client may have with regards to the site and its history be provided to Intrax for review. This may lead to Intrax amending the above classification and recommending additional geotechnical investigation.

5.2 Earthquake Subsoil Classification

Based on the evidence obtained during this geotechnical investigation, and in accordance with AS1170.4 (2007) Structural design actions Part 4: Earthquake actions in Australia, we recommend that structures be designed for the following classifications:

Hazard Factor (z):	0.11
Sub-soil Class:	Class Be - Rock site

6 Foundations

The proposed development is understood to comprise a new bar, dining, and function centre with carpark. Structural loading and building tolerance levels have not been provided to Intrax for assessment and incorporation into this report. Based on previous experience, it is anticipated that this development will comprise of loaded structures with uniform load distribution and rigid pavements.

Based on the findings of the geotechnical investigation and assumed construction type (reinforced concrete), imposed loads and tolerance to movement, Intrax recommends all structures foundations are uniformly founded on the residual clayey sand or sandy clay soils or underlying extremely to highly weathered sandstone rock.

6.1 Raft Footings

Based on the given site classification, an engineer designed raft/waffle founding system with minimum reinforced requirement of CLASS P site classification as described in AS 2870 (2011) is appropriate for this site.

At the time of Investigation, Intrax observed trees on site and adjoining sites. The structural design engineer must assess the potential impact tree drying of the surrounding soil will pose to the proposed foundations. Note, the designer should also consider the effects of removal of tree/s and the associated rebound expected when the moisture contents of the soil return to the normal condition.

The designer may follow methodology presented in Appendix H of AS2870-2011 or other suitable design methods to evaluate the impact of trees upon the characteristic surface movement on the site. The designer should consider the mature height of trees along with the climatic conditions to quantity the tree impacts.

Allowable bearing pressures provided in Section 6.2 for strip footings can be adopted for load bearing ribs beneath waffle/raft foundations.

6.2 Shallow Footings

Subject to design loads and settlement tolerances, pad and strip footings are considered a viable foundation system for the proposed development. It is recommended that any shallow footings are supported a minimum of 500 mm from surface into the residual material or underlying rock. Allowable bearing capacities for pad and strip footings are presented within Table 6-1. Values presented assume a 300 mm wide strip footing and 600 mm square pad footing. Bearing capacities may be tailored to project specific foundation sizes by the design engineer through adoption of well-established shallow bearing capacity equations, e.g. Meyerhof or Terzaghi.

All foundations must be supported at or below the zone of influence of adjacent structures (i.e. adjacent footings, service trenches & cuttings). The zone of influence can be defined as the area rising upwards from the lowest edge of the proposed structure towards the proposed footing at a gradient of 45 degrees in cohesive materials (clays).

Table 6-1: Allowable bearing capacities for shallow footings

Unit	Allowable Bearing Capacity[1] (kPa)	
	Strip	Pad
Fill, Topsoil or Alluvial Sandy Silt or Silty Sand	-	-
Residual Sandy Clay and Clayey Sand	100	120
Very Low Strength Sandstone (XW)	350	400
Very Low to Low Strength Sandstone (HW)	400	450

[1] Allowable bearing capacities should be reviewed and amended for eccentric loading, inclined loads or foundations supported on sloping ground.

Allowable bearing pressures presented are anticipated to result in settlement of less than 25 mm. Where detailed settlement predictions are required, modelling in appropriate stress-strain software such as PLAXIS should be conducted with the specific project loads and footing dimensions.

6.3 Piled Foundations

Piled foundations may be considered a suitable solution to support the proposed structure where the depth to bedrock exceeds about 1m. Intrax anticipates that bored piles may be adopted for this structure. Where alternative piling options are considered, Intrax should be contacted for commentary on their suitability and necessary design considerations.

Pile design and installation should be conducted in accordance with AS2159 (2009) Piling – Design and installation. AS2159-2009 requires that a geotechnical strength reduction factor (φ_g) be applied to the design ultimate geotechnical strength ($R_{d,ug}$) of the pile to provide the design geotechnical strength ($R_{d,g}$) of the pile. The $R_{d,g}$ should be less than the design action effect (E_d) on the pile.

Intrax recommend that a geotechnical strength reduction factor (φ_g) of 0.4 is adopted where no further assessments are undertaken. The design engineer may determine an alternative φ_g following the methodology of Section 4.3 of AS2159.

For estimation of the design ultimate geotechnical strength, the ultimate shaft resistance (Fs) and ultimate base resistance (Fb) are provided in the table below.

Table 6-2: Recommended ultimate pile resistance values (axial compression)

Unit	Ultimate Shaft Resistance (kPa)[1]	Ultimate Base Resistance (kPa)[2]
Very Low Strength Sandstone (XW)	80	2000
Very Low to Low Strength Sandstone (HW)	100	2500

[1] *Shaft resistance is an average over the layer*

[2] *Base resistance taken at the bottom of layer depth*

In addition to the above, the following recommendations are made:

- The contribution of the uppermost soil profile shall be considered ineffective in providing geotechnical shaft resistance. The recommended ineffective depth is the larger of 1.5 m or 1.5D, where D is the pile diameter.
- Ultimate shaft friction values provided in the table above shall be reduced by a factor of 0.8 for determination of tensile capacity. The pile self-weight may be included in tension capacities. The tension capacity shall also be limited by the self-weight of cone pull-out. A pull-out angle of 30 degrees from vertical commencing at the base of the pile may be adopted for initial estimation. Consideration of defect orientation and block sizes shall be made for pull-out in rock.
- Engagement of shaft resistance requires mobilisation of the pile. It is anticipated that settlement shall be in the order of 1% of the pile diameter to mobilise full shaft friction.
- Ultimate base resistance values provided in the table above assume a minimum embedment of 3D in soil and the lesser of 1D or 1.0 m in competent rock. It is recommended that the pile designer adopt these minimum embedment lengths.
- The values in the table above assume that pile shafts are clean (free from remoulded material) and that the pile base is clean (free of water, lose or softened material).

6.4 General Footing Considerations

Note that it is our preference for the design engineer to adopt the same founding material throughout the entire foundation. Where footings are founded in different materials, especially reactive soils and non-reactive materials (sand/gravel/rock), the designer should provide articulation for the structure to avoid potential damages which could be caused by differential movements due to seasonal moisture variations in the reactive soils.

If there is any doubt as to the identification of materials and determination of the bearing capacity of the founding materials during footing excavation, Intrax should be contacted, and an inspection of the founding conditions carried out.

7 Pavement Design

7.1 Subgrade Design California Bearing Ratio (CBR)

It is anticipated that the subgrade will be on the existing natural CLAY and SILT material. Based on the CBR result, correspondent DCP results were corrected from interpreted CBR. Detailed results are provided within table below.

Table 7-1 Corrected CBR of the site

Depth	BH01	BH02	BH03	BH04	BH05	BH06	BH07	BH08	BH09	BH10
0 to 0.1	0	1	1	1	0	0	0	0	0	0
0.1 to 0.2	1	1	3	2	0	0	2	0	1	1
0.2 to 0.3	0	2	4	4	6	1	1	0	0	2
0.3 to 0.4	4	2	6	6	4	1	8	4	1	2
0.4 to 0.5	6	2	12	8	3	1	8	4	3	3
0.5 to 0.6	4	4	16	16	5	2	11	7	20	3
0.6 to 0.7	4	5	20	16	3	2	15	9		5
0.7 to 0.8	7	8		20	5	3	20	8		8
	9	20			5	4		12		12
CBR	4.5	16			18					
Swell	0.5	0			0					
Average DCP	5	7	14	13	4	2	12	6	8	4
Interpreted CBR	9	15	33	32	8	3	30	14	18	9
Correction Value	0.85									
Corrected CBR	4.5	16.0	38.0	37.0	18.0	4.0	35.0	16.0	21.0	10.0
Design CBR	4.5									

Based on the table above, adapted design CBR for the proposed street site is 4.5%.

The site is also interbedded with alluvial silt, that is not considered a suitable subgrade material for pavement.

Since a portion of the site has a lower CBR value, imported capping shall be placed over natural sub-grade.

7.2 Design Traffic

With provided traffic impact assessment report, following aspects and assumptions have been adopted for the traffic load calculations.

- The site includes a total of 43 car parking spaces, which includes two accessible spaces.
- The function centre will have 9 staff members. It is assumed that 1 parking space will be required per staff member.
- Peak patron visits are expected on Fridays and Saturdays, with up to 200 patrons. Assuming 0.3 spaces per patron, the total parking demand during peak hours is estimated to be 67 spaces.
- With a conservative estimate of 5 vehicle trips per lot, the Average Annual Daily Traffic (AADT) is expected to be approximately 250.

- Heavy vehicles are anticipated to include a courtesy bus (estimated at 4 visits per day on average), supply deliveries (once per day), and a garbage truck (once per week).

Based on the traffic loading, the road type of the site was defined in the figure as follow.

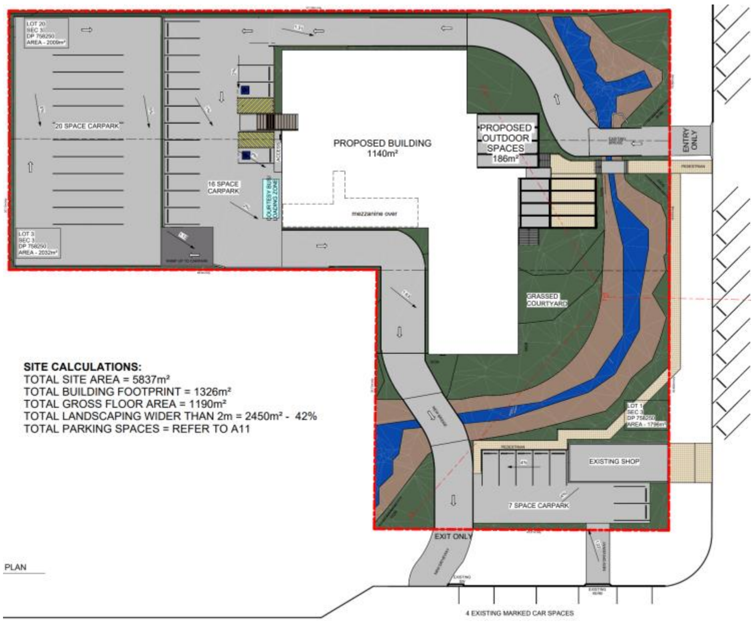

Figure 7-1 Pavement Areas

Table 7-2 Design traffic loading

Input Parameters	Carpark and Driveways
Project reliability level	90%
AADT (vehicles per day)	250
DF- Directional factor	0.5
%HV- Heavy Vehicle %	3
LDF- Lane directional factor	1
R- Annual growth rate (%)	1
P- Design life	20
CGF- cumulative growth factor	22.0
N_{HVAG} – average number of axle groups per heavy vehicle	2.2
N_{DT} – Cumulative heavy axle groups	6.63×10^4
ESAs/HVAG	0.4
DESA- design number of equivalent standard axles	**2.65×10^4**

7.3 Flexible Pavement Design

According to the example design chart from Pavement Design of Light Traffic – Austroads 2006 (Figure EC25), for a 40mm thickness asphalt, the required minimum unbound granular material thickness is 300mm.

The tables below present the design for the flexible pavement that incorporates lime stabilisation and capping over the subgrade options. These designs offer different solutions for improving the strength and durability of the pavement in order to accommodate the anticipated traffic loads.

7.3.1 Flexible Pavement Design, with Lime treatment – Option 1

Table 7-3: Proposed pavement design with lime treatment option

Thickness	Material type	Carpark and Driveways
		Thickness (mm)
Wearing Course	14 mm Dense Graded Asphalt with Class 170 bitumen (Modulus 1200MPa)	40
Waterproofing course	Prime or Prime seal	
Base Course	Class 2, Fine Crushed Rock 20mm Compacted to not less than 98% of AS 1289, 5.2.1 (Modified Compaction)	150
Subbase	Class 3, Crushed Rock 20mm Compacted to not less than 95% of AS 1289, 5.2.1 (Modified Compaction)	150
Total Pavement Depth		**340**
Lime Stabilisation	See Section 7.4 for options	Not Required
Subgrade	CLAY material	CBR of 4.5%

7.3.2 Flexible Pavement Design, with Capping Layer – Option 2

Table 7-4 Proposed pavement design with Capping Layer option

Thickness	Material type	Access Street
		Thickness (mm)
Wearing Course	14 mm Dense Graded Asphalt with Class 170 bitumen (Modulus 1200MPa)	40
Waterproofing course	Prime or Prime seal	
Base Course	Class 2, Fine Crushed Rock 20mm Compacted to not less than 98% of AS 1289, 5.2.1 (Modified Compaction)	150
Subbase	Class 3, Crushed Rock 20mm Compacted to not less than 95% of AS 1289, 5.2.1 (Modified Compaction)	150
Total Pavement Depth		**340**
Capping Layer	Select Type A Capping Material with a minimum soaked CBR of 10% compacted to 98% Standard dry density ratio with a mean value of at least 100% Standard Dry Density Ratio and within 1% of the Standard Optimum Moisture Content and a percentage swell of less than 1.5%	150
Subgrade	CLAY material	CBR of 4.5%

Subgrade materials which are 'very wet' (significantly above optimum moisture content) at the time of construction may not be considered suitable for stabilisation using an imported capping layer or geotextile may be required to bridge such ground conditions. We anticipate that costs associated with these options will not be acceptable, and highly recommend pavement construction following a period of dry weather.

Pavements require sufficient drainage to ensure that the subgrade remains dry over the expected design life of the pavement. As such it is recommended that adequate drainage be provided around the perimeter of the pavements to ensure the subgrade and subbase are protected from moisture variations. In addition, the effects of trees on the subgrade should also be isolated or removed to ensure the longevity of the pavement.

7.4 Subgrade stabilisation treatment

There are two construction options provided for subgrade stabilisation treatment.

Table 7-5 Options of subgrade stabilisation

Options	Thickness (mm)	Material type
	Carpark and Driveways	
Lime Stabilisation	200	CLAY ripped and treated with 3% lime and 0 – 3% cement. Following stabilisation, the layer must be rolled to achieve 98% standard compaction in accordance with AS1289.5.1.1
Cement Lime Stabilisation	150	CLAY ripped and treated with 3% cement and 3% lime. Following stabilisation, the layer must be rolled to achieve 98% standard compaction in accordance with AS1289.5.1.1

For lime stabilisation, the addition of cement is optional up to 3%.

For cement lime stabilisation, it is expected that in situ stabilisation with 3% Lime and 3% Cement will be appropriate to increase the mechanical properties of the subgrade. It is recommended that if:

- The soils are found to be marginally wet at the time of construction, or do not consist of cohesive material, consideration should be given to increasing the lime content to 4% (if above optimum moisture content) or replacing the lime with cement (if low to medium reactivity cohesive material is encountered).
- Guidance be obtained from stabilisation specialists and contractors prior to construction to determine the most appropriate additive and construction method for the conditions at the time of construction.
  - Note: Stabilisation of materials which are well above optimum moisture content or considered as wet at the time of construction or are non-cohesive (low clay content) may not be considered suitable for stabilisation and subsequently capping or geotextiles may be required to bridge such ground conditions.

7.5 Rigid Pavement Design

Rigid pavements are to be designed in accordance with CCAA's Guide to Industrial Floors and Pavements. The designer may adopt following Young Modulus values or estimated design CBR values for rigid pavement design.

Table 3-6: Pavement design parameters

Material Description	Young's Modulus		Design CBR
	Short Term (MPa)	Long Term (MPa)	
Stabilised or Capping Subgrade	40 - 45	23 - 28	10.0%
CLAY / SILT Subgrade	27 - 32	15 - 20	4.5%

Note: pavements require sufficient drainage to ensure that the subgrade remains dry over the expected design life of the pavement. As such it is recommended that adequate drainage be provided around the perimeter of the pavements to ensure the subgrade and subbase are protected from moisture variations. In addition to the effects of trees on the subgrade should also be isolated or removed to ensure the longevity of the subgrade.

7.6 Pavements and Engineered Fill

Where filling to raise site levels is proposed, all filling (where structures, pavements or pipework are proposed over or adjacent) with the exception of topsoil must be placed as engineered fill. Level 2 supervision of fill compaction is the minimum permissible by AS3798. Where proposed filling depths exceed 1m, we highly recommend formulating a plan in consultation with a Geotechnical Inspection and Testing Authority prior to the commencement of the earthworks.

Following stripping of silt, topsoil or any existing fill materials and proof rolling, any soft areas that are encountered must be locally excavated to achieve a suitable base (as assessed by the Geotechnical Testing Authority, GTA or Geotechnical Inspection and Testing Authority, GITA representative) and replaced with suitable material (well graded soils, or crushed / ripped rock with appropriate limits on particle size).

Depending on the compaction equipment used, horizontal layers may need to be placed at a maximum loose thickness of 200 mm to 300 mm. Compaction shall achieve Standard Maximum Dry Density (SMDD) of 98%, with uniform moisture condition between +/-2% of the Optimum Moisture Content (OMC). Density testing must be carried out in accordance with the requirements of Table 8.1 of AS3798-2007.

If isolated soft spots are encountered, they must be removed and replaced with suitable material (as described above) prior to placement of additional fill. A stable subgrade (‘suitable base’) is defined as that which exhibits negligible deflection during a proof roll. This judgement as well as the suitability of materials for use as structural fill should be made by the GTA or GITA representative.

7.7 Drainage

Subsurface drains are required to maintain the unbound aggregates adopted in the pavement design. Poor or insufficient drainage can lead to poor pavement performance throughout the design life. Where the pavement edges are kerbed, pavement drainage should be located beneath the toe of the kerb. If the pavement edges are not kerbed the pavement drainage should be positioned beneath the end of the pavement base.

The following specification should be adopted for the proposed drainage systems:

- The design is to be in accordance with Part 10: Subsurface Drainage of AGPT10-09: Guide to Pavement Technology
- Minimum trench width: 300mm
- Where the pipework is exposed to vehicular loads and is within 1000mm of the surface, the pipe should be: - 1000kN/m corrugated perforated plastic pipe, FRC or concrete pipe
- Filter sock is to be provided to the pipe
- Drainage backfill is to be Type A filter material or Sand with a Grade A4 to A6 with 10^{-9} to 10^{-5} m/sec permeability range (Type 2, 3 or 4 pavement drains)

It is recommended to that the adequate drainage both laterally and longitudinally provided along the length of the project. In order to meet the design requirements for the pavement life, the drainage requirements shall be satisfied all the time.

8 Construction Considerations

8.1.1 Trafficability

Trafficability is anticipated to be sufficient while soil conditions remain dry, however following significant or sustained rainfall periods, trafficability may be restricted to tracked machinery only. To improve trafficability during wet periods, access roads can be created by stripping unsuitable materials (where present) and replacing with a coarse aggregate (non-descript crushed rock) or similar. If adverse weather precedes construction, a geotextile may be required prior to placement of the crushed rock to prevent soft spot development.

8.1.2 Inspections (Hold Points)

Intrax **must** be engaged in the following events for further clarification and advice:

1. Where soil conditions encountered differ significantly from those described within this report.
2. If project design is altered significantly from drawings reviewed and outlined or project described within this report

Intrax or a suitably experienced geotechnical consultant **should** be engaged at the following stages:

1. To confirm safe batter angles and excavation geometry during construction.
2. To confirm founding materials and allowable bearing pressures.
3. To approve subgrade for pavement(s).

9 References

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- Variations in ground conditions;
- Ground disturbance or changes to the subsurface profile not discussed within the Document or for which Intrax was not consulted;
- Where key information relating to the contents of the Document is unavailable to Intrax when Services were provided. Key information may include but is not limited to information on the site history, proposed site treatment, development details, development position, loading and movement tolerance, and vegetation removal or planting;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

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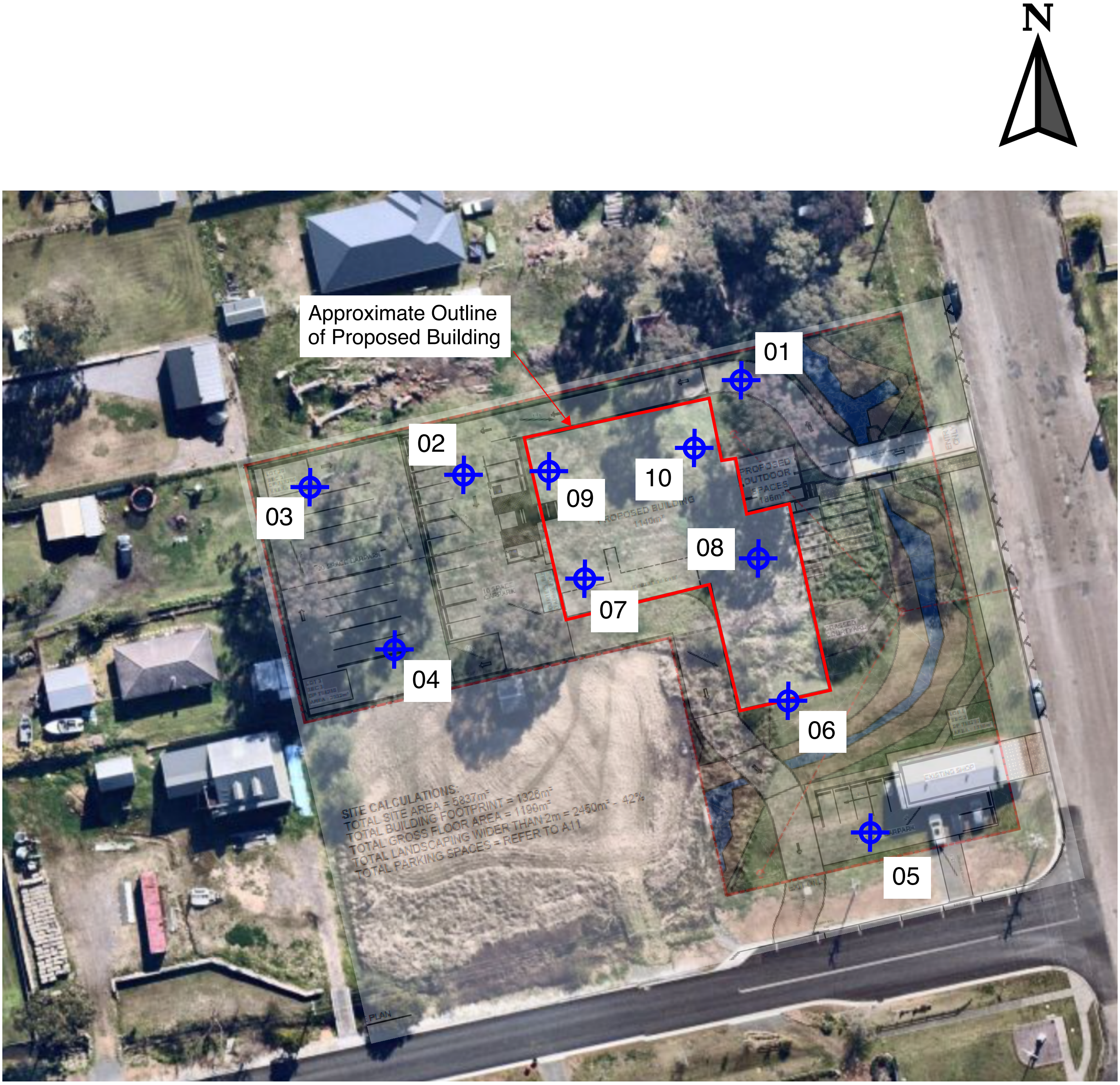
Appendix A

Site Plan



Legend ⌖ Borehole and Dynamic Cone Penetration (DCP) Test

Client Name: Williams River Steel

Site Address: 29 Grey Street
Clarence Town NSW

Drawing: Site Plan

Scale: NTS

Date: 23/08/2024

Sheet: 1 of 1

Project No: 230855

Version: 0

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Appendix B

Borehole Log(s) and Explanatory Notes

EXPLANATORY NOTES AND ABBREVIATIONS

The following presents a depiction and explanation of terms adopted by Intrax Land in geotechnical borehole logs, test pits and other soil and rock descriptions. Soil and rock descriptions are in accordance with Australian Standard 1726-2017, Geotechnical Site Investigations.

Investigation methods, sampling, testing & groundwater

Drilling Method	
AD/V	Auger drilling with V bit
AD/T	Auger drilling with TC-Bit
DPT	Direct push tube
HA	Hand auger
WB	Wash boring
HOA	Hollow auger
AH	Air Hammer
SPT	Standard Penetration Test
NQ	Diamond Core – 47mm
NMLC	Diamond Core – 52mm
HQ	Diamond Core – 63mm
PQ	Diamond Core – 81mm
SO	Sonic drilling
NDD	Non-destructive digging
EX	Excavator bucket
BH	Backhoe bucket
EE	Existing Excavation

Groundwater & Support	
▼	Standing water level at date shown
►	Water inflow
◄	Water loss
GROUNDWATER NOT OBSERVED	Observation of groundwater, whether present or not, was not possible due to drilling water, seepage or cave in
GROUNDWATER NOT ENCOUNTERED	Borehole was dry soon after excavation, however, no well was installed to monitor seepage from low permeability materials
C	Casing
M	Mud

Field Sampling & Testing	
W	Water Sample
D	Disturbed Sample
B	Bulk Disturbed Sample
U50 / U63	Undisturbed Tube Sample (50/63mm diameter tube)
E	Environmental Sample
PP	Pocket Penetrometer Test (kPa)
FV	Field Shear Vane (kPa)
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure measurement
DCP	**Dynamic Cone Penetrometer (blows / 100mm)**
R	DCP refusal condition 20 blows with less than 100mm penetration
SPT	**Standard penetration Test**
5, 8, 22	SPT blow counts (150mm increments)
N = 30	SPT N count (blows for final 300mm)
30/100mm	Refused test with partial penetration
R	SPT refusal conditions. 30 blows with less than 100mm penetration or 5 blows with hammer bounce or no measurable movement
RW	Rod Weight only causing penetration (SPT N < I)
HW	Hammer and rod weight only causing full penetration (N < I)
HB	Hammer Bouncing

Core Recovery Measurements		Definition
TCR	Total Core Recovery (%)	$\frac{Lenth\ of\ core\ recovered}{Length\ of\ core\ run} \times 100$
SCR	Solid Core Recovery* (%)	$\frac{\sum Lenth\ of\ cylindrical\ core\ recovered}{Length\ of\ core\ run} \times 100$
RQD	Rock Quality Designation* (%)	$\frac{\sum Length\ of\ sound\ core\ pieces > 100\ mm\ length}{Length\ of\ core\ run} \times 100$

*Only natural breaks considered, mechanical breaks shall be ignored, and core shall be marked with chalk

Penetration / Excavation Resistance

Symbol	Term	Description
L	Low resistance	Rapid penetration with little effort from equipment used
M	Medium resistance	Penetration progresses at normally accepted rate with moderate effort from equipment
H	High resistance	Penetration rate is slow and requires significant effort from equipment
R	Practical Refusal	Further progress is not practical without damage or unacceptable wear to the equipment

SOIL DESCRIPTION

Soil classification symbols

Classification Symbol	Typical Soil Name	Classification Symbol	Typical Soil Name
GW	Well graded gravels, sand-gravel mixtures – little or no fines	SW	Well graded sands, gravel-sand mixtures – little or no fines
GP	Poorly graded gravels, sand-gravel mixtures – little or no fines, uniform gravels	SP	Poorly graded sands, gravel-sand mixtures – little or no fines, uniform sands
GM	Silty gravels, gravel-sand-silt mixtures	SM	Silty sands, sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures	SC	Clayey sands, sand-clay mixtures
ML	Inorganic silts of low plasticity	CL	Inorganic clay of low plasticity
MH	Inorganic silts of high plasticity	CI	Inorganic clay of medium plasticity
OL	Organic silts of low plasticity	CH	Inorganic clay of high plasticity
OH	Organic clay of medium to high plasticity	Pt	Peat – highly organic material

Dual classification (SP-SM, GP-GC) may be adopted for coarse grained soils with fines contents between 5% and 12%

Particle size distributions and material components

Particle Size Divisions			
Group	**Name**	**Division**	**Size (mm)**
Coarse	BOULDERS		> 200
	COBBLES		63 to 200
	GRAVEL	coarse	19 to 63
		medium	6.7 to 19
		fine	2.36 to 6.7
	SAND	coarse	0.6 to 2.36
		medium	0.21 to 0.6
		fine	0.075 to 0.21
Fine	SILT		0.002 to 0.075
	CLAY		< 0.002

Minor and Secondary Components			
Fine Grained Minor Component		**Coarse Grained Minor Component**	
≤5%	Trace clay/silt	≤15%	Trace sand/gravel
>5%, ≤12%	With clay/silt	>15%, ≤30%	With sand/gravel
>12%	Prefix 'Silty' or 'Clayey'	>30%	Prefix 'Sandy' or 'Gravelly'

Plasticity

Descriptive Term	Range of liquid limit or silt	Range of liquid limit for clay
Low	≤50	≤35
Medium	Not Applicable	>35 and ≤50
High	>50	>50

Moisture Condition

Fine grain soils		Coarse grain soils	
w < PL	Moist, dry of plastic limit	D	Dry, non-cohesive and free running
w ≈ PL	Moist, near plastic limit	M	Moist, soil feels cool tends to stick together
w > PL	Moist, wet of plastic limit	W	Wet, soil feel cool, free water forms when handling
w ≈ LL	Wet, near liquid limit		
w > LL	Wet, wet of liquid limit		

Consistency of cohesive soils

Abbreviation	Term	Undrained Shear Strength (kPa)	Indicative SPT N*	Indicative DCP per 100mm*	Pocket Penetrometer	Visual Assessment
VS	Very Soft	≤ 12	0 to 2	NA	25	Exudes between the fingers when squeezed in hand
S	Soft	>12 to ≤25	2 to 4	0 to 1	25 to 50	Can be moulded by light finger pressure
F	Firm	>25 to ≤50	4 to 8	1 to 2	50 to 100	Can be moulded by strong finger pressure
St	Stiff	>50 to ≤100	8 to 15	2 to 5	100 to 200	Cannot be moulded by fingers
VSt	Very Stiff	>100 to ≤200	15 to 30	6 to 9	200 to 400	Can be indented by thumb nail
H	Hard	> 200	> 30	> 10	> 400	Can be indented with difficulty with thumb nail
Fr	Friable	-	-	-	-	Can be easily crumbled or broken into small pieces by hand

*Indicative correlations, accuracy will vary with soil type, testing equipment and groundwater conditions. Site specific correlations developed with more accurate testing methods would take precedence over the above relationships.

Relative density of non-cohesive soils

Abbreviation	Term	Density Index (%)	Indicative SPT (N) blows per 300mm	Approximate DCP per 100mm	Approximate PSP per 100mm
VL	Very Loose	0 to ≤15	0 to 4	0 to 1	0 to 2
L	Loose	>15 to ≤35	4 to 10	1 to 3	2 to 6
MD	Medium Dense	>35 to ≤65	10 to 30	3 to 8	6 to 8
D	Dense	>65 to ≤85	30 to 50	8 to 15	8 to 15
VD	Very Dense	> 85	> 50	> 15	> 15

Relative density is typically only provided where testing is conducted, where testing is not conducted the relative density shall be noted as inferred by use of an asterisk (*) symbol

ROCK DESCIPTION

Rock weathering

Abbreviation		Term		Definition
RS		Residual Soil		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
XW		Extremely Weathered		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
HW	DW	Highly Weathered	Distinctly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
MW		Moderately Weathered		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.
SW		Slightly Weathered		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
FR		Fresh		Rock shows no sign of decomposition of individual minerals or colour changes.

Residual soil and extremely weathered materials are to be described using soil descriptions

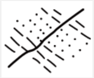
Rock strength

Symbol	Term	UCS* (MPa)	Is50* (MPa)	Field Assessment
VL	Very Low Strength	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm thick can be broken by finger pressure.
L	Low Strength	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium Strength	6 to 20	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High Strength	20 to 60	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
VH	Very High Strength	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High Strength	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Material with strength less than 'Very Low' shall be described using soil characteristics.

*Point load test values are provided a guide, however UCS strengths take precedence, and no correlation between the two measurements should be interpreted from the above

Defect type

Abbr.	Type	Definition	Diagram
P	Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.	
JT	Joint	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or sub-parallel to layering or to planar anisotropy in the rock material. May be open or closed.	
SF	Sheared Surface (fault)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.	
SZ	Sheared Zone (fault)	Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
SS	Sheared Seam (fault)	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
CS	Crushed Seam (fault)	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.	
IS	Infilled Seam	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1 mm thick may be described as a veneer or coating on a joint surface.	
XS	Extremely Weathered Seam	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.	
FZ	Fractured Zone	Heavily fractured section of containing large number of defects	

Defect type

Surface Roughness		Surface Shape		Coating / Infill	
VR	Very Rough	ST	Stepped	CN	Clean
RO	Rough	CU	Curved	SN	Stained
SM	Smooth	UN	Undulating	VN	Veneer
PO	Polished	IR	Irregular	CT	Coating
SL	Slickensided	PL	Planar	Infill described separately	

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Geotechnical Log - Borehole

BH01

UTM : 56H
Latitude : -32.587073
Longitude : 151.780093
Ground Elevation : 7.64 (m)
Total Depth : 2 m BGL

Drill Rig : Christie Engineering Tracked (Yellow)
Driller Supplier : Intrax
Logged By : MH
Reviewed By : DF
Date : 22/08/2024

Job Number : 230855
Client : Williams River Steel
Project : Clarence Town Geotechnical Investigation
Location : 29 Grey Street, Clarence Town NSW, Australia
Loc Comment :

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.3		0 1 0		▤	CL	Sandy CLAY CL: low plasticity, brown, fine to medium grained sand.	w > PL		Topsoil	
			1 1.2		4 6 4 4 7 9 7 10 13		▤	CL	Sandy CLAY CL: low plasticity, light grey and orange brown, fine to medium grained sand.		St-V St	Residual	
			1.5		11/25mm Refusal		░	SST	Clayey SAND SST: fine to medium grained, trace fine to medium sized gravel, light brown and light grey, light grey.	M	D	Rock	
			2				░	SST	Sandy CLAY SST: low plasticity, orange brown and light brown, light brown, fine to medium grained sand, trace fine to medium sized gravel.	w < PL	H		
			3 4						**BH01 Terminated at 2m**				

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Geotechnical Log - Borehole

BH02

UTM : 56H
Latitude : -32.587233
Longitude : 151.779681
Ground Elevation : 10.13 (m)
Total Depth : 1.8 m BGL

Drill Rig : Christie Engineering Tracked (Yellow)
Driller Supplier : Intrax
Logged By : MH
Reviewed By : DF
Date : 22/08/2024

Job Number : 230855
Client : Williams River Steel
Project : Clarence Town Geotechnical Investigation
Location : 29 Grey Street, Clarence Town NSW, Australia
Loc Comment :

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.2		1 1			CL	FILL- CLAY CL: low plasticity, with fine grained sand, undefined dark brown, presence of ceramic and metal, organic.	w > PL	S	Fill	
			0.5		2 2 2			ML	Sandy SILT ML: low plasticity, grey and brown, fine to medium grained sand.		St	Alluvial	
			0.8		4 5 8			ML	As above .		St-V St		
			1		10/30mm Refusal			SST	Sandy CLAY SST: medium plasticity, grey and brown, orange brown, fine to medium grained sand, extremely weathered sandstone.	w < PL	H	Rock	
			2 3 4						**BH02 refusal at 1.8m**				

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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Geotechnical Log - Borehole

BH03

UTM	**: 56H**	**Drill Rig**	**: Christie Engineering Tracked (Yellow)**	**Job Number**	**: 230855**
Latitude	**: -32.587279**	**Driller Supplier**	**: Intrax**	**Client**	**: Williams River Steel**
Longitude	**: 151.779444**	**Logged By**	**: MH**	**Project**	**: Clarence Town Geotechnical Investigation**
Ground Elevation	**: 11.84 (m)**	**Reviewed By**	**: DF**	**Location**	**: 29 Grey Street, Clarence Town NSW, Australia**
Total Depth	**: 1.8 m BGL**	**Date**	**: 22/08/2024**	**Loc Comment**	**:**

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.2		1 3		▤	CL	Sandy CLAY CL: low plasticity, light grey light brown, fine to medium grained sand, organic.	w > PL	F-St	Topsoil	
			0.5		4 6 12		▨	SC	Clayey SAND SC: fine to medium grained, light brown and orange brown, low plasticity clay.	M	MD	Residual	
			0.7		16 12/50mm		▩	SST	Clayey SAND SST: fine grained, light brown and orange brown, orange brown, extremely weathered sandstone.		D	Rock	
			1		Refusal		▩	SST	SANDSTONE: light brown and orange brown, fine to medium grained.		VLS-LS		
			2 3 4						**BH03 refusal at 1.8m**				

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Geotechnical Log - Borehole

BH04

UTM : 56H
Latitude : -32.587477
Longitude : 151.779569
Ground Elevation : 9.00 (m)
Total Depth : 1.4 m BGL

Drill Rig : Christie Engineering Tracked (Yellow)
Driller Supplier : Intrax
Logged By : MH
Reviewed By : DF
Date : 22/08/2024

Job Number : 230855
Client : Williams River Steel
Project : Clarence Town Geotechnical Investigation
Location : 29 Grey Street, Clarence Town NSW, Australia
Loc Comment :

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.1		1		▤	CL	Sandy CLAY CL: low plasticity, light brown, fine to medium grained sand, with fine to coarse sized gravel, organic.	w > PL	S	Topsoil	
			0.3		2 4		▤	CL	Sandy CLAY CL: low plasticity, light brown and orange brown, fine to medium grained sand, with fine to medium sized gravel.		F	Residual	
			0.9		6 8 16 16 12/50mm Refusal		▤	CL	As above .	w ≈ PL	VSt-H		
			1 1.3				⁙	SST	Clayey to sandy CLAY SST: low to medium plasticity, light brown and orange brown, orange brown, extremely weathered sandstone.	w < PL	H	Rock	
							⁙	SST	SANDSTONE: light grey and orange brown, fine to medium grained.	M	LS		
			2 3 4						**BH04 refusal at 1.4m**				

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Geotechnical Log - Borehole

BH05

UTM : 56H
Latitude : -32.587725
Longitude : 151.780324
Ground Elevation : 7.47 (m)
Total Depth : 1.8 m BGL

Drill Rig : Christie Engineering Tracked (Yellow)
Driller Supplier : Intrax
Logged By : MH
Reviewed By : DF
Date : 22/08/2024

Job Number : 230855
Client : Williams River Steel
Project : Clarence Town Geotechnical Investigation
Location : 29 Grey Street, Clarence Town NSW, Australia
Loc Comment :

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
					0 0				FILL- SILT low plasticity, light grey.	w > PL	VS-S	Fill	
			0.2		6				FILL- SILT low plasticity, red brown and orange brown.		F-St		
			0.3		4 3 5 3 5 5 3 2 2 2			SM	Silty SAND SM: fine to medium grained, orange brown and light brown.	M	L	Alluvial	
			1.3		3 4 6			CI	Sandy CLAY CI: medium plasticity, brown, fine to medium grained sand, ground water encountered at 0.8m .	w > PL	F-St	Residual	
			1.6		21/90mm Refusal			SST	SANDSTONE: orange brown and light grey, fine to medium grained.	M	LS	Rock	

BH05 refusal at 1.8m

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Geotechnical Log - Borehole

BH06

UTM	: 56H	**Drill Rig**	: Christie Engineering Tracked (Yellow)	**Job Number**	: 230855
Latitude	: -32.587562	**Driller Supplier**	: Intrax	**Client**	: Williams River Steel
Longitude	: 151.780224	**Logged By**	: MH	**Project**	: Clarence Town Geotechnical Investigation
Ground Elevation	: 6.65 (m)	**Reviewed By**	: DF	**Location**	: 29 Grey Street, Clarence Town NSW, Australia
Total Depth	: 3 m BGL	**Date**	: 22/08/2024	**Loc Comment**	:

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.2		0 0		▩		SILT low plasticity, dark brown.	w > PL	VS-S	Topsoil	
			0.8		1 1 1 2 2 3		☰	CL	CLAY CL: low plasticity, grey and orange brown.		F	Residual	
			1 1.2		4 7 7 8		☰	CL	As above .		St-VSt		
		▽ Level during drilling	2 2.4		12 13 14 12 9 End		☰	CL	As above - ground water encountered at 1.2m.		VSt-H		
			3				⁘	SST	SANDSTONE: grey and orange brown, fine to medium grained.	M	VLS	Rock	
			4						**BH06 Terminated at 3m**				

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Geotechnical Log - Borehole

BH07

UTM	: 56H	**Drill Rig**	: Christie Engineering Tracked (Yellow)	**Job Number**	: 230855
Latitude	: -32.587470	**Driller Supplier**	: Intrax	**Client**	: Williams River Steel
Longitude	: 151.779852	**Logged By**	: MH	**Project**	: Clarence Town Geotechnical Investigation
Ground Elevation	: 7.42 (m)	**Reviewed By**	: DF	**Location**	: 29 Grey Street, Clarence Town NSW, Australia
Total Depth	: 0.9 m BGL	**Date**	: 22/08/2024	**Loc Comment**	:

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.1		0		▤	CL	CLAY CL: low plasticity, brown, organic.	w > PL	S	Topsoil	
			0.3		2 1		▥	ML	Sandy SILT ML: low plasticity, orange brown, fine to medium grained sand.		F	Alluvial	
			0.8		8 8 11 15 12/80mm		▨	CI	Sandy CLAY CI: medium plasticity, light brown and orange brown, fine to medium grained sand, trace fine to medium sized gravel.		St-V St	Residual	
					Refusal		░	SST	SANDSTONE: orange brown with light brown, fine to medium grained.	M	LS	Rock	

BH07 refusal at 0.9m

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Geotechnical Log - Borehole

BH08

UTM : 56H
Latitude : -32.587359
Longitude : 151.780123
Ground Elevation : 6.87 (m)
Total Depth : 1.4 m BGL

Drill Rig : Christie Engineering Tracked (Yellow)
Driller Supplier : Intrax
Logged By : MH
Reviewed By : DF
Date : 22/08/2024

Job Number : 230855
Client : Williams River Steel
Project : Clarence Town Geotechnical Investigation
Location : 29 Grey Street, Clarence Town NSW, Australia
Loc Comment :

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.3		0 0 0			ML	Sandy SILT ML: low plasticity, light grey and light brown, fine to medium grained sand.	w > PL	S	Topsoil	
			1 1.2		4 4 7 9 8 12 15 25			ML	Sandy SILT ML: low plasticity, light brown and light grey, fine to medium grained sand.		St-V St	Alluvial	
					15/50mm Refusal			SST	SANDSTONE: light brown and orange brown, fine to medium grained.	M	VLS	Rock	
			2 3 4						**BH08 refusal at 1.4m**				

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Geotechnical Log - Borehole

BH09

UTM : 56H
Latitude : -32.587208
Longitude : 151.779808
Ground Elevation : 8.93 (m)
Total Depth : 0.7 m BGL

Drill Rig : Christie Engineering Tracked (Yellow)
Driller Supplier : Intrax
Logged By : MH
Reviewed By : DF
Date : 22/08/2024

Job Number : 230855
Client : Williams River Steel
Project : Clarence Town Geotechnical Investigation
Location : 29 Grey Street, Clarence Town NSW, Australia
Loc Comment :

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.6		0 1 0 1 3 5/70mm			ML	Sandy SILT ML: low plasticity, light grey and light brown, fine to medium grained sand.	w ≈ LL	S	Topsoil	
					Refusal			SST	SANDSTONE: light brown and orange brown, fine to medium grained.	M	LS	Rock	
			1 2 3 4						**BH09 refusal at 0.7m**				

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Geotechnical Log - Borehole

BH10

UTM : 56H
Latitude : -32.587190
Longitude : 151.780044
Ground Elevation : 7.50 (m)
Total Depth : 1.7 m BGL

Drill Rig : Christie Engineering Tracked (Yellow)
Driller Supplier : Intrax
Logged By : MH
Reviewed By : DF
Date : 22/08/2024

Job Number : 230855
Client : Williams River Steel
Project : Clarence Town Geotechnical Investigation
Location : 29 Grey Street, Clarence Town NSW, Australia
Loc Comment :

Drilling Method	Penetration Resistance	Water	Depth (m)	Samples	DCP Test (blows/100mm)	Testing	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Soil Origin	Remarks
			0.3		0 1 2			ML	Sandy SILT ML: low plasticity, grey, fine to medium grained sand.	w > PL	S	Topsoil	
			0.9		2 4 4 5 8 12			CL	Sandy CLAY CL: low plasticity, light brown and light grey, fine to medium grained sand.		F	Residual	
			1.6		24/90mm Refusal			SST	CLAY SST: medium plasticity, light grey orange brown and light brown, light grey and orange brown light brownlight grey orange brown and light brown, extremely weathered sandstone.	w < PL	H	Rock	
								SST	SANDSTONE: orange brown and light grey, fine to medium grained.	M	LS		

BH10 refusal at 1.7m

Appendix C

Site Photography

Appendix D

Laboratory Test Reports

Material Test Report

Report Number: **PRJ1278804-1**
Issue Number: 1
Date Issued: 12/09/2024
Client: William river steel

Project Number: PRJ1278804
Project Name: Proposed Bar, Dining and Function Centre
Project Location: S#230855 No. 29 Grey Street Clarence Town, NSW, 2321
Work Request: 4748
Sample Number: SC24-4748A
Date Sampled: 22/08/2024
Dates Tested: 27/08/2024 - 11/09/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH01, Depth: 0.3-1.0m**
Material: Sandy CLAY, grey brown, low plasticity, trace gravel

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Accredited for compliance with ISO/IEC 17025 - Testing

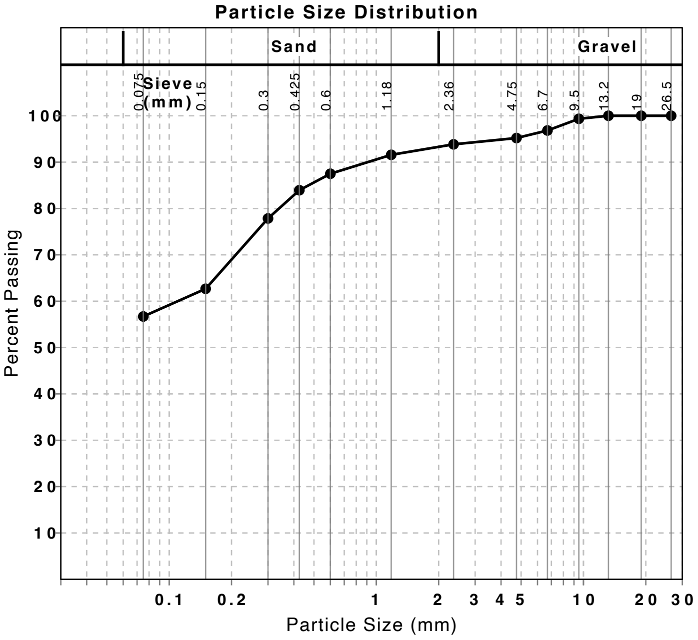
NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Divashan Pather
Senior Geotechnician
NATA Accredited Laboratory Number: 19862

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**99**			1		
6.7 mm	**97**			3		
4.75 mm	**95**			2		
2.36 mm	**94**			1		
1.18 mm	**92**			2		
0.6 mm	**87**			4		
0.425 mm	**84**			4		
0.3 mm	**78**			6		
0.15 mm	**63**			15		
0.075 mm	**57**			6		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	28		
Plastic Limit (%)	13		
Plasticity Index (%)	**15**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**6.5**		
Cracking Crumbling Curling	None		



Material Test Report

Report Number: **PRJ1278804-1**
Issue Number: 1
Date Issued: 12/09/2024
Client: William river steel

Project Number: PRJ1278804
Project Name: Proposed Bar, Dining and Function Centre
Project Location: S#230855 No. 29 Grey Street Clarence Town, NSW, 2321
Work Request: 4748
Sample Number: SC24-4748A
Date Sampled: 22/08/2024
Dates Tested: 27/08/2024 - 05/09/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH01, Depth: 0.3-1.0m**
Material: Sandy CLAY, grey brown, low plasticity, trace gravel

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Approved Signatory: Divashan Pather
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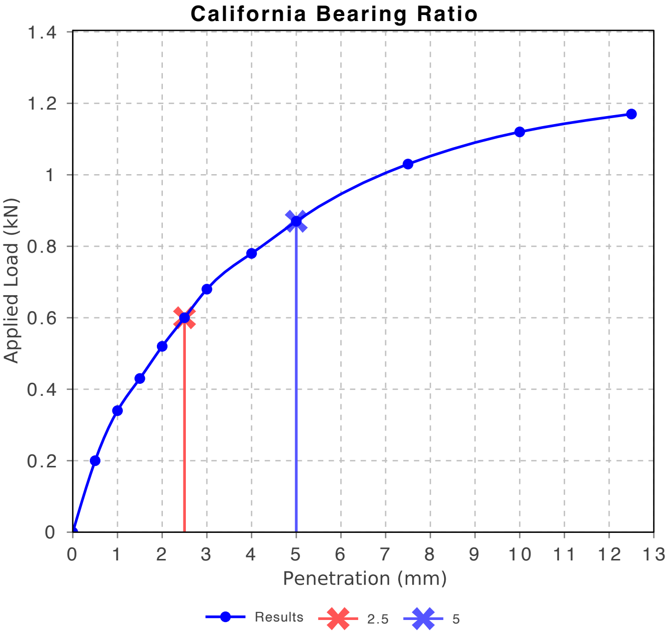
NATA Accredited Laboratory Number: 19862

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**4.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.75		
Optimum Moisture Content (%)	16.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.74		
Field Moisture Content (%)	18.7		
Moisture Content at Placement (%)	16.0		
Moisture Content Top 30mm (%)	20.6		
Moisture Content Rest of Sample (%)	18.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	168.0		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Report Number: **PRJ1278804-1**
Issue Number: 1
Date Issued: 12/09/2024
Client: William river steel

Project Number: PRJ1278804
Project Name: Proposed Bar, Dining and Function Centre
Project Location: S#230855 No. 29 Grey Street Clarence Town, NSW, 2321
Work Request: 4748
Sample Number: SC24-4748B
Date Sampled: 22/08/2024
Dates Tested: 27/08/2024 - 05/09/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH02, Depth: 0.2-0.4m**
Material: Sandy SILT, grey brown, low plasticity, trace gravel

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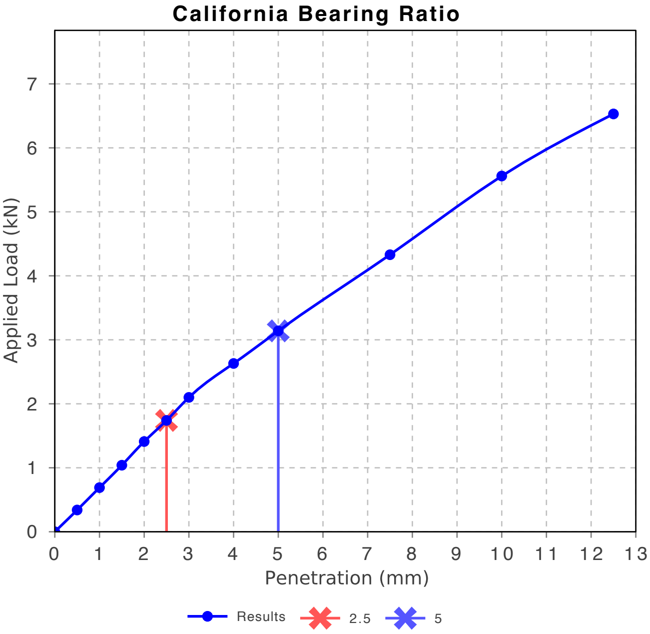
California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**16**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.84		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.84		
Field Moisture Content (%)	15.7		
Moisture Content at Placement (%)	12.8		
Moisture Content Top 30mm (%)	15.0		
Moisture Content Rest of Sample (%)	13.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	168.0		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Report Number: **PRJ1278804-1**
Issue Number: 1
Date Issued: 12/09/2024
Client: William river steel

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Project Number: PRJ1278804
Project Name: Proposed Bar, Dining and Function Centre
Project Location: S#230855 No. 29 Grey Street Clarence Town, NSW, 2321
Work Request: 4748
Sample Number: SC24-4748C
Date Sampled: 22/08/2024
Dates Tested: 27/08/2024 - 11/09/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH05, Depth: 0.4-1.0m**
Material: Sandy SILT, grey brown, low plasticity, trace gravel

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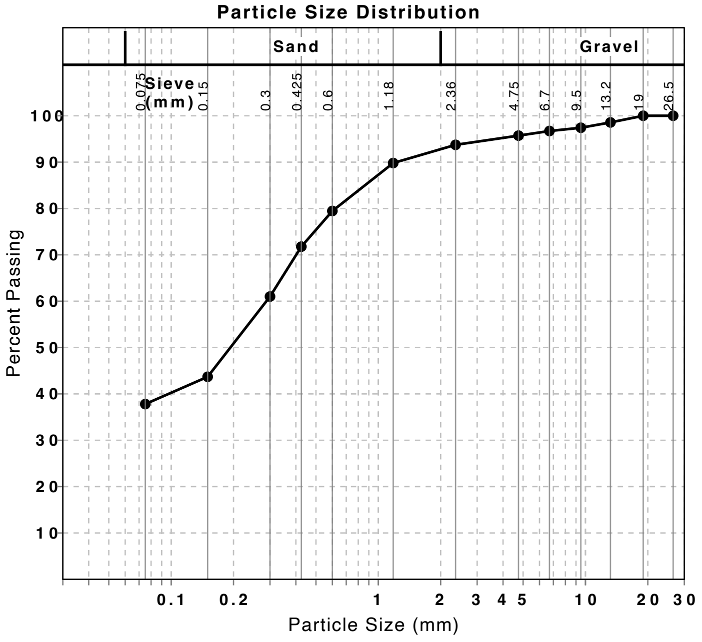
Approved Signatory: Divashan Pather
Senior Geotechnician
NATA Accredited Laboratory Number: 19862

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**99**			1		
9.5 mm	**97**			1		
6.7 mm	**97**			1		
4.75 mm	**96**			1		
2.36 mm	**94**			2		
1.18 mm	**90**			4		
0.6 mm	**79**			10		
0.425 mm	**72**			8		
0.3 mm	**61**			11		
0.15 mm	**44**			17		
0.075 mm	**38**			6		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	21		
Plastic Limit (%)	15		
Plasticity Index (%)	**6**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**3.0**		
Cracking Crumbling Curling	None		



Material Test Report

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Accredited for compliance with ISO/IEC 17025 - Testing

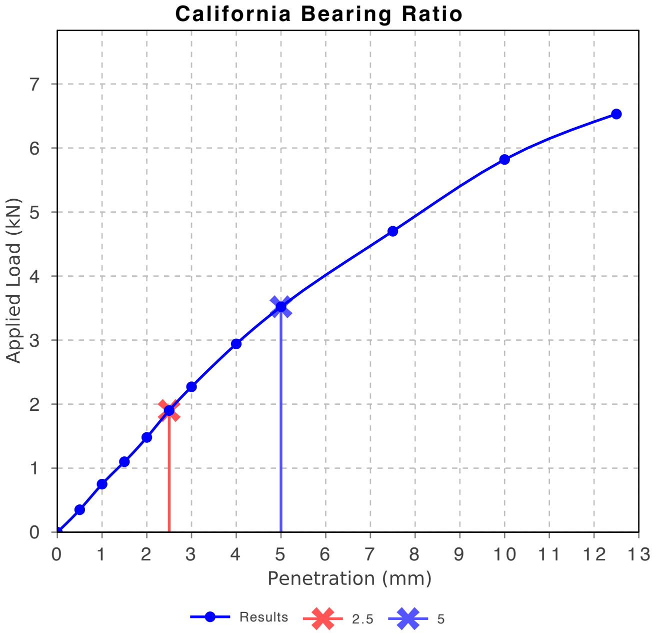
Approved Signatory: Divashan Pather
Senior Geotechnician

NATA Accredited Laboratory Number: 19862

Report Number: **PRJ1278804-1**
Issue Number: 1
Date Issued: 12/09/2024
Client: William river steel

Project Number: PRJ1278804
Project Name: Proposed Bar, Dining and Function Centre
Project Location: S#230855 No. 29 Grey Street Clarence Town, NSW, 2321
Work Request: 4748
Sample Number: SC24-4748C
Date Sampled: 22/08/2024
Dates Tested: 27/08/2024 - 05/09/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH05, Depth: 0.4-1.0m**
Material: Sandy SILT, grey brown, low plasticity, trace gravel

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**18**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.87		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.87		
Field Moisture Content (%)	26.1		
Moisture Content at Placement (%)	12.2		
Moisture Content Top 30mm (%)	13.8		
Moisture Content Rest of Sample (%)	12.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	168.0		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Report Number:	**PRJ1278804-1**
Issue Number:	1
Date Issued:	12/09/2024
Client:	William river steel
Project Number:	PRJ1278804
Project Name:	Proposed Bar, Dining and Function Centre
Project Location:	S#230855 No. 29 Grey Street Clarence Town, NSW, 2321
Work Request:	4748
Sample Number:	SC24-4748D
Date Sampled:	22/08/2024
Dates Tested:	27/08/2024 - 30/08/2024
Sampling Method:	Sampled by Client - Tested as Received *The results apply to the sample as received*
Site Selection:	Selected by Client
Sample Location:	**BH10, Depth: 0.5-0.8m**
Material:	Sandy CLAY, light brown, medium plasticity, soft

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Divashan Pather
Senior Geotechnician

NATA Accredited Laboratory Number: 19862

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**0.8**
Visual Description	Sandy CLAY, light brown, medium plasticity, soft
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**0.9**
Estimated % by volume of significant inert inclusions	0
Cracking	Moderately Cracked
Crumbling	No
Moisture Content (%)	15.3

Swell Test	
Initial Pocket Penetrometer (kPa)	350
Final Pocket Penetrometer (kPa)	
Initial Moisture Content (%)	15.3
Final Moisture Content (%)	16.8
Swell (%)	**1.0**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.